USAID
FROM THE AMERICAN PEOPLE

The Asia Foundation
Improving Lives, Expanding Opportunities

India-U.S. Triangular Development Partnership

Renewable Energy: Establishing India-U.S. Triangular Development Cooperation Partnerships in the Indo-Pacific Region

teri
The Energy and Resources Institute
Creating Innovative Solutions for a Sustainable Future

USAID
FROM THE AMERICAN PEOPLE

The Asia Foundation
Improving Lives, Expanding Opportunities

India-U.S. Triangular Development Partnership

Renewable Energy: Establishing India-U.S. Triangular Development Cooperation Partnerships in the Indo-Pacific Region

teri
The Energy and Resources Institute
Creating Innovative Solutions for a Sustainable Future

Suggested Citation

T E R I. 2022. Renewable Energy: Establishing India-U.S. Triangular Development Cooperation Partnerships in the Indo-Pacific Region. New Delhi: The Energy and Resources Institute.

Disclaimer

This report is made possible by the generous support of the American people through the United States Agency for International Development (USAID) under the 'India-U.S. Triangular Development Partnership (TriDeP)' project at The Asia Foundation. The opinions expressed here are solely of the authors and do not necessarily reflect the views of USAID or the United States Government and The Asia Foundation.

For more information

The Asia Foundation

114, Jor Bagh (First Floor),
New Delhi 110003, India

Tel: +91-11-47363100

Project Monitoring Cell

T E R I
Darbari Seth Block
IHC Complex, Lodhi Road
New Delhi – 110 003
India

Tel. 2468 2100 or 2468 2111
E-mail pmc@teri.res.in
Fax 2468 2144 or 2468 2145
Web www.teriin.org
India +91 • Delhi (0)11

Foreword

India and the U.S. share a common vision for a free and open Indo-Pacific region. India's long-standing engagement in the region makes it a strong development partner and leader. The Asia Foundation through the India-U.S. Triangular Development Partnership (TriDeP), a program funded by USAID, is working toward realizing this vision and strengthening India's and the U.S.'s development cooperation footprint in the Indo-Pacific region and beyond. The program builds on the U.S. government's commitment to strengthen triangular partnership programs with India in the Indo-Pacific region and is informed by the U.S. government's Indo-Pacific Strategy and its Pacific Islands Strategy.

TriDeP seeks to support the Government of India's development assistance in the Indo-Pacific region by identifying countries keen to expand their development partnership with India in sectors defined by their country needs, and by supporting programming based on such identification. Disaster Risk Reduction, Climate Smart Agriculture and Renewable Energy are sectors where India demonstrates policy leadership and technical skills, and thus can provide sustainable solutions.

India has spearheaded national, regional, and global efforts to strengthen knowledge-sharing, innovation and partnerships for low-emission and high-performance renewable energy pathways. Supported by a commitment to achieve its Intended Nationally Determined Contributions to address climate change, India engages with a range of stakeholders, both public and private, to meet its renewable energy goals and targets. It is now home to a thriving and inclusive entrepreneurial ecosystem, benefiting consumers across the socio-economic spectrum.

This report presents the diagnostic study undertaken by The Energy and Resources Institute (TERI) in the renewable energy sector. It maps relevant institutions that can work in the Indo-Pacific countries to advance India's development partnership efforts through co-created solutions in renewable energy policy and regulatory initiatives, innovative products, services, and technologies. Several energy-related initiatives led by India are already underway in the South Asian region. Learning from them, the report provides an overview of the need and demand for low-carbon pathways and solutions in the Indo-Pacific.

I would like to thank the research team and technical experts at TERI for undertaking this diagnostic study, led by Shirish Garud, Senior Fellow & Director; Souvik Bhattacharjya, Senior Fellow & Associate Director; and Sunil Dhingra, Senior Fellow & Associate Director. The research team included Ria Sinha, Fellow; G Mini, Fellow; Rashmi Murali, Associate Fellow; Sarvesh Devraj, Associate Fellow; Kartikey Sharma, Research Associate; Nitin Bajpai, Research Associate; and Sandeep Thakre, Research Associate. The report was edited and designed by Sudeep Pawar, Graphic Designer and Abhas Mukherjee, Editor.

I thank Veena Reddy, USAID/India and Bhutan Mission Director; Karen Klimowski, Deputy Mission Director; John Smith-Sreen, Director of the Indo-Pacific Office; MaryTyler E. Holmes, Deputy Director of the Indo-Pacific Office; Sukanya Banerjee, Development Partnership Adviser and the Activity Manager for TriDeP; and Arun Sahdeo, Project Management Specialist (Disaster Risk Management), for their support to the program and their valuable suggestions that enhanced the quality of the report.

Our thanks to all the technical experts from India, South Asia, Southeast Asia, and the Pacific Island countries for participating in the research and for their valuable insights. At The Asia Foundation, Anthea Mulakala, Senior Director for International Cooperation; Atul Kaushik, TriDeP Chief of Party; Ramesh Navaladi, Deputy Chief of Party; and Ajay Singh, Monitoring, Evaluation, Learning and Adaptation Specialist, made valuable contributions to the report's approach and content. Malavika Thirukode, Program Officer, and Kanika Jha, Communications Manager, made valuable contributions to refining the report.

I hope the findings from this report will pave the way for strengthening India's and the U.S.'s approach to triangular partnerships in the Indo-Pacific region.

Nandita Baruah
Country Representative – India
The Asia Foundation

Table of **Contents**

List of **Figures**

List of **Tables**

Acronyms and Abbreviations

AARDO	Afro-Asian Rural Development Organization
ADB	Asian Development Bank
ACE	ASEAN Centre for Energy
AEPC	Alternative Energy Promotion Centre
AEDP	Alternative Energy Development Plan
AERD	Centre of Alternative Energy Research and Development
AHEC	Alternate Hydro Energy Center (Now Department of Hydro and Renewable Energy (HRED), Indian Institute of Technology, Roorkee
ASEAN	Association of Southeast Asian Nations
AU	African Union
BAU	Business as Usual
BIMSTEC	Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation
BRI	Belt and Road Initiative
CAGR	Compound Annual Growth Rate
CARICOM	Caribbean Community
CBA	Community Business Associations
CCDA	Climate Change and Development Authority
CEEW	Council on Energy, Environment and Water
CEM	Clean Energy Ministerial
CEP	Continuing Education Program
CII	Confederation of Indian Industry
CoE	Centers of Excellence
CSTEP	Centre for Study of Science, Technology and Policy
DOE	Philippines Department of Energy
DPE	Department of Petroleum and Energy
EDC	Electricite du Cambodge
EEZ	Exclusive Economic Zones
EESL	Energy Efficiency Services Limited
EEP	Energy Efficiency Plan
EPPO	Energy Policy and Planning Office
EPC	Engineering, Procurement and Commissioning
FAME	Faster Adoption and Manufacturing of (Strong) Hybrid and Electric Vehicles
FSPV	Floating Solar PV
GESI	Gender Equality and Social Inclusion
GHG	Greenhouse Gas

ICCC	Independent Consumer and Competition Commission
IEA	International Energy Agency
INDC	Intended Nationally Determined Contributions
IIT-D	Indian Institute of Technology Delhi
IPPs	Independent Power Producers
IPBC	Independent Public Business Corporation
IRADe	Integrated Research and Action for Development
IREDA	Indian Renewable Energy Development Agency
IRENA	International Renewable Energy Agency
IOR-ARC	Indian Ocean Rim – Association for Regional Cooperation
I-REIP	India for Renewable Energy in the Indo-Pacific
I-REAP	India for Renewable Energy in Asia Pacific
ISA	International Solar Alliance
ITEC	Indian Technical and Economic Collaboration
KCHL	Kumul Consolidated Holdings Limited
LaBL	Lighting a Billion Lives
MEA	Ministry of External Affairs
MGC	Mekong-Ganga Cooperation
MI	Mission Innovation
MMT	Multi-partite Monitoring Team
MNRE	Ministry of New and Renewable Energy
MoU	Memorandum of Understanding
NCD	National Capital District
NDCs	Nationally Determined Contributions
NEPO	National Energy Policy Office
NREP	National Renewable Energy Program
NREB	National Renewable Energy Board
NISE	National Institute of Solar Energy
NSM	National Solar Mission
OSOWOG	One Sun One World One Grid
PDP	Thailand Power Development Plan
PEP	Papua New Guinea Electrification Partnership
PNG	Papua New Guinea
PM-KUSUM	Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyan
PMUY	Pradhan Mantri Ujjwala Yojana
POs	Peoples' Organizations
POSOCO	Power System Operation Corporation

PPP	Purchasing Power Parity
PPL	PNG Power Limited
PRESPL	Punjab Renewable Energy Systems Private Limited
PTA	Preferential Trade Agreements
QIP	Quality Improvement Program
RCEP	Regional Comprehensive Economic Partnership
REDD	Reducing Emissions from Deforestation and Forest Degradation
REE	Rural Electrification Entrepreneurs
RGGVY	Rajiv Gandhi Grameen Vidyutikaran Yojana
RTP	Rooftop Solar Projects
SAUBHAGYA	Pradhan Mantri Sahaj Bijli Har Ghar Yojana
SAGAR	Security and Growth for All
SCJI	Skill Council for Green Jobs
SDGs	Sustainable Development Goals
SECI	Solar Energy Corporation of India
SE4ALL	Sustainable Energy For All
SGtech	School of Renewable Energy and Smart Grid Technology
SLCS	Solar Lantern Charging Stations
TERI	The Energy and Resources Institute
TrC	Triangular Cooperation
VGF	Viability Gap Funding Scheme
WB	World Bank
WTO	World Trade Organization
WEE	Women's Economic Empowerment
UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organization

Key Findings for **Supply Section**

India has progressively developed its regulatory policy and quality monitoring framework to accommodate and accelerate the research, technology development, manufacturing, and deployment of renewable energy (RE) technologies (main focus being on solar PV, solar thermal, wind, biomass/bioenergy, and small hydro). India has successfully implemented one of the most ambitious programs for development of 175 GW of renewable power generation capacity. Thus, India has attracted international funding, investors, and technologies. One of the focus areas of the Indian RE program has been making renewable energy a part of the major policy and regulatory framework resulting in mainstreaming it. India has focussed on development and capacity building of all types of stakeholders including civil society, manufacturing and project implementation industries, research and technology development, and local entrepreneurs at village or grassroot levels. Thus, it has brought renewable energy to the households in urban and rural and remote areas. Since the 1980s, India's RE interventions have focused on RE for just transition and access to energy among rural and economically backward sections of the society. Providing access to clean and modern energy sources has been one of the main objectives of India's RE program over decades. The program also focuses on development of local manufacturing industry producing indigenous products and technologies.

Introduction

Overview

The India-U.S. Triangular Development Partnership (TriDeP) is aimed at enhancing India's development cooperation footprint in the Indo-Pacific region and achieving shared goals for the development of the region. TriDeP is being implemented by The Asia Foundation (the Foundation). The TriDeP will focus on three priority areas where India demonstrates policy leadership, practical experience, and sustainable results. Renewable Energy (RE) is one of the three priority areas. TriDeP will identify cooperation opportunities to support transition to renewable energy leading to low carbon pathways in partner countries. The Foundation assigned The Energy and Resources Institute (TERI) to carry out a diagnostic analysis for the RE sector interventions. This report covers the analysis and recommendations emerging out of the diagnostic study.*

Objective

The overall objective of this diagnostic study was to identify Indian expertise and relevant institutions in the RE sector and identify countries in the Indo-Pacific region that are more likely to benefit from the Indian expertise. The study also aims to develop and recommend a programmatic triangular cooperation (TrC) partnerships approach to facilitate energy transition along the low carbon pathways in the shortlisted countries based on supply-demand match strategies. It further aims to identify avenues for implementation of RE triangular cooperation (TrC) partnerships identified and initiated under the TriDeP.

Approach and Methodology

The study uses a political economy approach to analyze Indian competencies and lessons learned, RE transition plans and likely demand for the Indian expertise, and best practice principles in the selected partner countries, which can lead to the development of future sustainable TrC partnerships.

The study is divided into three major activities: supply analysis, demand analysis, and way forward. The approach includes desk-based research, national and international convening and in person virtual individual meetings with experts, government officials, and policy makers.

The approach followed in conducting the supply and demand analysis is discussed in the following subsections.

---

* The Asia Foundation's India-U.S. Triangular Development Partnership (TriDeP) has partnered with The Energy and Resources Institute (TERI) for this study. TERI is an independent, multi- dimensional organization, with capabilities in research, policy, consultancy, and implementation. Over the last four decades of its journey, TERI has emerged as one of the world's pre-eminent think tanks and research institutions in the field of energy, climate change, and sustainability.

Supply Analysis

The supply analysis is a mapping exercise to map the capabilities, experiences, institutional frameworks, and key stakeholders including centres of excellence (COE) in the Indian RE sector and provide comprehensive analysis of the same.

An enquiry-based approach was adopted in completing the supply analysis. It included a detailed literature review that analyzed data from research papers, news articles, and sectoral reports by reputed organizations and institutions including the government departments and multilateral agencies such as the International Energy Agency (IEA), the World Bank (WB), International Renewable Energy Agency (IRENA), and International Solar Alliance (ISA). This was followed by one-on-one interactions with sector experts, senior ministry officials, heads of major institutions, program heads, and so on. TERI and the Foundation team interviewed 10 Indian experts and officials. Details of the experts consulted are mentioned in Annexure 1.0. The interactions laid emphasis on possible areas of collaborations, interest of the respective institutions in supporting such collaborations, and the expertise that India can offer. The third and final stage of the supply analysis was to organize a supply convening with experts, officials, key subject experts and academicians, industry leaders and project implementers, and so on. The report on the supply convening is covered in Annexure 2.0. Forty-seven experts from various institutes/organizations attended the supply convening. These include private sector companies, research institutes, power exchange, financing institutions, government officials, NGOs, independent consultants, and so on.

Demand Analysis

The process of demand analysis started with the shortlisting of countries using sound framework based on multiple criteria. Analysis was carried out to shortlist the countries from the Southeast Asian and Pacific Islands regions. The countries were ranked on parameters such as bilateral relations with India, renewable energy capacity addition target, renewable energy installed capacity, share of renewable energy in overall electricity portfolio, trade dependence on China, trade dependence on India, access to electricity by percentage of populations, cost of electricity (households), access to clean cooking by percentage of population, and gender participation. Secondary data about demography, international trade, policies, energy sector, renewable energy sector, and so on were compiled from authentic reports that were publicly available with data verified. The data were used to analyze issues such as lack of energy access, future energy demand and renewable targets. Country mapping was carried out using the secondary data. This was followed by the demand convening covering experts from the selected countries. Finally, one-on-one interactions with selected experts from the shortlisted countries were held to gain a deeper insight into the relevant issues concerning the sector. This report is a synthesis of the supply and demand analysis. Details of the experts consulted are given in Annexure 1.0. The report on demand convening is covered in Annexure 3.0.


Photo Credit: TERI


Photo Credit: TERI


Photo Credit: TERI


Photo Credit: TERI

INDIA'S Renewable Energy Story

Introduction

India, the world's second most populated country behind China, is the third largest country in terms of carbon emissions (2018) and roughly accounts for 7% of total global CO_2 emissions.[1] India's cumulative power generating capacity at utility scale has reached 383.34 GW[2] (till May 2021) from 1.36 GW in 1947.[3] The per capita electricity consumption has increased to 1208 kWh in FY 2019-20 from 16.3 kWh in 1947. Additionally, the pace of renewable energy expansion in India over the last decade or so has been remarkable. Earlier this year the total installed renewable energy capacity in India, excluding large hydro, has crossed the milestone of 100 GW. Today, India stands at 4th position in the world in terms of installed RE capacity, 5th in solar, and 4th in wind in terms of installed capacity. While 100 GW has been installed, 50 GW is under installation and 27 GW is under tendering. India has also enhanced its ambition to install 500 GW of renewable energy capacity by 2030. If large hydro is included, the installed RE capacity will increase to 146 GW.

The rising global emissions and unfavorable changes triggered by these emissions have brought the whole world together to mitigate the risk of climate change. To address the daunting issues of climate change, India has submitted its Nationally Determined Contributions (NDCs) under the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement, which include increase in total cumulative electricity generation from fossil free energy sources to 40% by 2030. India is also committed to the Sustainable Development Goals (SDGs) including SDG 7 of ensuring access to affordable and clean energy for all by 2030. Energy is also a common resource that connects economic growth, social equity, and environmental sustainability.

To promote renewable energy (RE) sources for achieving sustainable growth with lower emissions, the country has developed a sustainable path for energy supply. India has been working for more than five decades on achieving energy access, energy efficiency, clean technology for addressing electricity, heating, and cooling demands. India's renewable movement started as the aftermath of the oil shock of 1973. Energy self-sufficiency was identified as the major driver for new and renewable energy in the country in the wake of the two oil shocks of the 1970s. During that time key programs for providing energy access, community development, and clean cooking interventions were developed. India's off-grid market had accelerated between 1980 and 2010 and during this period the focus was largely on solar lighting systems, small scale mini/micro grids, and other applications. However, the RE landscapes have changed significantly from 2010 onwards with the launch of the National Solar Mission (NSM) in 2010. Under the NSM, India has set a target to generate RE power of 175 GW by 2022

1 https://www.ucsusa.org/resources/each-countrys-share-co$_2$-emissions

2 Central Electricity Authority of India (CEA) report, May 2021

3 Ministry of Power report, "Growth of Electricity Sector in India from 1947-2020", 2020

and 500 GW[4] by 2030 for reduction of greenhouse gas (GHG) emissions from the energy sector by deploying large-scale grid integrated RE technologies and this sector is expected to create 330,000 new jobs and livelihood opportunities.[5] With a strong policy push, aggressive regulatory framework, and awareness programs, India is now recognized as one of the fastest developing markets for RE development.

Installed renewable power generation capacity has gained pace over the past few years, posting a compound annual growth rate (CAGR) of 17.33% between FY 2015-16 and FY 2020-21. With the increased support of the government and improved economics, the sector has become attractive from investors' perspective. As India looks to meet its energy demand on its own, which is expected to reach 15,820 TWh by 2040, renewable energy is set to play an important role.[6]

As on May 31, 2021, around 25% of the total installed capacity was from RE resources (see Figure 1) excluding large hydro.

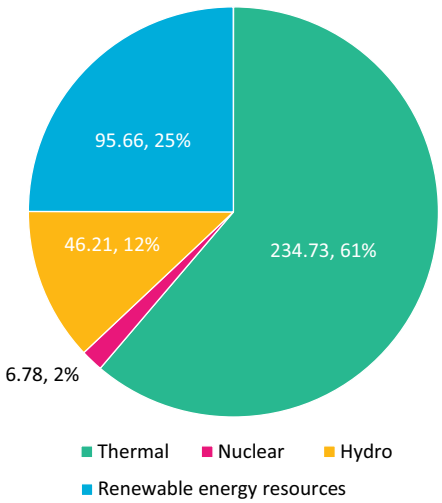


FIGURE 1: Total installed power capacity in GW (utility)

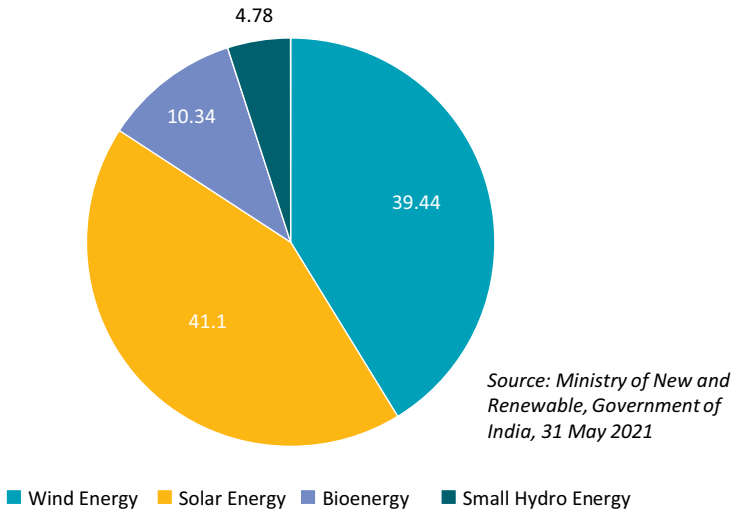
4 https://pib.gov.in/PressReleasePage.aspx?PRID=1768712

5 Kumar, J.C.R., Majid, M.A. Renewable energy for sustainable development in India: current status, future prospects, challenges, employment, and investment opportunities. Energy Sustain Soc 10, 2 (2020). https://doi.org/10.1186/s13705-019-0232-1

6 Details available at https://www.ibef.org/industry/renewable-energy.aspx, last accessed on May 28, 2021

The details of renewable energy installed capacity are given in Figure 2.

It is evident from Figure 2 that solar and wind energy has almost equal share of above 40% each in the total installed capacity. Of the remaining RE, contributions come from bioenergy and small hydro projects.



Source: Ministry of New and Renewable, Government of India, 31 May 2021

FIGURE 2: Installed power from RE resources (in GW)

India as a Catalyst for RE Adoption

The fate of independent India's development is a consequence of its unprecedented population growth and the corresponding decisions made in the energy sector. While India experienced accelerated urbanization after independence, the climate responsive energy policy space remained uneventful till liberalization in 1991. The country's rapid growth largely defines the route of energy policy development in India, the increase in the energy deficit, and the search for alternative sources of energy, mainly solar, nuclear, and wind energy.

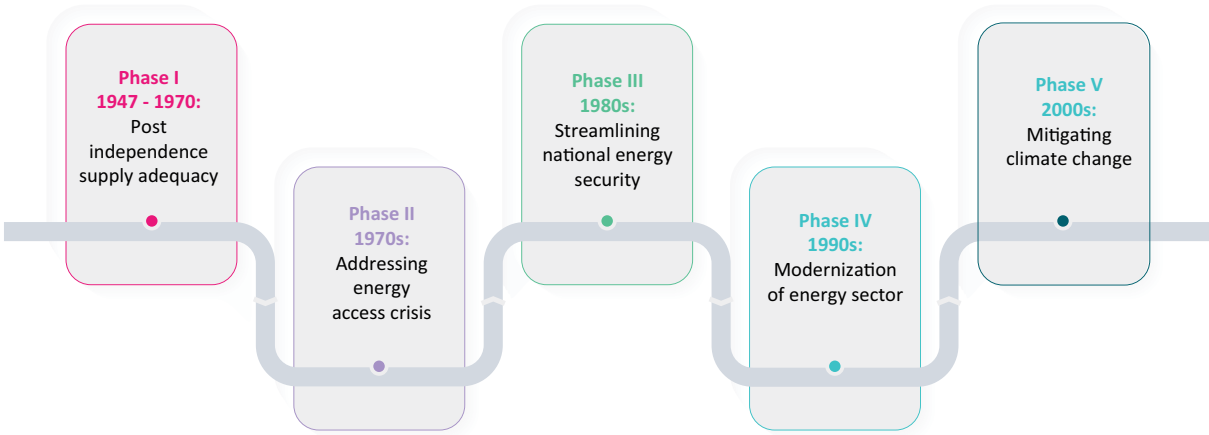


FIGURE 3: Five distinct phases of energy development in India

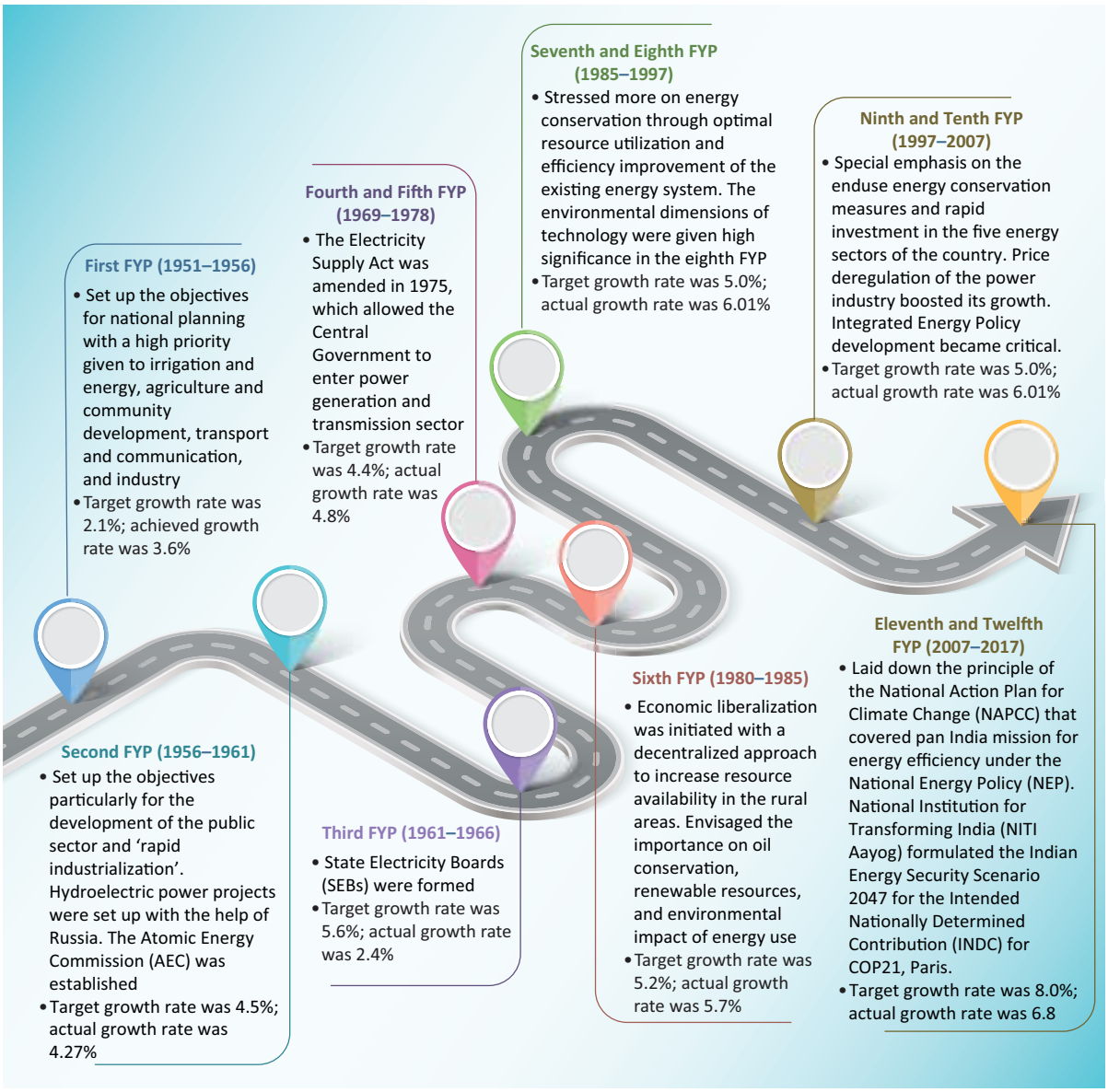


FIGURE 4: Energy road map of India through five-year plans[7]

[7] An economic plan that allocates the resources of a nation to fulfil the general and specific goals as planned by the government for a specified period. In India, these plans are made for five years and hence are known as five-year plans. These five-year plans are ultimately a short-term plan for a perspective plan.

Key Achievements of India in Renewable Energy

Solar water heating system

India has attained the 4th position globally for overall installed renewable energy capacity, secured the 4th position for wind power and 5th position for solar power. India is among the countries with large production of energy from renewable sources. As of November 27, 2020, 38% of India's installed electricity generation capacity was from renewable sources (136 GW out of 373 GW).[8] The Government of India has also set a target for installation of rooftop solar projects (RTP) of 40 GW by 2022 including installation on rooftop of houses. As of September 2020, 89.22 GW of solar energy was operational, projects of 48.21 GW were at various stages of implementation, and projects of 25.64 GW capacity were under various stages of development.[9]

India was the first country in the world to set up a ministry of non- conventional energy resources (Ministry of New and Renewable Energy (MNRE) in the early 1980s, and its public sector undertakings such as the Indian Renewable Energy Development Agency (IREDA), the Solar Energy Corporation of India (SECI), National Institute of Solar Energy (NISE), and National Institute of Wind Energy (NIWE) are responsible for the development of solar and wind energy industry in India.

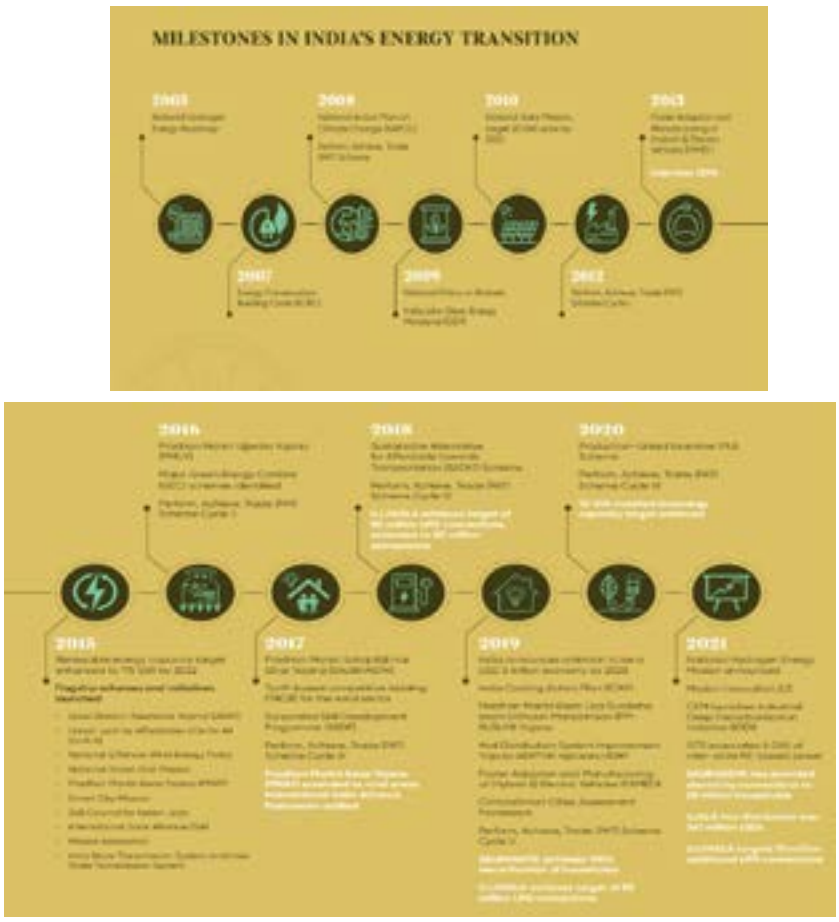
With the help of solar energy backed microgrids households located in the remotest rural areas of India have finally gained access to electricity. This has generated additional employment opportunities, ensuring electrical connectivity for longer hours, particularly for children's education, farm produce improvement, and improved levels of household security. India has a strong manufacturing base in wind power with 20 manufacturers of 53 different wind turbine models of international quality up to 3 MW in size and it exports to Europe, the United States, and other countries. Wind or solar PV paired with four-hour battery storage systems is already cost-competitive, without subsidy, and a source of dispatchable generation compared with new coal and new gas plants in India.

Further, India is making rapid progress towards its ambitious goal to install 500 GW of RE capacity by 2030. It has also emerged as one of the world's most attractive destinations for investments in RE. The 2022 electrical power targets include achieving 227 GW (earlier 175 GW) of energy from renewable

---

8 Koundal, A. (26 November 2020). India's renewable power capacity is the fourth largest in the world, says Prime Minister Modi. ET Energy world

9 https://pibindia.wordpress.com/2018/12/11/achievements-of-ministry-of-new-renewable-energy-during-2018/



Source: Accelerating citizen-centric energy transition - the India story. CEEW, 2021

sources – nearly 113 GW through solar power, 66 GW from wind power, 10 GW from biomass power, 5 GW from small hydro, and 31 GW from floating solar and offshore wind power.[10]

Most important of all, India's energy transition is citizen centric. It is powered by schemes that have provided electricity access and clean cooking fuels to millions of households (Pradhan Mantri Sahaj Bijli Har Ghar Yojana - SAUBHAGYA and Pradhan Mantri Ujjwala Yojana (PMUY)), enabled the installation of hundreds of thousands of solar agri-pumps (Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyan (PM-KUSUM)), and improved livelihoods through skill development (Skill Council for Green Jobs). India is also taking steps to building sustainable cities through the Smart Cities Mission and accelerating electrical mobility through the Faster Adoption and Manufacturing of (Strong) Hybrid and Electric Vehicles (FAME) scheme. This will not only improve quality of life but also enable sustainable living.

10 Saluja, N., Singh, S. (5 June 2018). Renewable energy target now 227 GW, will need $50 billion more in investments. *The Economic Times*

Mapping of Indian Agencies and Supply Actions

Sl. No	Potential Indian Expertise	Suggested Lead Indian Agencies	Suggested Supply Potential from India
1	Policy and regulatory	Ministry of New and Renewable Energy; Ministry of External Affairs; Central Electricity Authority of India; The Energy and Resources Institute; Council on Energy, Environment and Water; Integrated Research and Action for Development; and Centre for Policy Research	Studies on policy and regulations, preparation of policy briefs, training and capacity building of policy makers, politicians
2	Technology, products, and services	Private and public sector companies, research institutes, universities, and educational institutes (Indian Institute of Technology, Indian Institute of Sciences, National Institute of Technology, Indian Renewable Energy Development Agency Limited, National Skill Development Corporation, Skill Council for Green Jobs, Indian Space Research Organisation, etc.)	Made in India RE products such as wind turbines, modules, balance of system, gasifiers, cold storages, solar pumping systems, clean cooking devices, solar thermal collectors, solar dryers, biogas technologies, fuel cell technology, engineering, procurement and construction, project management expertise and skills, biomass treatment technologies, RE financing, detailed project report, feasibility studies, raising of finance

Sl. No	Potential Indian Expertise	Suggested Lead Indian Agencies	Suggested Supply Potential from India
3	RE program development	Ministry of New and Renewable Energy; The Energy and Resources Institute; Council on Energy, Environment and Water; Center for Study of Science, Technology and Policy; Power System Operation Corporation Limited; Central Electricity Authority of India; National Institute of Wind Energy; National Institute of Solar Energy; Sardar Swaran Singh National Institute of Bio-Energy; and Energy Efficiency Services Limited	Technical assistance in renewable energy planning, grid integration studies, grid management and extension planning, energy planning and integrated energy modelling studies, resource assessment and resource planning studies, procurement strategies, demand aggregation models
4	Research and training	Indian Institute of Technology; Indian Institute of Sciences;National Institute of Technology;, Skill Council for Green Jobs; Barefoot College; and Council of Scientific and Industrial Research laboratories.	Joint Research & Development programs, skill development of engineers, technicians, managers, entrepreneur development training, standardization, technical collaborations for research infrastructure and testing and quality infrastructure, data analytics and modelling

Indian Institutes of Excellence

» **Skill Council for Green Jobs (SCGJ)**

SCGJ is an autonomous body created by the National Skill Development Corporation (NSDC). Its objective includes preparing occupational maps for the RE industry to help identify the requirement of human resource capacity in the respective RE sector and their training needs. Additionally, it is also responsible for skilling, certification, and standardization of capacity building programs in the renewable energy industry.

» **National Institute of Solar Energy (NISE)**

National Institute of Solar Energy, an autonomous institution of the MNRE, is the apex national R&D institution in the field of solar energy. NISE works in the area of R&D, in projects around PV cell development, solar water pumping, water purification, solar lighting, batteries, inverters, solar cookers, solar dryers, and solar chillers. NISE has accredited laboratories for solar PV modules, solar water pumping systems, and solar lighting systems as per national and international standards. It also works towards skill development in the area of solar energy for industry, academia, entrepreneurship, financial institutes, and governmental organizations.

» **National Institute of Wind Energy**

The main focus of NIWE is on wind and solar resource assessments, testing, and certification of wind turbines. In addition to R&D initiatives, NIWE works on grid integration of RE, forecasting of wind and solar energy generation using advanced data analytics techniques. NIWE has achieved forecasting with a daily accuracy of more than 90%.

» **Indian Institute of Technology: IIT-Delhi**

The Department of Energy Studies (formerly Centre for Energy Studies) at the Indian Institute of Technology Delhi was established by the Government of India in 1976 for education and research in the field of energy. Currently, the department offers three postgraduate courses, including one sponsored by ISA and catering to students from ISA countries. The department also conducts capacity building programs under Continuing Education Program (CEP), which aims to cater to the training and development needs of working professionals, and the Quality Improvement Program (QIP), which aims to upgrade the expertise and capabilities of teachers.

» **Punjab Renewable Energy Systems Private Limited (PRESPL)**

PRESPL is currently the largest aggregator of biomass in India. They have developed processes and infrastructure for aggregation of various types of farm agricultural residues that involves specialized equipment and machinery for post-harvest agricultural management. It works across the value chain of biomass collection, processing, and utilization for end use applications.

---

11 https://sscgj.in/

12 https://nise.res.in/

India's International Initiatives in RE

ndia has been active in promoting international initiatives and collaborations for long. A few of the important initiatives include the following:

1. International Solar Alliance (ISA)

ITEC training participants

The International Solar Alliance (ISA), a global treaty based multilateral organization, is a crucial advocate and change agent for solar power. It was launched on November 30, 2015, by the Prime Minister of India Shri Narendra Modi and the then President of France François Hollande on the sidelines of the 21st session of the Conference of the Parties to the UNFCCC (COP21) in Paris. The Paris Declaration defines the ISA as an alliance dedicated to the promotion of solar energy among its member countries. It is headquartered in Gurugram in Haryana, India. The ISA's major objectives include facilitating the deployment of 1000 GW of solar capacity and mobilizing USD 1 trillion investment in the solar energy sector by 2030.

2. Mission Innovation (MI)

Mission Innovation is an international initiative to promote scientific collaborations among the member countries. It was launched in November 2015 at COP21 by India, France, and the United States as an action-oriented global forum of 22 countries and the European Commission.

3. Clean Energy Ministerial (CEM)

The Clean Energy Ministerial (CEM) is a high-level global forum meant to promote policies and programs that advance clean energy technology, share lessons learned and best practices, and encourage the transition to a global clean energy economy. India has been a founding member of the CEM since 2009.

4. Indian Technical and Economic Collaboration (ITEC) program

The Ministry of External Affairs (MEA) has been running the Indian Technical and Economic Collaboration (ITEC) program since 1964. The program has been funding various international training and capacity building courses for international participants from developing countries. Renewable energy and clean energy are the focus areas of the ITEC courses. ITEC resources have also been used for cooperation programs conceived in regional and interregional contexts such as the Economic Commission for Africa, Commonwealth Secretariat, United Nations Industrial Development Organization (UNIDO), Group of 77, and G-15. In more recent years, its activities have also been associated with regional and multilateral organizations and cooperation groupings such as Association of Southeast Asian Nations (ASEAN), Bay of Bengal Initiative for

Multi-Sectoral Technical and Economic Cooperation (BIMSTEC), Mekong-Ganga Cooperation (MGC), African Union (AU), Afro-Asian Rural Development Organization (AARDO), Pan African Parliament, Caribbean Community (CARICOM), World Trade Organization (WTO), Indian Ocean Rim – Association for Regional Cooperation (IOR-ARC), and India-Africa Forum Summit.

5. International Collaborations

The Ministry of New and Renewable Energy (MNRE) has signed Memorandum of Understanding (MoU) with many countries including countries in the Asia Pacific region for cooperation in renewable energy sectors. It has signed MoUs with the governments of Philippines, Fiji, Indonesia, and Thailand in the region.

6. Other Initiatives

The MNRE, ISA, and the World Bank signed a tripartite agreement to execute an international project 'One Sun One World One Grid' (OSOWOG) on September 8, 2020. OSOWOG is India's initiative of establishing a transnational electricity grid supplying solar power across the globe. The idea was proposed by the Government of India (GoI) in the first assembly of the ISA in 2018. As per the draft plan of the MNRE, the initiative seeks to connect 140 countries via a common grid for transfer of solar power. Under this mega plan, with India at the fulcrum, the solar spectrum is divided into two zones: i) Far East countries – Myanmar, Vietnam, Thailand, Lao, Cambodia, and ii) Far West countries – Middle East and the Africa Region.

Renewable Energy and Gender Equality and Social Inclusion (GESI)

The focus of India's RE movement has been on social development and social inclusion. Specific programs such as promotion of improved cookstoves and alternative clean fuels for cooking are the best example of this.[13] The programs on promotion of solar home lighting systems and solar lanterns are also focused on women. There are several successful examples of how women's involvement has led to efficient management and customer outreach at different stages of the energy value chain[14] (Glemarec et al., 2016). In India, Frontier Markets developed a women entrepreneurship model where more than 3000 rural women were trained as Saral Jeevan Sahelis or last mile delivery agents selling solar products.[15] Barefoot College, Rajasthan through its global campaign on women entrepreneurship trained rural women from various countries to be solar engineers.[16] There are other similar examples from across the globe that have promoted women entrepreneurship and women as change agents, such as the Solar Sister program of Uganda and the Women Economic Empowerment (WEE) initiative of the International Network for Gender

13 https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1525934

14 Glemarec, Y., Bayat-Renoux, F. & Oliver, W., 2016. Removing barriers to women entrepreneurs' engagement in decentralized sustainable energy solutions for the poor. AIMS Energy, 4(1), pp. 136-172.

15 https://frontiermkts.com/

16 https://barefootcollegetilonia.org

and Energy (ENERGIA) in Indonesia, Kenya, Nepal, Nigeria, Senegal, Tanzania, and Uganda[17] (Dutta, 2018). Furthermore, SEforALL recently announced a global initiative 'People Centred Accelerator on Advancing Gender Equality, Social Inclusion, and Women's Empowerment in the Sustainable Energy Sector', with one of its focus areas directed towards empowering women engaged in energy service delivery in terms of autonomy and a greater role in decision-making[18] (SEforALL, 2017). These efforts have succeeded in inclusion of tens of thousands of women in the RE sector as active participants.

Gender mainstreaming in India, though acknowledged and to some extent present, is not well defined for every sector, especially renewable energy. In contrast, Nepal has formulated the Gender Equality and Social Inclusion (GESI) guidelines[19] through the Alternative Energy Promotion Centre (AEPC), which is the nodal agency of Nepal for development of renewable energy, to provide a clear pathway for formalizing the GESI mainstreaming process among renewable energy project developers, policy makers, and other stakeholders. However, there are examples of how efforts have been made in the direction of increasing women's participation in the renewable energy sector. The Skill Council for Green Jobs (SCGJ), an initiative of the Government of India, promoted by the Ministry of New and Renewable Energy (MNRE) and the Confederation of Indian Industry (CII), in alignment with the National Skill Development Mission, has the objective of identifying and developing skills and entrepreneurship among the users and service providers (manufacturers, project developers, and other stakeholders) of India's 'green businesses' such as renewable energy. Initiatives for encouraging women's participation and employment generation have been demonstrated by the SCGJ. For instance, under Project Disha, one million underprivileged women in India were to be provided marketable skills for better income opportunities, in addition to generating awareness among industry and policy makers on the importance of women's participation in the workforce. SCGJ also trained rural women as entrepreneurs for promotion, sale, and maintenance of improved biomass cookstoves through a pilot project on 'Smart Model Village' (SCGJ Annual Report, 2016). [20] Another initiative of the MNRE, the Suryamitra Skill Development Program conducted by the National Institute of Solar Energy (NISE), aims to build the skills of the youth to be engaged productively in the rapidly growing solar energy sector. The scheme involves a residential training program of 600 hours, and among the candidates eligible to participate, women, rural and marginalized people, and unemployed youth are given preference.[21] Ministry of New and Renewable Energy programs such

Photo Credit: TERI

Women Self-help group training

17 Dutta, S., 2018. Supporting last-mile women energy entrepreneurs: What works and what does not, The Hague: ENERGIA the International Network on Gender and Sustainable Energy

18 https://www.seforall.org/sites/default/files/People-Centered_Accelerator.pdf

19 https://www.aepc.gov.np/gender-equality-social-inclusion

20 https://sscgj.in/wp-content/uploads/2018/08/SCGJ-Annual-Report-2016-17-v2.0.pdf

21 https://suryamitra.nise.res.in/info/About-Suryamitra.html

as domestic and community biogas projects largely benefitted women as burning of fuelwoods for cooking is avoided. This has benefitted millions of women and children in rural areas. Moreover, over the years participation of women in emerging fields like data analytics has reached as high as 30–40% in certain cases.

Solar powered boats in Banaras

From a policy perspective, energy planning in India has largely donned the hat of a vehicle to push welfare objectives, particularly that of universal electrification, with provisions to provide access to the poor, marginalized, and disadvantaged. Govindan et al. (2020a[22]) in their paper on gender in electricity policy making find that gender has historically failed to take centre stage in electricity policies in India, making an appearance only recently. Of the 14 Indian policies analyzed in the paper, only four show gender related terms and indicators, as most policies addressed beneficiaries of both genders in an equal manner, implying that policy makers intended the benefits of electricity policies and programs to trickle down equally to all without discrimination. Only the Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY), a large-scale rural electrification program (2005-14), identified women or groups of women as potential electricity franchisees, in charge of metering, billing, providing connections, and running local networks. The Rural Electrification Policy 2006, the Integrated Energy Policy 2006, and the SAUBHAGYA scheme 2017 are other national energy policies that have, though sparingly, recognized the need for women's participation. By far the most gender mainstreamed policy for energy in India is the Pradhan Mantri Ujjwala Yojana (PMUY), which has provided over 80 million LPG connections to women from underprivileged households.[23]

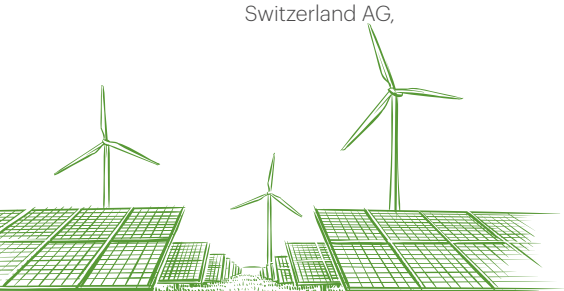
However, there have been some positive policy actions that have borne fruit in terms of realizing gendered outcomes. In the Indian state of Odisha, women-run electricity franchises reportedly succeeded in reduced distribution losses, reduced aggregate technical and commercial losses, increased billing percentages, increased consumer coverage, and increased total annual collection. Govindan et al. (2020 b)[24] documented the case of gender mainstreaming by Mahavitaran, the electricity distribution company of the state of Maharashtra, India, wherein women line staff, known as Mahila Vidyut Sahayak (women electricity support staff), were recruited and trained under a policy provision of reserving 30% of the electricity line staff jobs for women. An all-women squad, popularly known as Damini Phatak, was also implemented to address the consumer complaints regarding photo meter reading and to check meter tampering.

---

22 Govindan, M., Palit, D., Murali, R. & Sankar, D., 2020 a. Gender in electricity policymaking in India, Nepal and Kenya. I. In: G. Bombaerts, K. Jenkins, Y. A. Sanusi & e. W. Guoyu, eds. Energy Justice Across Borders. Cham: Springer Nature Switzerland AG, pp. 111-135

23 https://www.india.gov.in/spotlight/pradhan-mantri-ujjwala-yojana#tab=tab-1

24 Govindan, M., Palit, D., Murali, R. & Sankar, D., 2020 a. Gender in electricity policymaking in India, Nepal and Kenya. I. In: G. Bombaerts, K. Jenkins, Y. A. Sanusi & e. W. Guoyu, eds. Energy Justice Across Borders. Cham: Springer Nature Switzerland AG,



Lighting a Billion Lives (LaBL) – Emerging Opportunities for Women

A study was conducted in the state of Rajasthan to assess the distribution of gender roles and the resultant opportunities for women and men in the Lighting a Billion Lives (LaBL) initiative undertaken by TERI.

LaBL is a community-based solar lighting initiative through which local entrepreneur-driven delivery channels are created for distribution and servicing of solar lanterns to rural communities, households, and small enterprises that experience unreliable power supply. LaBL operates on a fee-for-service or rental model where centralized solar lantern charging stations (SLCS) are set up in villages for charging the lanterns and providing the lanterns daily on rent to households and enterprises.

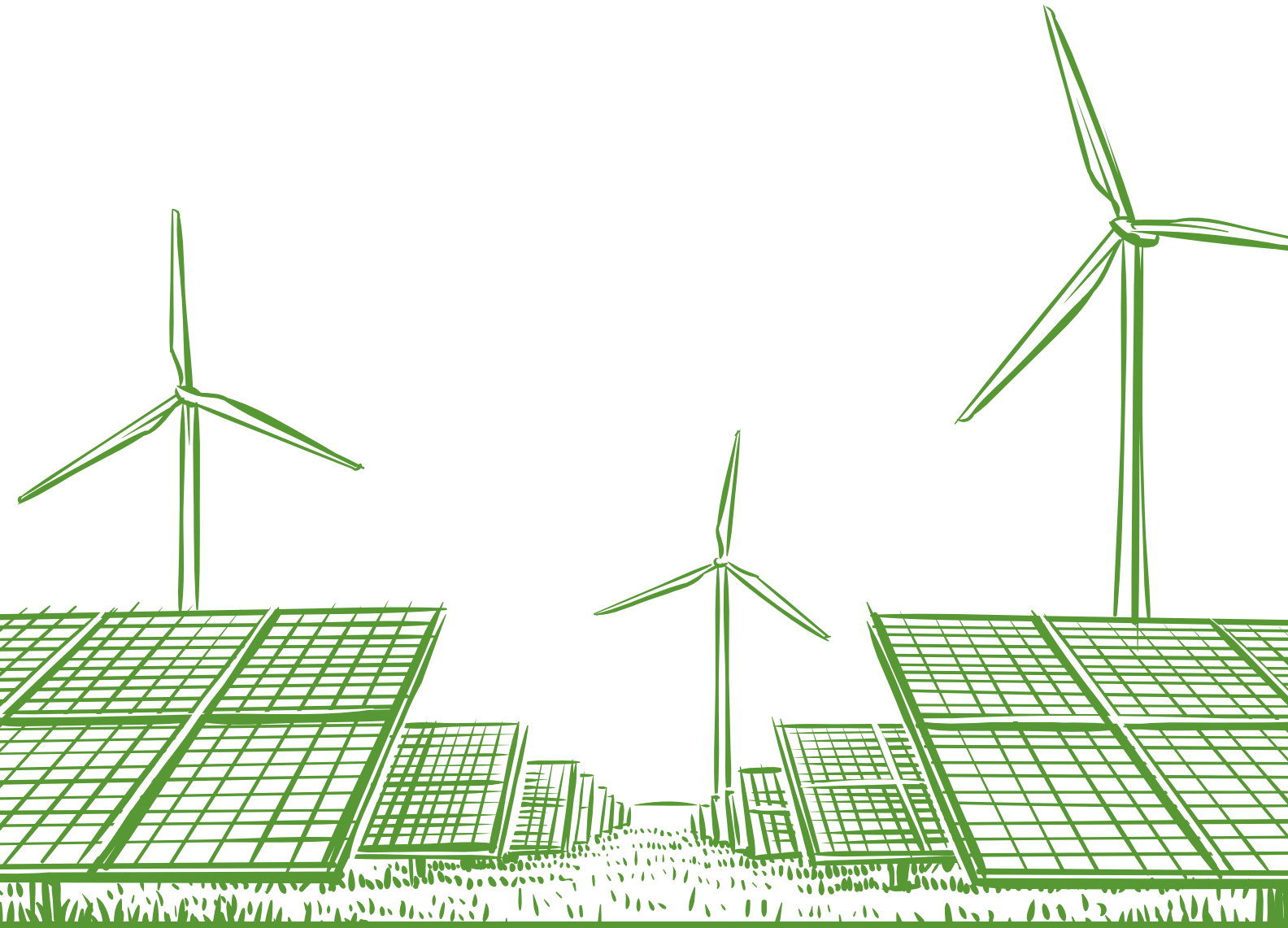
The study reveals that despite the traditionally dominant division of labour between men and women amongst the Gujjar community (traditionally agro-pastoral nomads who have now moved into more settled agriculture), the LaBL initiative has brought significant benefits specific to domestic and practical needs of women, in addition to opening up entrepreneurial opportunities.

The introduction of solar lanterns has impacted women's time allocation and distribution of work. The lanterns have also aided women in better cooking and working conditions. LaBL has also boosted income generation in the villages. Households get cash income from high value crops and vegetable cultivation due to grading and packaging at night, which was not being done earlier. LaBL has helped augment family incomes of the LaBL entrepreneurs and in the case of the women entrepreneurs, the project has motivated them to get actively involved in social gatherings and other community development initiatives. Furthermore, women entrepreneurs also have control over the earned resources and are able to spend the money earned on their children and themselves.

Lighting has also allowed increased mobility at night for women and helped communities to hold marriages and festivals for longer hours in the evening. The greatest beneficiaries of this initiative, however, have been children (both boys and girls) who are able to study beyond the daylight hours.

The effectiveness of the interventions lies in improving the existing living conditions of women and in opening avenues for entrepreneurial activities. The findings of the study confirmed that solar lanterns have contributed positively through increased economic resources, health and well-being, better social activities, and environmental protection.

Finally, India is not only accelerating its own energy transition but also laying down a sustainable growth pathway for other emerging economies to emulate. It is behind path breaking initiatives such as the International Solar Alliance and Mission Innovation which are helping multiple countries transform their energy systems while meeting their climate and developmental commitments.



DEMAND
Analysis

Key Findings from Demand Side Studies

The countries in the Indo-Pacific region lack impetus required for faster and deeper penetration of renewable technologies. Typically, these countries have developed plans but lack in suitable policy and regulatory push required to accelerate the development.

Access to technologies, lack of trained personnel skilled at development, deployment and project management and limited access to international finance and technologies are some of the major barriers for faster and widespread development of renewable technologies, especially for rural, remote, and distributed applications. Some countries need handholding to strengthen their policy and regulatory frameworks. Human capacity building with focus on gender and just transition issues is of paramount importance in the region.

Country Identification, Economic Indicators, and Relationship Analysis

The country identification process was undertaken using an extensive multi-criteria approach, considering the relevant energy, economic, environmental, and social parameters and a detailed rank-based approach where the countries were ranked on bilateral relations with India, renewable energy capacity target, renewable energy installed capacity, share of renewable energy in overall electricity portfolio, trade dependence on China, trade dependence on India, access to electricity by percentage of population, cost of electricity (households), and access to clean cooking by percentage of population. A total of 15 countries were initially identified from Southeast Asian and the Pacific Islands regions. The selected countries hold potential and opportunities in terms of developing triangular cooperation between India, the United States, and the selected country. The first filter applied for screening of the countries is that of economic development. Developed countries in the region have been eliminated from initial selection. This is followed by a multi-criteria framework approach wherein countries have been ranked using the parameters explained below. A weighted average of the selected indicators has been considered for ranking, and the details of the weights and total scores are provided in Annexures 5.0, 6.0, 7.0, and 8.0. The following section gives an overview of the overarching variables that were used to rank the countries.

Renewable Energy and Nationally Determined Contribution Targets

The identified countries within the region are signatories to the Paris Agreement and are committed to reduce their carbon intensity within the stipulated time frame. This has led to setting renewable energy targets by countries to accomplish commitments to the Paris Agreement. However, some countries are keeping the pace to achieve the same while some others may require support from the front runners. This assessment intends to track the performance of these countries towards their renewable energy development. The least performing countries will be better suited for further selection.

Political and Economic Cooperation with India

The countries that are listed out have been analyzed with respect to the degree of their bilateral trade relationship with India, growth over time, future growth potential, existing energy related trade pacts or MoUs signed, and strength of their trade participation with China. Based on these indicators, a few countries that can potentially be a strong market for India were selected to be further analyzed for the study.

Access to Electricity and Clean Cooking

The access to electricity for clean cooking options emerges as one of the key challenges for uptake of cleaner fuels. The RE-based electricity particularly from solar sources in the form of mini or micro grids can be developed in lesser time in regions located in tough terrains. Hence, the identification of such countries with low per capita electricity will be a suitable indicator for selection. The renewable energy options like solar cookers for cooking are not widely accepted. However, the electrification of cooking can be done, which again reiterates the demand for renewable energy. Thus, analyzing the access to clean cooking is one of the indicators for evaluation.

Cost of Electricity

With decline in costs of RE-based electricity particularly from solar and wind sources, the fossil-based electricity generation is becoming economically uncompetitive. Hence, the assessment of electricity cost per unit helped us analyze the potential of RE (solar) development in the country. It is envisaged that the country with high cost of electricity may want to explore cost-effective renewable options.

Gender Equity in Opportunities

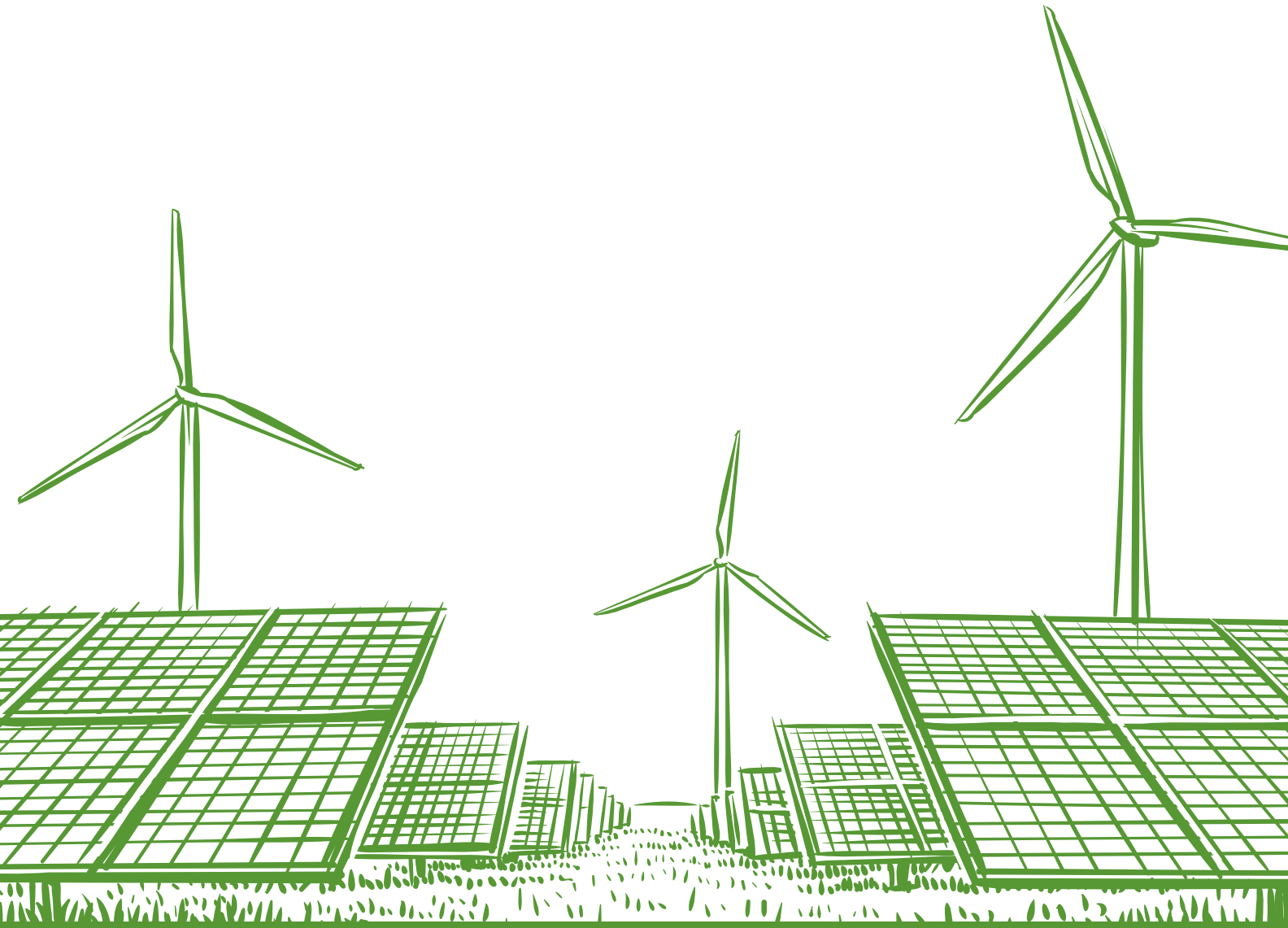
The employment of women in the RE sector is also one of the indicators for selection of countries. The existing literature suggests that participation of women in this space is considerably low vis-à-vis other sectors.

Final Selection

The countries in the selected regions have been ranked using a weighted average of selected indicators. The process is carried out separately for the Pacific Islands region and Southeast Asian region.

The top five countries have been finally selected for in-depth analysis: two from the Pacific Islands region and three from the Southeast Asian region. The selected countries include Indonesia, Thailand, Fiji, Papua New Guinea (PNG), Philippines, and Cambodia. The details of the assessments are provided in the Annexures 5.0 – 8.0.

Detailed studies of these selected countries have been conducted through literature reviews, stakeholder discussions, and demand side convening to get relevant feedback. The following sections discuss the prospects of renewable energy development in the selected countries of Indonesia, Thailand, Fiji, Philippines, PNG, and Cambodia.



INDONESIA

Country Profile–Indonesia

Indonesia is the largest country in the Association of Southeast Asian Nations (ASEAN) region and accounts for nearly two-fifths of the region's energy consumption. The country houses 275 million people and the population is increasing at an annual rate of 1.1% in an area of 1.905 million sq km.[25] The key contributing economic sectors in the country's GDP include agriculture, industry, and services. The share of agriculture in Indonesia's GDP was around 13.7%. Industry contributed approximately 38.26% and the service sector contributed about 44.4%.[26]

Table 1: Country Indicators–Indonesia

Indicator	Figure
GDP (current US$)	1058 billion as of 2020
GDP per capita PPP (current international $)	12,312.6 as of 2019
Population growth rate	1.1% (2010 – 2020)
Population density	143 per sq km as of 2018
Inflation (%)	1.9
% of population with access to electricity	98.8
% of renewable energy in final energy consumption	36.88*

** Source: Details available at https://tradingeconomics.com/indonesia/renewable-energy-consumptionpercent-in-tfec-wb- data.htm*

Indonesia is among the fastest growing countries in terms of energy consumption, and its electricity consumption increased rapidly by around 7% during the period 2010 – 2019. The nation's energy consumption portfolio accounted for 43% households, 34% of industry, and 22% of services in 2020. The projected electricity demand in the country could increase by three times between 2015 and 2030 (IRENA, 2017).

Indonesia in its first NDC commitments targeted to reduce GHG emissions by 29% by 2030 with a conditional target of 41% if global agreements on various factors are reached with the assistance of bilateral cooperation on technology development and transfer, financial help, and so on. In the draft of second NDC, the country planned to reach net-zero emissions by 2070 and reduction in the use of coal by 60% in 2050.[27]

---

25 O'Neill, A. (2021) Indonesia – Statistics & Facts, Statista. Available at: https://www.statista.com/topics/2398/indonesia/

26 O'Neill,A. (2021) Indonesia: share of economic sectors in the gross domestic product (GDP) from 2010 to 2020, Statista. Available at: https://www.statista.com/statistics/319236/share-of-economic-sectors-in-the-gdp-in-indonesia/

27 Republic of Indonesia (2021) NDC Republic of Indonesia

Coal dominates the power mix in the country with a share of 63.6% in 2020, which has increased by 22% since 2010.[28] The gas exports have reduced by 50% since 2010 and Indonesia will become a net importer of gas in the coming decade.[29] The energy security has become the key agenda as Indonesia is on the track of economic development. The renewable energy development has been far from satisfactory and indicates enormous potential and opportunity for future interventions that India can offer.

The country targets a share of renewables of 23% in total primary energy supply by 2025 and 28% in power capacity by 2038.[30] Currently, a majority of RE uses in the country is represented by traditional uses of bioenergy, mainly for cooking practices; however, for electricity purposes there is not much development except for geothermal and hydro installations of 10.5 GW. In terms of solar and wind energy potential, an estimated 716 GW of theoretical potential has been identified for RE-based generation in Indonesia. Solar PV potential in the region is as high as 532.6 GW, with onshore wind potential of 9.3 GW.[31] However, these potential figures are irrespective of the demand. Indonesia as an archipelago offers inhabited islands at a range of scales and population densities. Access to modern energy and cost of energy are two major challenges faced by the country.

Relationship Analysis: India–Indonesia

Diplomatic and bilateral trade relations between India and Indonesia have always been cordial. Indonesia is India's second largest trading partner in the ASEAN region with imports as of 2019 totaling $11 billion and exports totaling $4.5 billion. Indian investments in Indonesia totaled $995 million between 2000 and 2018.[32] In 2015, India signed an MoU with Indonesia in the field of new and renewable energy cooperation. The objective of the MoU is to establish the basis for a cooperative institutional framework to encourage and promote technical bilateral cooperation on new and renewable energy issues based on mutual benefit, equality, and reciprocity.[33]

---

28 Statista (2021a) Electricity generation by coal as a share of energy mix in Indonesia from 2014 to 2020, Statista. Available at: https://www.statista.com/statistics/994184/coal-electricity-generation-indonesia/

29 Statista (2021c) Value of gas exports in Indonesia from 1996 to 2020, Statista. Available at: https://www.statista.com/statistics/878715/gas-export-value-indonesia/#:~:text=In 2020%2C the total value, terms of value in 2020

30 ADB (2020b) Renewable Energy Tariffs and Incentives in Indonesia: Review and Recommendations

31 IRENA (2017b) Renewable Energy Prospects: Indonesia, International Renewable Energy Agency (IRENA). Available at: http://www.irena.org/remap

32 MEA (2020b) India-Indonesia Bilateral Relations

33 Times, T. E. (2015) India, Indonesia sign two MoUs; to expand defence cooperation, The Economic Times, p. 1. Available at: https://economictimes.indiatimes.com/news/defence/india-indonesia-sign-two-mous-to-expand-defence-cooperation/ articleshow/49628344.cms?from=mdr

While India has a textbook trade and multilateral relationship with Indonesia, over the years the country has been warming up to China. Amongst ASEAN countries Indonesia at $171 billion is the recipient of the largest capital inflow from the Belt and Road Initiative (BRI).[34] It is expected that this relationship will now result in China exporting more to these countries. Chinese steel and aluminum once destined for the US market might now be diverted to Indonesia.

However, while the trade relationship has been on the rise, the growing trade imbalance and BRI are slowly becoming an irritant amongst ASEAN nations. For instance, after 2013 Chinese firms in Indonesia moved away from the mining of coal and mineral ores and switched from undertaking construction contracts to investments in coal-fired power plants. This resulted in Indonesia employing protectionist policies to retain control over mining permits, seeking majority ownership of large-scale mining projects, and avoiding the export of raw commodities in favor of value-adding in country. Essentially, this move propelled Indonesia to build 14 new coal-fired power plants between 2013 and 2015.[35]

Indonesia's battle with regulatory uncertainties has been a thorn in its quest to enable renewable energy technologies across the country. Its documents have been perceived by private investors and financiers as lacking clarity and attractiveness, especially in terms of the applicable tariffs for renewables and independent power producers (IPPs) (which use the national and regional average costs of generation as reference points) and the tendering regime to award such projects (Ashurst, 2021)[36]. Although policy irregularities exist, the success of the clean cooking program in Indonesia wherein the government doubled the proportion of its population with access to clean cooking – from 40% to 80% (Imelda, 2020)[37] is a testimony of the level of success that can be achieved via clean energy initiatives. With an industry primed to thrive, renewable energy has a bright future in Indonesia. India can leverage its large-scale technical expertise in the segment to help develop renewable energy ecosystem in Indonesia. It can also aid in institutional capacity development and help create an enabling policy environment by leveraging the policy expertise of its agencies.

Country's Priorities

As per our understanding the country's priorities include the following:

1. Studies to assess renewable energy sources
2. Developing and identifying cost-effective technical solutions for remote island electrification

---

34 CIMB (2018) China's Belt and Road Initiative (BRI) and Southeast Asia

35 Lechner, A. (2019) 'Trends in Southeast Asia', in The Belt and Road Initiative: Environmental Impacts in Southeast Asia, pp. 1–41. doi: 10.1355/9789814881432-002

36 Ashurst (2021) Indonesia Renewables - ICLG Guide on Renewable Energy 2022.

37 Imelda, C. I. (2020) Indonesia shows clean cooking saves lives, East Asia Forum. Available at: https://www.eastasiaforum.org/2020/10/03/indonesia-shows-clean-cooking-saves-lives/.

3. Developing an ecosystem of key stakeholders to deliver cost-effective renewable energy solutions
4. Stimulating and restructuring the power sector with favorable regulatory environment, attractive feed-in tariffs, and tax incentives

These focal areas go well with the identified capacities of Indian institutions as mentioned in the supply analysis.

Gender and Social Inclusion in Energy Policy

The long-term National Energy Policy,[38] 2014–2050, of Indonesia does not explicitly mention gender inclusion in its provision. However, it prioritizes subsidized energy supply to economically disadvantaged people of the country. It also mentions providing incentives to consumers and producers of energy practicing energy conservation and efficiency. The areas of potential collaborations with Indonesia include the following:

» Support to the Royal Indonesian government, policy makers and regulatory agencies in creating enabling environment for the faster adoption of renewable energy. This can be achieved through effective collaborations between Indian stakeholders such as MNRE, NISE, NIWE, and CERC and the counterparts from the Indonesian government.

» Experience of Indian agencies such as Power System Operation Corporation (POSOCO), The Energy and Resources Institute (TERI), the Centre for Study of Science, Technology and Policy (CSTEP) can be leveraged to develop island-wise renewable energy plans and grid integration studies of variable energy renewables such as solar and wind energy.

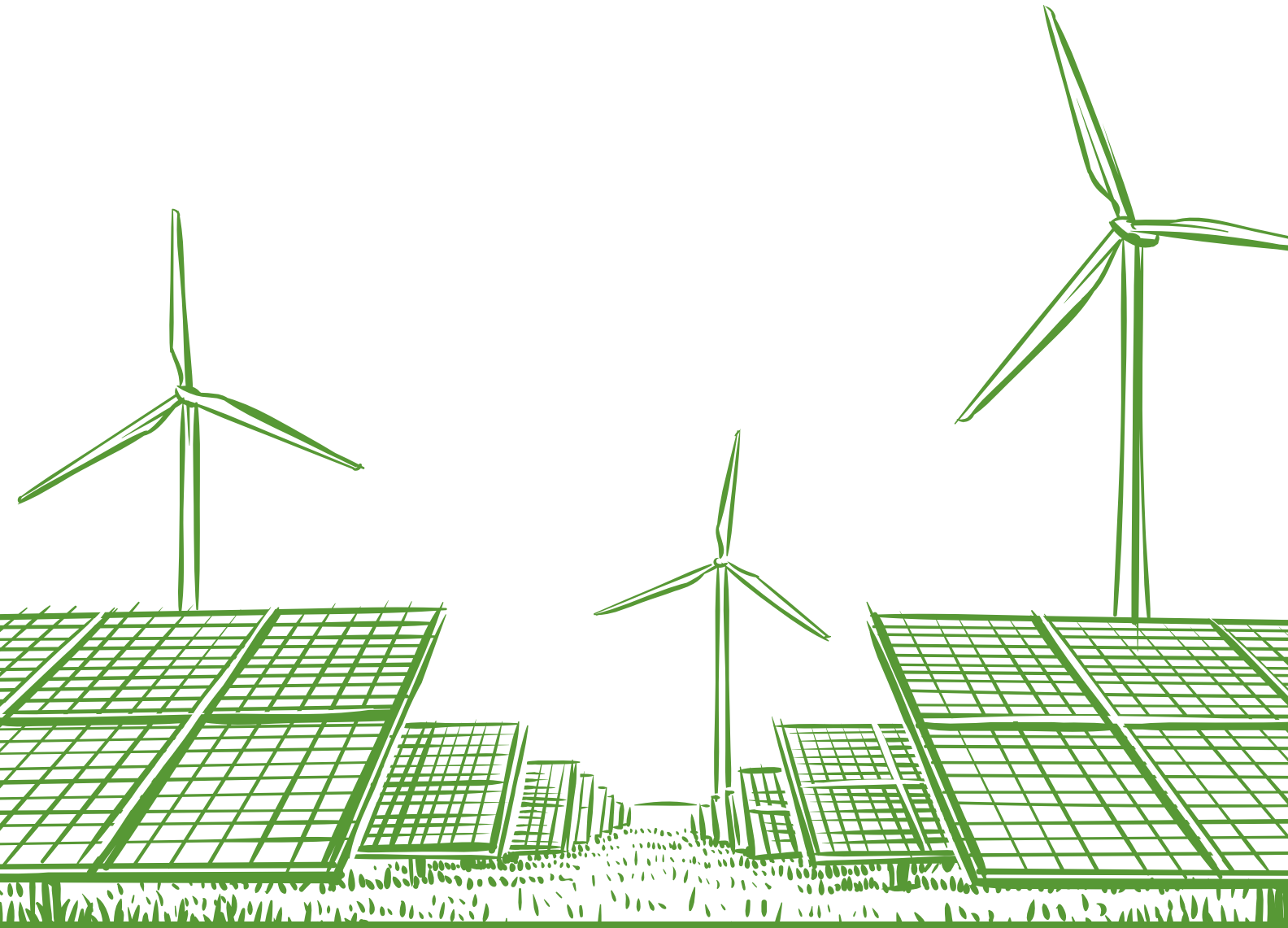
» Institutional capacity building through the interventions of skill council, educational, and research institutes.

» Development of local ecosystem including manufacturing, project development, and project management can be promoted through the active participation of Indian industry players and Skill Development Council, FICCI, and so on.

» India's vast experience of developing and implementing clean cooking programs can be leveraged to promote clean cooking through a programmatic approach.

---

38 https://policy.asiapacificenergy.org/sites/default/files/National%20Energy%20Policy%20 2014_0.pdf, last accessed on December 26, 2020



THAILAND

Country Profile – Thailand

The Kingdom of Thailand is located in the Southeast Asia region and is home to 69.9 million people. It covers an area of 513,000 sq. km. More than half of its energy supply is dependent on imported energy, which is likely to increase further as its proven reserves of oil and gas are depleting at a faster rate.[39] The country relies heavily on the conventional sources for meeting its energy demand, and around 54% of final energy consumption is supplied through oil products. Natural gas is by far the primary source for power generation, accounting for around 65% in 2020. This also translates into high electricity prices, which have increased since 2017 due to higher fuel costs. In 2017, the residential sector accounted for 23.01% of all electricity consumed in Thailand. The growth rate of electricity demand was 5.20% per year, increasing from 32,799.46 GWh in 2011 to 44,373.96 GWh in 2017 (Poolsawat et al. 2020).[40] This provides the opportunity for the transition to RE sources, which in addition to environmental benefits has demonstrated economic viability.[41]

Table 2: Country Indicators - Thailand

Indicator	Figure
GDP (current US$)	501.79 billion as of 2020
GDP per capita PPP (current international $)	19,208.6 as of 2019
Population growth rate	0.3%
Population density	136 sq km as of 2018
Inflation (%)	–0.8
% of population with access to electricity	99.9
% of renewable energy in final energy consumption	22.86*

**Source https://tradingeconomics.com/thailand/renewable-energy-consumptionpercent-in-tfec-wb-data.html*

Energy demand in Thailand is expected to increase by 78% by 2036 and GDP by 126% (IRENA, 2017a). Renewables, particularly solar and wind, will play an important role in meeting this demand. Solar radiation in the region is as high as 1400 kWh per square meter per year. The current target for solar installations is 6 GW by 2036, which suggests scope for increasing the target as installations are already halfway. Wind energy potential in the region can reach up to 13 GW to an average wind speed of 6 m/s at a height of 90 m based on assessments by DEDE. These installations too have reached 50% of its 3 GW target by 2037 (Ranthodsang et al., 2020). Thailand has set a new renewable energy target of 30% of total final energy consumption by 2036 in its Alternative Energy Development Plan (AEDP) 2015 (IRENA, 2017a).

39 IRENA (2017a) Renewable Energy Outlook: Thailand, International Renewable Energy Agency

40 Poolsawat, K. *et al.* (2020) 'Electricity consumption characteristics in Thailand residential sector and its saving potential', in *International Conference on Power and Energy Systems Engineering*. Elsevier Ltd, pp. 337–343. doi: 10.1016/j.egyr.2019.11.085.

41 ibid.

Thailand submitted its first NDC in 2016 and updated it in October 2020 with unchanged targets. The commitments of reduction in greenhouse gas emissions by 20–25% from the business-as-usual scenario by 2030 require concerted actions with international and technology support.[42]

The Thailand's Cabinet in October 2020 asked the Ministry of Energy to draw up Thailand's Integrated Energy Blueprint putting together energy plans issued in 2018, namely, the Thailand Power Development Plan (PDP),[43] the Energy Efficiency Plan (EEP),[44] the Alternative Energy Development Plan (AEDP),[45] the Natural Gas Supply Plan (Gas Plan),[46] and the Petroleum Management Plan.

Relationship Analysis: India – Thailand

India's ties with Thailand have now evolved into a comprehensive partnership. India's 'Act East' policy has been complemented by Thailand's 'Act West' policy in bringing the two countries closer. While MoUs on energy have not been signed over the years, India has broadened its security presence and measures with the ASEAN nations, especially with regard to the Indo-Pacific region, for which Thailand is a key member. The two nations currently have a very strong cooperation on the maritime security front within the Indian Ocean. Given the expanding nature of blue economy finances in Thailand, the two nations can leverage their strong oceanic ties and expand their cooperation on sustainable ocean energy development.

Centers of Excellence in Thailand

Energy Policy and Planning Office

EPPO was set up in 1986 as National Energy Policy Office (NEPO), which was renamed as Energy Policy and Planning Office (EPPO) in 1992 and was transferred from the Prime Minister office to the Ministry of Energy, the Royal Government of Thailand. EPPO is responsible for recommending national energy policies and plans, including energy-related measures and energy conservation to ensure well-proportioned, adequate, and efficient supply of energy that corresponds with the situation of the country.

EPPO can work closely with the MNRE in developing progressive policies and regulatory framework.

---

42 Government of Thailand (2020) Thailand NDC, UNFCCC. Available at: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Thailand First/Thailand Updated NDC.pdf

43 https://www.thaienergy.org/Blog/5

44 https://policy.thinkbluedata.com/node/4352

45 https://policy.asiapacificenergy.org/node/4351

46 https://policy.asiapacificenergy.org/node/4349

School of Renewable Energy and Smart Grid Technology

The School of Renewable Energy and Smart Grid Technology (SGtech) was established in 1995. As an autonomous institute within Naresuan University, SGtech works flexibly to develop renewable energy technologies to meet the energy demands of developing countries in Southeast Asia and to promote the industrial applications of renewable energy.

SGtech offers professional training programs at both master's and doctorate degree levels. Its activities include carrying out research on new approaches of renewable energy generation and identifying feasible areas in Thailand where the renewable energy technologies could effectively be utilized. A collaboration between SGtech and Indian Institutes of Technology and other research institutes is recommended.

Centre of Alternative Energy Research and Development

Centre of Alternative Energy Research and Development (AERD) was established at the Department of Mechanical Engineering, Khon Kaen University, Khon Kaen, Thailand. It is aimed to conduct renewable energy research and development with excellence in research and development, academic service consultation, teaching and learning curriculum, and training and seminars on the power side. The structure of the Centre consists of the following research groups. (i) Alternative energy research groups include research on biomass, solar energy, micro-hydro power, fuel cells, as well as the implementation of results, research into national policies such as energy consumption policies in the country for higher efficiency, energy consumption standards or establishing an energy information and communication database system, and so on and (ii) research group of energy technologies and equipment, including energy-saving equipment as well as technologies to produce fuels in the form of solids, liquids, and gases.

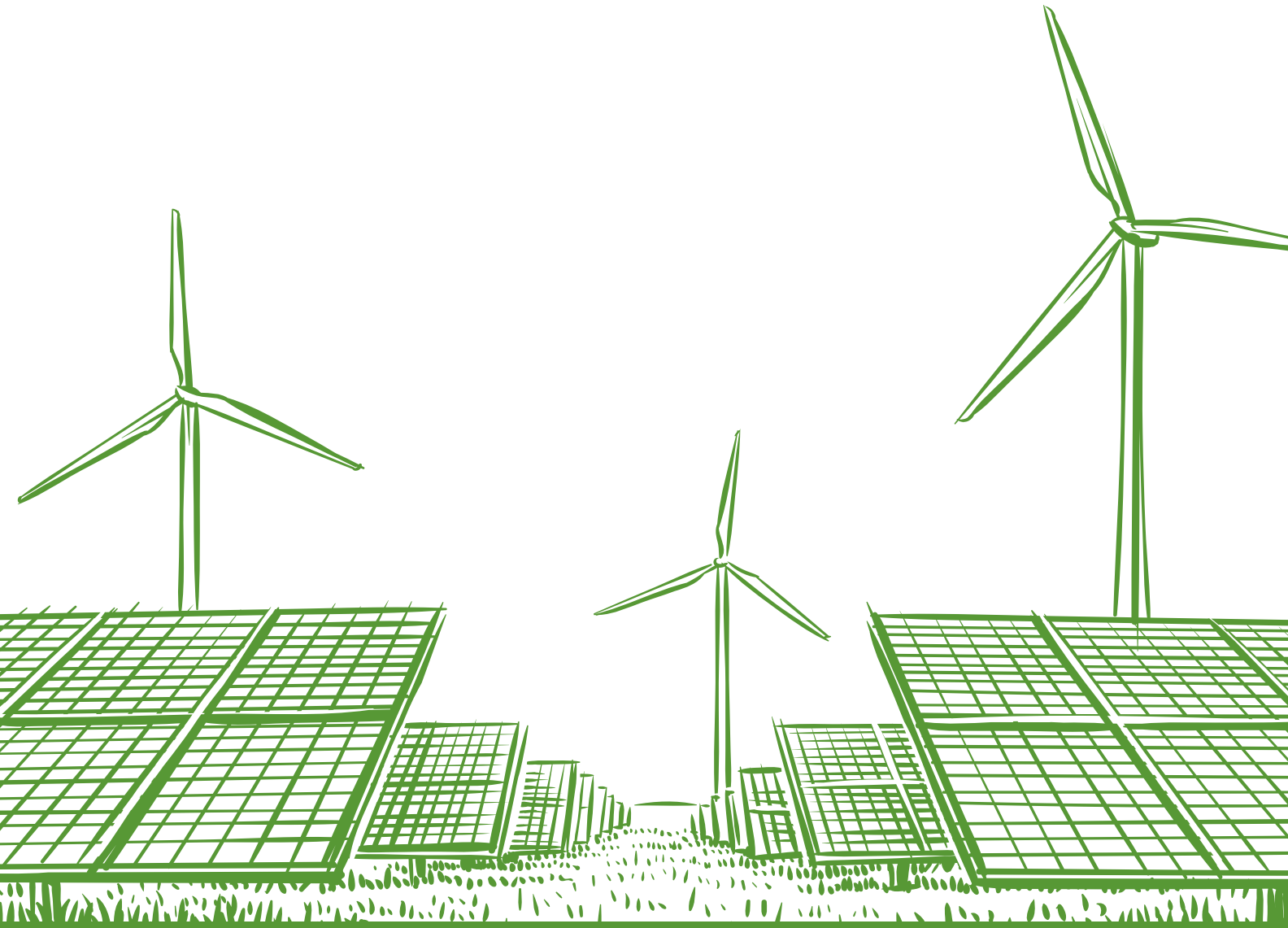
Collaborations with Indian research institutes can be explored for joint research and development projects.

Areas of Potential Collaboration with Thailand

The Royal Government of Thailand has ambitious plans focusing on clean energy, decarbonization, and deregulation/decentralization of electricity sector, promotion of electric vehicles, and so on. Several initiatives with support from the Indian government can be initiated under the proposed program, which can include the following:

1. Focus on development of the EV sector powered by green renewable energy. Agencies such as Energy Efficiency Services Limited (EESL) and MNRE, private sector players, and manufacturers in the EV sector could be roped in to support and develop renewable energy powered EV sector in Thailand.

2. Identifying and promoting new technology solutions for clean and renewable energy. The tripartite program can focus on various techno-economic studies to develop a road map and plan for grid integration of renewables.
3. Thailand has immense potential for renewable energy-based power generation. The proposed interventions to achieve this include the following:
    a. Demand forecasting studies
    b Grid integration studies for variable renewables
    c. Policies and regulations
    d. Risk analysis
4. MNRE agencies, grid management company POSOCO, think tanks such as CEEW, TERI, and CSTEP, educational institutes like Indian Institute of Technology, and private players can contribute and play a leading role in developing the RE sector in Thailand. Joint ventures with Indian companies working in Engineering, Procurement and Commissioning (EPC) of projects, solar PV module manufacturers, wind turbine manufacturers, and small off-grid system manufacturers can be explored.



PHILIPPINES

Country Profile – Philippines

Located in Southeast Asia within the western part of the Pacific Ocean, Philippines consists of more than 7000 islands and an area that stretches about 1150 miles (1850 km) from north to south and its widest east – west extent, at its southern base, is some 700 miles (1130 km). The country has a population of 108 million and is rapidly escalating while the total land area is 298,170 km^2 (115,124 sq miles). Further, the country's population density is 368 per km^2 (952 people per sq miles) but the distribution of the population is uneven, as over 53% of the population resides in rural areas and 47% in urban. Parts of Metro Manila have a population density that is more than 100 times that of some outlying areas such as the mountainous area of northern Luzon. With a Purchasing Power Parity (PPP) of $8,390.4, Philippines annual PPP has grown steadily at a rate of 1.68% yoy.[47], [48], [49]

Table 3: Country Indicators – Philippines*

Indicator	Figure
GDP (current US$)	361.48 billion as of 2020
GDP per capita PPP (current international $)	8300 as of 2019
Population growth rate	1.3%
Population density	358 sq km as of 2018
Inflation (%)	2.6 (2020)
% of population with access to electricity	95.6
% of renewable energy in final energy consumption	27.45

**Source Trading Economics website*

With almost 10% of the country's GDP fuelled by remittances,[50] the COVID-19 pandemic and the travel restrictions that ensued largely impacted Philippines' growth trajectory as its GDP plummeted by 9 percentage points. However, the economy is expected to recover and grow by 4.5% in 2021.[51] Additionally, at basic price the gross value added by the country stood at $376.8 billion for the year 2020[52] and the per capita income stood at $3298.[53]

---

47 World Bank (2020) GDP per capita, PPP (current international $) – Philippines, World Bank. Available at: http://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG

48 Worldometer (2021) Philippines Population, Worldometer. Available at: https://www.worldometers.info/world-population/philippines-population/

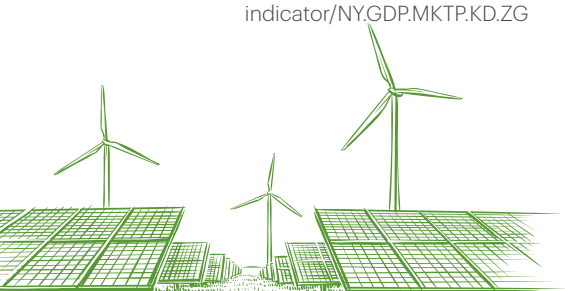
49 Carolina G. Hernandez (2021) Philippines, Britannica. Available at: https://www.britannica.com/place/Philippines#ref23724

50 Statista (2021b) Personal remittances received as share of the gross domestic product (GDP) in the Philippines from 2010 to 2019, Statista. Available at: https://www.statista.com/statistics/1241883/remittance-share-of-gdp-philippines/#:~:text=Personal remittances received/fluctuated in the past decade

51 ADB (2021b) Economic indicators for the Philippines, Asia Development Bank. Available at: https://www.adb.org/countries/ philippines/economy

52 World Bank (2020d) 'Gross value added at basic prices (GVA) (current US$) – Philippines', 2010, p. 1. Available at: http://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG

53 World Bank (2020b) GDP per capita (current US$) – Philippines, World Bank. Available at: http://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG



Investments in renewable production and installation have grown significantly in the country over the past few years. By 2017 these investments were the reason why the country saved more than $80 million in total electricity cost[54] However, still only about 24% of all electricity use in Philippines comes from renewable energy resources[55] while only about 43% of the population has access to clean fuels and technologies for cooking;[56] this number however is still greater than the Southeast Asia average of 27%.[57]

Philippines is aiming to increase the prominence of renewable energy within its electricity grid from the current capacity of 24% to 60% by 2030.[58] The country's geographic location in the Pacific makes it a good potential for renewable energy generation across hydropower, solar, geothermal, and wind energy. To further ascend its position within the climate change narrative, the country has listed out two major NDCs that it has committed under the Paris Agreement.[59]

» Philippines has committed to a projected GHG emissions reduction and avoidance of 75%, of which 2.71% is unconditional and 72.29% is conditional, representing the country's ambition for GHG mitigation for the period from 2020 to 2030 for the sectors of agriculture, wastes, industry, transport, and energy.

» The country, in line with its national security policy and its sustainable development aspirations and in solidarity with ASEAN member states, shall endeavor to peak its emissions by 2030 in the context of accelerating the just transition of its sectors into a green economy and the delivery of green jobs and other benefits of a climate and disaster-resilient and low carbon development to its people, among others.

Relationship Analysis: India – Philippines

India-Philippines bilateral relations are now reaching new heights in the political, defense, and economic domains. The continuous elevation of this partnership will have strong and positive implications for the Philippines' strategic policy vis-à-vis China's increasing assertion in the region. Economic relations between the two countries have grown rapidly in recent years, although still modest given the potential that exists. India–Philippines trade in 2018–19 was around US$2.32 billion while in 2017–18 bilateral trade grew by nearly 25% to US$2.45 billion (MEA, 2019)[60]. With India opting out of the Regional Comprehensive Economic Partnership (RCEP), the nation plans to have preferential trade

54 WWF (2017) Renewables Best Way to Power Philippine Development, World Wildlife Foundation. Available at: https://wwf. org.ph/what-we-do/climate/renewables/renewables-to-power-ph-dev/

55 Agaton, C. B (2018) 'Use coal or invest in renewables: a real options analysis of energy investments in the Philippines', Renewables: Wind, Water, and Solar, 5(1), pp. 1–8. doi: 10.1186/s40807-018-0047-2

56 World Bank (2016c) Access to clean fuels and technologies for cooking (% of population) – Philippines, World Bank. Available at: https://data.worldbank.org/indicator/EG.USE.ELEC.KH.PC?end=2014&start=1960&view=chart

57 Rowling, M (2020) Dirty secret: Half of world lacks clean cooking, at a huge cost, Reuters. Available at: https://www.reuters.com/article/us-global-energy-cooking-idUSKCN26G2GE

58 Agaton, C. B (2018) 'Use coal or invest in renewables: a real options analysis of energy investments in the Philippines', Renewables: Wind, Water, and Solar, 5(1), pp. 1–8. doi: 10.1186/s40807-018-0047-2

59 Philippines (2021). Philippines NDC. Available at: https://climateactiontracker.org/countries/philippines/

60 http://www.mea.gov.in/Portal/ForeignRelation/Bilateral_Brief_India-Philippines_2019.pdf

agreements (PTA) with individual countries, a move that can be an effective instrument in establishing large trade and commercial connections. India and Philippines are currently in the process of deepening their bilateral trade relationships with the help of these PTAs.[61]

On the renewable energy and climate sustainability front, India has not signed any significant MoUs with Philippines since 2009 and also not conducted any joint working group on the subject since 2013.[62] The Sino–Philippine relationship has come under some scrutiny recently since the Pacific nation has long been an ally of United States and President Duterte has decided to improve their ties with China. Although Philippines has strong defense ties with the USA, it has begun to maintain more cordial ties with the two countries.

This diplomatic strategy gives India a significant opportunity to expand its relationship with the Philippines and further build those ties. Since it is already in the process of initiating PTAs with the country, it must also focus on specific energy security ties especially from the context of blue economy on areas such as sustainable fisheries, tidal energy, and cultivation of seaweed industry and build networks for institutional transfer of information and technology to aid in the process of deepening sustainable energy relationship with the nation.

National Renewable Advisory Board

The National Renewable Energy Board (NREB) – Philippines is the advisory body primarily tasked with recommending policies to the Philippines Department of Energy (DOE) and monitoring the implementation of the Republic Act No. 9513 or the Renewable Energy Act of 2008.

Inputs from Demand Convening and One-on-One Discussions

During interaction with local experts, the following observations were made:

1. Most rural power supply companies (electric cooperatives) are struggling to remain financially viable and need support in building the capacity of engineers and management to integrate renewable energy systems with the grid.
2. There is no quality control mechanism or regulation for distributed energy systems, and hence low-quality systems are being supplied by fly-by-night operators. This may need to be considered and adequately addressed. Rural island grid planning and RE integration is an important issue and training and capacity building is required.

---

61 Basu, N. (2021). India considers long-term economic ties with the Philippines, to boost Indo-Pacific initiative, The Print. Available at: https://theprint.in/diplomacy/india-considers-long-term-economic-ties-with-the-philippines-to-boost- indo-pacific-initiative/613360/

62 Embassy of the Philippines (2020). Establishment of Philippines-India Diplomatic Relations, Embassy of the Philippines. Available at: https://newdelhipe.dfa.gov.ph/index.php/2014-04-14-03-09-43

3. The project can work with the National Renewable Advisory Board, which is the advisory body for the Ministry of Energy in the country.

Gender and Social Inclusion in Energy Policy

Three energy policies of the Philippines were examined to understand the nature of inclusion of gender in the policy guidelines. The Renewable Energy Act, 2008[63] was the first comprehensive legislation on renewable energy in Southeast Asia. The policy, however, does not mention provisions for gender inclusion explicitly. Nevertheless, it uses terms such as 'community' and 'end-users,' which are gender-neutral and consider women and marginalized sections of the society. The National Renewable Energy Program (NREP), 2011[64] also falls short of addressing gender in its objectives and provisions and relies on terms like 'communities' to address all types of consumers and beneficiaries. However, the Philippines Energy Plan, 2018–2040[65] makes provisions for social welfare and women and gender inclusion in its planning. The Social Amelioration and Welfare Program within the plan mentions providing social protection and welfare to biofuel workers. It also calls for the monitoring teams for energy project to be inclusive to women and the community. The Plan further talks about training a gender-inclusive energy workforce.

Recommendations for Philippines

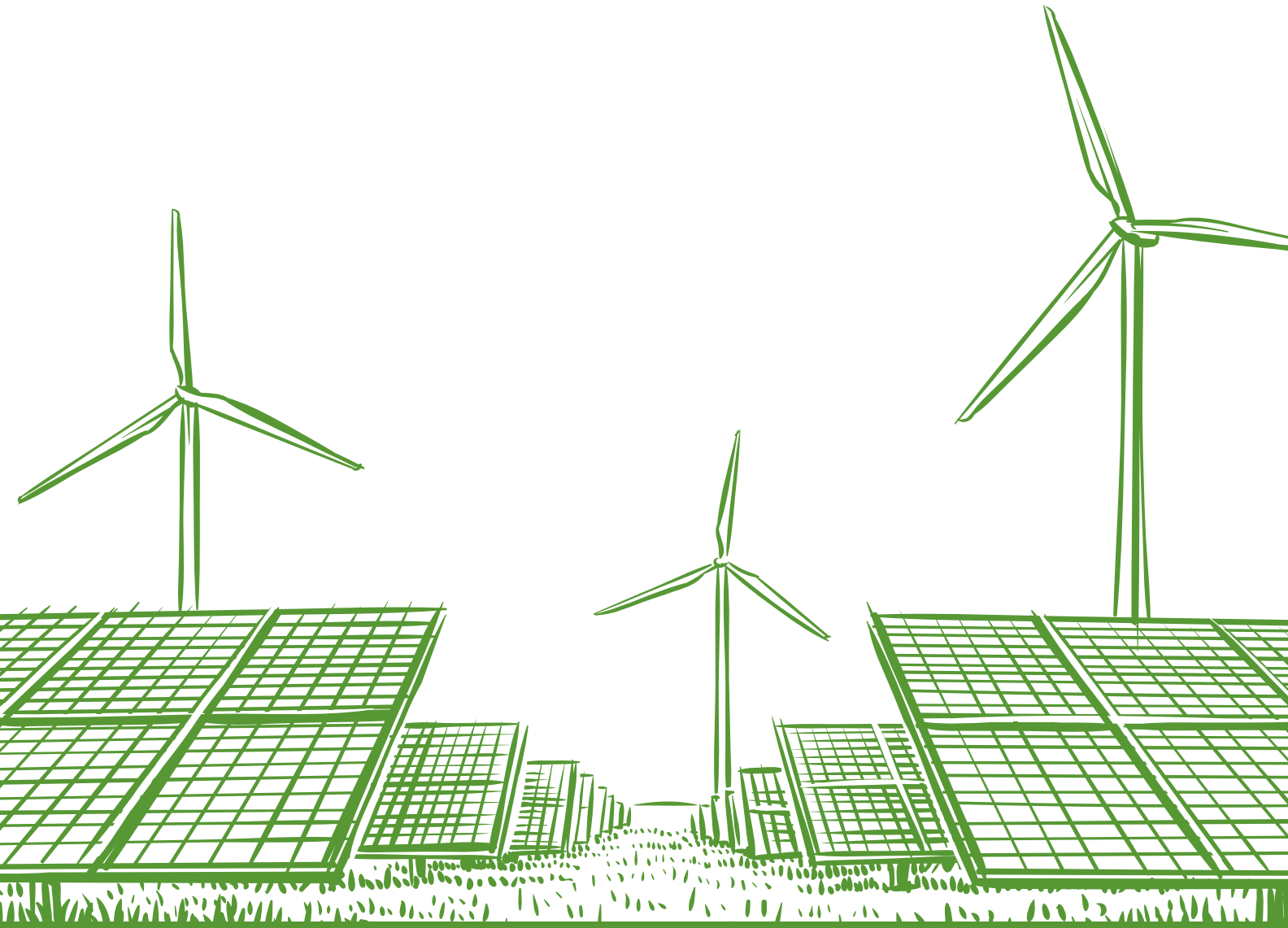
1. During the demand convening, it was observed that the energy projects supported by the United States in the Philippines include 'Energy Secure Philippines' in partnership with the Government of Philippines to help the country reach its power sector reform goals and support mobilization of resources for the energy sector. There are two levels of partnerships possible. India has existing MoUs with shortlisted countries and the Philippines too has certain cooperative agreements with some of these countries. The TriDeP project will need to engage government officials and COPs of existing energy programs to identify specific areas of collaboration. In the Philippines and PNG, 2022 is an election year and hence consideration will also need to be made on the priorities of the new governments for the energy sector.
2. The project can organize a focused stakeholder convening on 'Renewable Energy Program in the Philippines' to bring all stakeholders on board and to put forward major concerns regarding the renewable energy program in the Philippines. The convening can focus on issues raised above.
3. Discussions with MNRE to take forward the actions under MoU signed between MNRE and the Government of Philippines earlier.

63 https://www.officialgazette.gov.ph/2008/12/16/republic-act-no-9513/, accessed on November 20, 2021

64 https://policy.asiapacificenergy.org/sites/default/files/NREP_red.pdf, accessed on November 20, 2021

65 https://policy.asiapacificenergy.org/sites/default/files/Philippine%20Energy%20Plan%202018-2040.pdf

4. Specific focus on utility engineers' capacity building, grid planning, and developing strategy for improving quality of distributed generation devices and systems. Technical training for utility engineers can be organized.
5. Local entrepreneurship development programs can be developed and organized by Skill Council for Green Jobs and other organizations active in training and capacity building.
6. Other important areas of cooperation would be the following:
    a. Island electrification planning: Regional or mini-grid approach for designing RE-based grids in remote islands
    b. Institutional infrastructure and capacity building
    c. Energy planning



CAMBODIA

Country Profile–Cambodia

Cambodia is in the southern part of the Indo-Chinese peninsula in Southeast Asia. It has a geographical area of 181,035 sq km (69,898 sq miles). The state is represented through a constitutional monarchy with a parliamentary democracy.[66]

The country has a total population of 15.7 million as of 2020, out of which 8.5 million are female.[67] Some of the other economic and demographic parameters of the country are listed in Table 4.

Table 4: Country Indicators–Cambodia

Indicator	Figure
GDP (current US$)	25.29 billion as of 2020
GDP per capita PPP (current international $)	73 billion as of 2020
Population growth rate (%)	0.9
Population density	94.7 per sq km
Inflation (%)	2.9
% of population with access to electricity	92
% of renewable energy in final energy consumption	61.5

Sources: World Bank, ADB, and Statista

The major economic sectors in the country include agriculture, industry, and services, which comprise 22.84%, 34.67%, and 36.21%, respectively.[68]

In 2015, renewable energy accounted for 65% of Cambodia's total energy consumption, of which 46% came from traditional biomass such as wood, charcoal, and dung, 15% from modern biomass such as biogas produced from human and animal waste, and 3% from hydropower. Traditional biomass remains the cooking fuel for 82% of the population.

Cambodia's Nationally Determined Contribution, enshrined in the 2015 Paris Agreement, commits to a 16% reduction in greenhouse gas emissions from the energy sector from a business-as-usual scenario by 2030. An additional 7% reduction is to be achieved from the promotion of energy efficiency and renewable energy initiatives in the manufacturing sector and a further 1% reduction from the promotion of building energy efficiency and improved cookstoves, the use of biodigesters and water filters in waste management, and the use of renewable energy for irrigation and lighting (solar lamps).[69]

---

66 Chandler, D. P. (2021) Cambodia, Britannica. Available at: https://www.britannica.com/place/Cambodia

67 Chandler, D. P. (2021) Cambodia, Britannica. Available at: https://www.britannica.com/place/Cambodia

68 https://www.statista.com/statistics/438728/share-of-economic-sectors-in-the-gdp-in-cambodia/

69 Kingdom of Cambodia (2020) Cambodia's updated nationally determined contribution, UNFCCC

Considering that Cambodia has a huge potential for exploring renewable sources of energy such as solar, several pilot projects have been operationalized since 2015. The country is also in the process of developing a renewable energy promotion strategy and action plans.[70]

Relationship Analysis: India–Cambodia

India's investment into Cambodia totaled $250 million in FY19, with large-scale exports focusing on industries such as agricultural machinery, power, mining, and construction.[71] Although India is one of the top 10 investors in Cambodia, its investment makes up for only a fraction of the money that other countries have put in. United States, Japan, Germany, China, and United Kingdom that feature in the top five have trade valued at billions of dollars.[72] With three of its five largest trade partners being western countries, Cambodia must consider the influence of these countries within its own political economy scenario.

Cambodia's is among China's strongest allies over the years. In the 2012 ASEAN summit held in Cambodia, when the countries failed to reach a joint communique for the first time in 45 years, Cambodia was labelled as a vassal state for China by many diplomats.[73] Further, when the country's bid to become a non-permanent member of the United Nations Security Council fell through, one of the reasons cited for the rejection was its troubling human rights record, which is often linked to China's backing of the current government.[74]

India's bilateral trade relations on the energy front with Cambodia have not been significant. However, there has been an uptake in the overall bilateral trade front with the country, as India is strategically looking to expand its partnerships under the Mekong-Ganga Cooperation (MGC), which consists of six countries, namely, India, Cambodia, Myanmar, Thailand, Laos, and Vietnam, and was created to shore up cooperation in the areas of tourism, culture, education, and transport.[75], [76] By strengthening its ties with the country, India can use Cambodia as an important partner to build value chains and use that to establish capital intensive industries to manufacture green-based products.

---

70 ADB (2018) CAMBODIA Energy Sector Assessment, Strategy, and Road Map. Available at: www.adb.orgwww.adb.org%0Awww.adb.org

71 MEA (2020a) India-Cambodia Bilateral Relations

72 WITS (2019) Cambodia Trade, World Integrated Trade Solution. Available at: https://wits.worldbank.org/countrysnapshot/ en/KHM

73 Ciorciari, J. D. (2014) A Chinese model for patron-client relations? The Sino-Cambodian partnership, International Relations of the Asia-Pacific, 15(2), pp. 245–278. doi: 10.1093/irap/lcu021

74 Bong, C. (2019) Cambodia's Disastrous Dependence on China: A History Lesson, The Diplomat. Available at: https://thediplomat.com/2019/12/cambodias-disastrous-dependence-on-china-a-history-lesson/

75 Niseiy, S. P. (2018) Cambodia's Special Relationship With India, The Diplomat. Available at: https://thediplomat.com/2018/01/ cambodias-special-relationship-with-india/

76 Chronicle, G. (2021) India looking to expand connectivity with countries of Mekong-Ganga region, broadbase partnership, Goa Chronicle. Available at: https://goachronicle.com/india-looking-to-expand-connectivity-with-countries-of-mekong- ganga-region-broadbase-partnership/

Inputs from Demand Convening and One-on-One Discussions

Cambodia has recently submitted its update on Nationally Determined Contributions (NDCs) to UNFCC. This includes a commitment to increase renewable energy share to 23% by 2030 and one of the action points is to develop RE integration strategy. However, following major droughts in 2019 in Cambodia that impacted hydro energy production in the country, new contracts for coal-fired power plants have been signed, two are already in operation with a third expected to begin shortly. With these initiatives being implemented, there is a risk that Cambodia's NDCs will not be met as the main source of energy in the country will be coal. Further, in the region, engagement with ASEAN and the Mekong region will be helpful for Cambodia to make this transition as it imports 30% of its energy from countries in the region. While there are donors and stakeholders from civil society organizations working to promote renewable energy in Cambodia, there is a need for political will. Additionally, agencies such as Electricite du Cambodge (EDC), the firm that manages electricity in Cambodia, have been hesitant to include more renewable energy. There is preference among such private sector players to manage the national supply of electricity through one grid over an upgraded decentralized model that civil society is trying to facilitate and support.

Gender and Social Inclusion in Energy Policy

Of the two energy policies reviewed for Cambodia, the National Policy and Strategic Plan for Green Growth 2013–2030,[77] clearly mentions including gender for enhancing and mainstreaming green concepts. It also mentions the need for generating awareness and skills on green growth among all stakeholders, which includes gender and marginalized communities. The National Policy on Rural Electrification by Renewable Energy[78] however, confines itself to gender-neutral terminology for its provisions. For instance, it mentions creating Community Business Associations (CBA) and Rural Electrification Entrepreneurs (REE) for promoting renewable energy based rural electrification.

Recommendations for Cambodia

Developing the knowledge of the stakeholders and prioritizing renewable energy integration plan for Cambodia can be emphasized under the proposed interventions. Cambodia is also focusing on e-mobility and renewable energy integration with e-mobility plan is another area for focused interventions.

---

77 https://policy.asiapacificenergy.org/sites/default/files/national-policy-on-green-growth_2013.pdf, last accessed on November 27, 2021

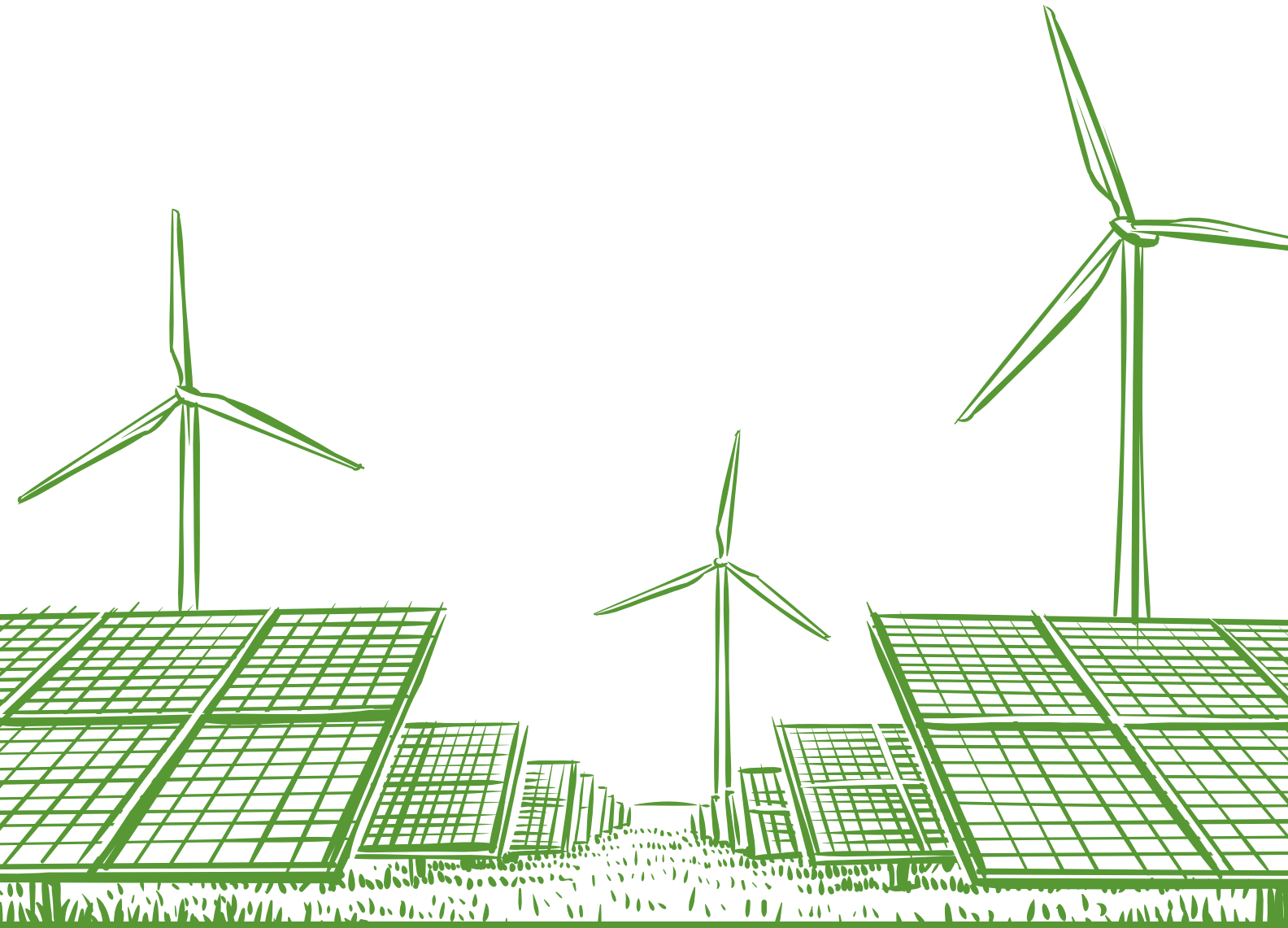
78 https://data.opendevelopmentmekong.net/dataset/b8ee6a26-816b-4eec-8c6c-1d7fbed13500/resource/59c068bc-225a-4b1d-9c2b-7034069aca43/download/96829bb3-18e1-4285-9aa3-fffd7c4fc6bd.pdf, last accessed on November 28, 2021

Following areas of cooperation are recommended for the proposed TriDeP activities:

1. Project development/investment opportunities identification for industries and project developers
2. Capacity building of utility
3. Grid analysis and financial impact analysis of renewable energy integration for the utility
4. Extending activities under the clean cooking initiative
5. Regulations and policy development
6. Energy planning

Regional Approach for ASEAN Region

The study is informed by detailed discussions with experts from ASEAN Centre for Energy (ACE). The ASEAN countries have committed to increase RE contribution to 23% by 2030 from the current level of 14%. This is a huge target and India's experience in handling big targets with tight timelines will be critical. The recommended areas were policy and regulation studies especially with Indonesia and Philippines, which are populous countries in the region. Still about 50–60 million population in the region lacks access to electricity and that is an area of concern. Clean cooking is an important area but it is complex and hence not many funding agencies are now focusing on it.



FIJI

Country Profile–Fiji

Located in the Pacific Ocean, Fiji is an island country that consists of more than 300 islands and 540 islets scattered over about 1,000,000 sq miles (3,000,000 sq km). Of the 300 islands, about 100 are inhabited. It currently has a population of 898,600 people, which is expected to grow to 921,100 by 2030. Further, with a density of 49 persons per sq km, over 56% of the population in the countrylives in urban areas, whilst 44% reside in the rural part of the country. With a purchasing power parity (PPP) of $11,604, the country fares slightly better than the overall average PPP of the Asia Pacific region, which currently stands at $10,210.[79], [80], [81]

Although the COVID-19 pandemic hindered the country's GDP growth rate, the country is still expected to grow at the third fastest rate within the Pacific region at 2% in 2021, only behind Papua New Guinea and Tuvalu, which are expected to grow at 2.5% in 2021. Additionally, at basic price the gross value added by the country stood at $3703 million for the year 2020.[82], [83] Fiji also performs better on the per capita income scale as the nation averages $4881.5, significantly better than the Pacific region average, which currently stands at $3626.3.

In Fiji, 100% of the population has access to electricity, both in rural and urban areas with a transmission and distribution loss of 10%.[84],[85] While currently over 50% of the electricity generated in Fiji is from renewable energy sources (including hydroelectric), only about 40% of the population has access to clean fuels and technologies for cooking.[86] Although this number is better than the average for all countries within the Pacific islands, where only 27% of the total population has access to clean cooking fuels,[87] this number is still considerably lower than the global average of 63%.[88]

---

79 World Bank (2020a) GDP per capita, PPP (current international $) - Fiji, World Bank. Available at: http://data.worldbank.org/ indicator/NY.GDP.MKTP.KD.ZG ZG, last accessed on July 20, 2021

80 Foster, S. (2020) Fiji, Britannica. Available at: https://www.britannica.com/place/Fiji-republic-Pacific-Ocean

81 Joshi, K., Song, I. and Accad, M. L. (2021) The size of the Asia and the Pacific economy based on purchasing power parities: results from the International Comparison Program, World Bank. Available at: https://blogs.worldbank.org/opendata/size- asia-and-pacific-economy-based-purchasing-power-parities-results-international

82 World Bank (2020c) Gross value added at basic prices (GVA) (current US$), World Bank. Available at: http://data.worldbank. org/indicator/NY.GDP.MKTP.KD.ZG, last accessed on July 21, 2021

83 ADB (2021a) Economic indicators for Fiji, Asian Development Bank. Available at: https://www.adb.org/countries/fiji/economy, last accessed on July 21, 2021

84 UNFCCC (2018) Fiji: Low Emission Development Strategy 2018-2050 | UNFCCC. Available at: https://unfccc.int/documents/193323

85 World Bank (2019) Access to electricity (% of population) – Fiji, World Electric power consumption (kWh per capita), p. 1. Available at: https://data.worldbank.org/indicator/EG.USE.ELEC.KH.PC?end=2014&start=1960&view=chart

86 World Bank (2016a) Access to clean fuels and technologies for cooking (% of population) – Fiji, World Bank. Available at: https://data.worldbank.org/indicator/EG.USE.ELEC.KH.PC?end=2014&start=1960&view=chart

87 World Bank (2016b) Access to clean fuels and technologies for cooking (% of population) – Pacific island small states, World Bank. Available at: https://data.worldbank.org/indicator/EG.USE.ELEC.KH.PC?end=2014&start=1960&view=chart

88 Nations, U (2020) Ensure access to affordable, reliable, sustainable and modern energy for all, UN Department of Economic and Social Affairs. Available at: https://unstats.un.org/sdgs/report/2020/goal-07/

Table 5: Country Indicators–Fiji

Indicator	Figure
GDP (current US$)	4.37 billion as of 2020
GDP per capita PPP (current international $)	11,604 as of 2019
Population growth rate	0.7%
Population density	48 sq km as of 2018
Inflation (%)	–2.6 (2020)
% of population with access to electricity	100
% of renewable energy in final energy consumption	31.26

Data Source: Trade Economic Website

Additionally, Fiji has been identified by the Geothermal Energy Association as one of 39 countries that could meet their electricity demand solely by tapping the renewable energy from underground heat. With over 53% of its electricity coming from hydropower, Fiji has the lowest oil dependency within the Pacific nation community. Photovoltaic (off-grid and grid-connected) renewables are slowly becoming a popular source of energy (Chen, Gönül and Zieroth, 2015)[89] and have the potential to become the second highest renewable energy resource. To further augment its presence within the green energy segment, the Fijian government offered a 5-year tax-free investment to promote green power generation to achieve its goals to make the power generation sector a low carbon emitter.[90] The option of duty-free imports on renewable and sustainable technologies is given to private investors including a 100% write-off on imports of power plants, energy storage and water storage amenities that are directly or indirectly relevant to generate pollution-free power.[91] Amongst its several NDC's (Nationally Determined Contributions) as part of its commitment under the Paris Agreement, the country aims to achieve 100% renewable energy by 2030. Besides this, its other NDC targets are as follows:[92]

- Reduce 30% of business-as-usual (BAU) CO_2 emissions from the energy sector by 2030
- Reduce energy sector CO_2 emissions by 10% through energy efficiency improvements
- Reduce domestic maritime shipping emissions by 40%
- Adopt climate-smart agriculture practices, with emphasis on the promotion of sustainable practices in crop management, livestock and sugarcane farming and fisheries

89 Chen, Y., Gönül, G. and Zieroth, G. (2015) Fiji Renewables Readiness Assessment

90 https://www.investmentfiji.org.fj/investment-incentives/energy

91 Malik, A. Q. (2021) Renewables for Fiji – Path for green power generation, Renewable and Sustainable Energy Reviews, 149 (May), pp. 1–15

92 Republic of Fiji (2017) Fiji NDC Implementation Roadmap

» Enhance resilience by upgrading, repairing, and relocating existing critical public infrastructure

» Develop simplified and standardized early warning and monitoring systems and prioritize nature-based solutions to mitigate the impact of flooding and cyclones

» Relocate highly vulnerable communities and implement the concept of 'build back better'

» Build strong healthcare system by implementing the 'guidelines for climate-resilient and environmentally sustainable health care facilities'[93]

» Conserve natural environment and biodiversity wealth enabling sustainable long-term provision of ecosystem services, including carbon sequestration potential

» Plant 30 million trees by 2035. The Fijian Ministry of Forestry has committed 60% of its employees towards this target.[94] The Ministry is yet to undertake a full reconnaissance of all seedlings planted under the '30 Million Trees in 15 Years' (13MT15Y) initiative

» Establish 30% of exclusive economic zones (EEZ) as marine protected areas and work towards 100% management of the EEZ by 2030 through the implementation of the National Ocean Policy

Fiji's electricity demand has increased by 18% in the last 4 years.[95] Primarily, hydro is the biggest source of electricity (53%) followed by oil (40%) and renewable energy (6%).[96] Hydro also comes under the renewable portfolio, and therefore the total share of renewables in electricity production stands at 60% (Figure 5).

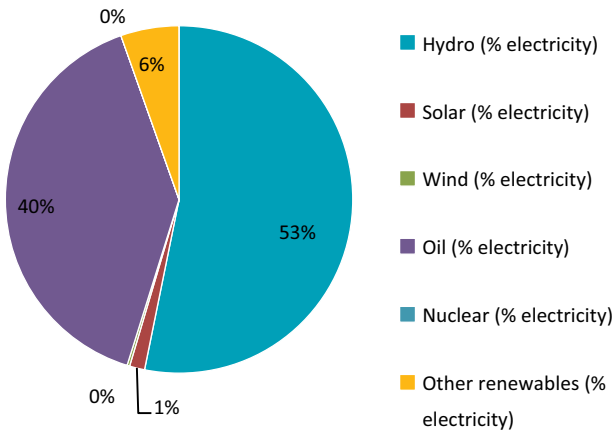


FIGURE 5: Source wise electricity production in Fiji (2019)

93 https://www.who.int/news/item/03-03-2021-fiji-launches-national-guidelines-for-climate-resilient-and-environmentally-sustainable-health-care-facilities

94 http://www.xinhuanet.com/english/2020-01/10/c_138693766.htm

95 https://www.export.gov/apex/article2?id=Fiji-Energy

96 https://ourworldindata.org/electricity-mix

The electricity capacity from renewables for the year 2019 is as per Figure 6.

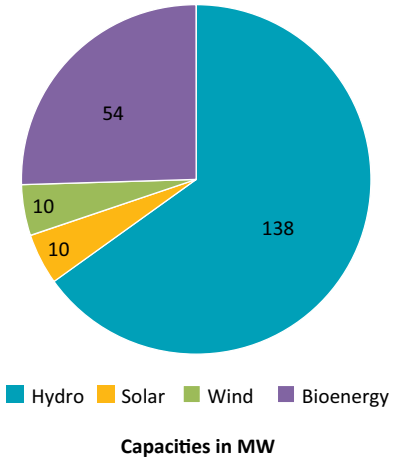


FIGURE 6: Renewable capacity in Fiji (2019)[97]

Additionally, as per 2019 analysis, Fiji ranked 6th among countries with the highest electricity access rate from distributed renewable energy (DRE) solutions and around 6.1% comes from DRE resources[98]. DRE resources mainly includes solar PV mini grids, mini hydel projects, and solar lighting systems. The share of mini grids in overall electricity generation is found to be 2%, including solar and mini hydro projects.[99]

Fiji National Energy Policy

The Fijian market has been attracting power from renewable resources. Taking this into account, the government launched the National Energy Policy in 2013.[100] This policy aimed to strengthen the government's vision for the energy sector for the period from 2013 to 2020 and it replaced the 2006 policy.

The objectives are in line with the United Nations Sustainable Energy for All (SE4ALL) objectives of ensuring clean, efficient, and sustainable energy access to all. The policy incorporates major reforms in transport and industrial sectors to ensure affordable clean energy inclusion. The following are the key challenges that need to be addressed through this policy:

» Reduction on imported fossil fuel resources and around half of Fiji's electricity demands have been fulfilled from imported diesel from nearby countries. Hence, there is a need for a strategy to reduce the burden of imported oil on country's economy.

97 https://www.irena.org/IRENADocuments/Statistical_Profiles/Oceania/Fiji_Oceania_RE_SP.pdf

98 https://www.ren21.net/wp-content/uploads/2019/05/GSR2021_Full_Report.pdf

99 https://trackingsdg7.esmap.org/data/files/download-documents/2021_tracking_sdg7_report.pdf

100 https://policy.asiapacificenergy.org/sites/default/files/Fiji%20National%20Policy%202013-2020%20%28Final%20Draft%29.pdf

» Fiji's transport sector alone consumes ample amount of oil. Therefore, there is a need to ensure clean transport fuels while ensuring affordability and quality. Limited research has been done to investigate the role of alternative fuels such as biofuels for the transport sector.

» There is no comprehensive assessment of Fiji's renewable energy resources and their viability. Therefore, there is a need to focus on developing renewable energy technologies for implementation at various areas and incentives for increasing the share of renewables in the electricity mix.

» Energy efficiency measures in the country are very limited. Therefore, the focus is on developing performance standards and labelling schemes to promote energy efficiency in households and industrial applications, for example, cooling applications.

» Develop a national electrification master plan to ensure 100% electricity across the country by 2020. For this a dedicated electrification fund and an associated framework will be developed to provide capital subsidies for electrification projects.

» There should be an increase in private sector investment in large-scale electricity generation by establishing a transparent process for procurement of new large-scale capacity from independent power producers (from both renewable and non-renewable energy sources), and pricing and other principles should be applied in all new power purchase agreements and grid-connection standards.

Relationship Analysis: India–Fiji

Since the current National Democratic Alliance (NDA) government established its 'Act East Policy' in 2014, India's relations with Fiji have significantly improved over the last few years. Prime Minister Narendra Modi's visit to the country in 2014 proved to be a pivotal watershed moment between the two nations, which resulted in an uptick in bilateral trade relations. Imports from Fiji are minimal, and India largely exports goods to the country, which grew from $43 million in 2016-17 to upwards of 60 million in 2018-19.[101] Further, India has been supporting the Fijian small and medium-sized enterprise (SME) sector through grant assistance and the Fijian sugar industry through direct financial assistance and also through training programs. Further, in 2017, a memorandum of understanding (MoU) on Cooperation in Renewable Energy between India and Fiji was signed. The MoU aimed at establishing a cooperative institutional relationship to encourage and promote technical bilateral cooperation on new and renewable issues based on mutual benefit, equality, and reciprocity.[102] Additionally, Fiji in 2018 became one of the first founding members of the International Solar Alliance (ISA) – a joint initiative of the governments of India and France to promote solar energy.

India's approach to the relationship with Fiji can be qualified as one that functions at a high level of diffused reciprocity. It is largely a strategic extension of the blueprint India has followed with the SAARC nations well, which over the years became key developmental partners as their economic

101 MEA (2020d) India – Fiji Bilateral Relations

102 Standard, B. (2017) Cabinet apprised of an MoU between India and Fiji on Cooperation in Renewable Energy, Business Standard. Available at: https://www.business-standard.com/article/news-cm/cabinet-apprised-of-an-mou-between-india-and-fiji-on-cooperation-in-renewable-energy-118030100171_1.html

positions strengthened.

Potential Collaborative Institutions in Fiji

As part of stakeholder consultations, TERI and the Foundation team had interactions with the experts from the College of Engineering, Science and Technology, Fiji National University coordinated by Dr Ravita Prasad. Distributed renewable energy (DRE) projects can be implemented in remote islands. Technology development projects have been initiated by the Fiji National University. A brief presentation shared by the experts from the College of Engineering, Science and Technology is enclosed in Annexure 9.0. Some of these projects can be considered for support under the first phase of the program after evaluating their appropriateness with the program goals and norms.

Gender and Social Inclusion in Energy Policy

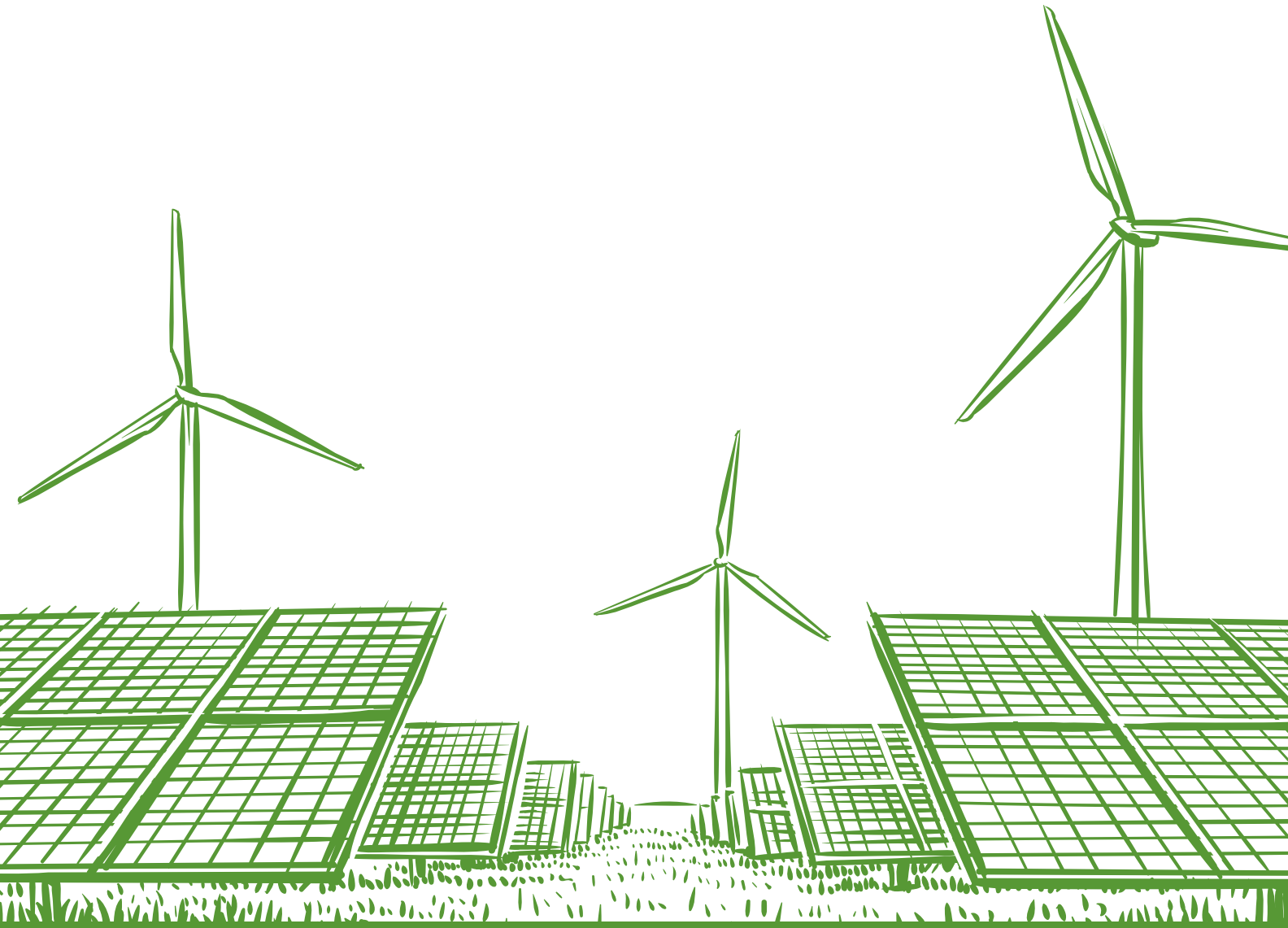
The National Energy Policy 2013–2020[96] of Fiji considers the needs of all types of stakeholders, including women. The policy calls for involving women as a target group while introducing new cooking energy technologies to shift from traditional biomass-based cooking. The policy also promotes equitable access to electricity, by considering gender aspects and vulnerable groups, by setting up an exclusive electrification fund. In terms of rural electrification through off-grid models, the policy calls for analyzing existing governance models in terms of transparency, capacities, and gender balance to improve their functioning. Community participation in decision-making regarding energy access, infrastructure, and finance is also encouraged in the policy.

Possible Areas of Cooperation with Fiji

The Government of Fiji has identified focus areas for renewable energy integration in power, transport, and industry sectors. The proposed interventions focus on the following priority areas:

1. Island electrification planning
2. Institutional capacity building programs
3. Distributed solar promotion
4. Clean cooking
5. Local industry development
6. Privatization of electricity companies
7. Private sector participation in power sector
8. Regulations and institutional infrastructure development

Various programs can be initiated under the leadership of MNRE and its agencies such as NIWE and NISE. Stronger collaboration between the Fiji National University and NISE/IIT Bombay is recommended to carry forward the research in solar cell technologies, biogas and solar dryer technologies. Joint field projects, training, and capacity building activities could be initiated jointly with Indian organizations such as TERI, CEEW, Barefoot College, Tilonia, Solar Electric Light Company (SELCO) and so on.



PAPUA
New Guinea

Country Profile – Papua New Guinea (PNG)

Papua New Guinea is classified as a developing country and is located on the western border of the Pacific Ocean. It is the third largest island country of the world with an area of 462,840 km², of which 452,860 km² (174,850 sq miles) is land and 9980 km² (3,850 sq mi) is water.[103] The state is represented through a constitutional monarchy with a parliamentary democracy.

The country has a total population of 9.1 million as of 2020, out of which 4.5 million is female.[104] Some of the other economic and demographic parameters of the country are listed in Table 6.

Table 6: Country Indicators–Papua New Guinea

Indicator	Figure
GDP (current US$)	23.59 billion as of 2020
GDP per capita PPP (current international $)	4326 as of 2020
Population growth rate	1.9–2% (2010–2020)
Population density	19 per sq km. as of 2018
Inflation (%)	4.9
% of population with access to electricity	63
% of renewable energy in final energy consumption	49.6

Data Sources: World Bank, ADB, and Statista

The economy of PNG is small, open, and export oriented. Mineral products (including oil, gas, liquid natural gas, gold, and copper) account for roughly 84% of all exports, with agriculture, forestry, and marine products contributing the other 16%.[105]

PNG is blessed with numerous energy resources, including oil, gas, wind, solar, tidal, and biomass. Renewable energy resources have taken centre stage as PNG has committed to generating 78% of its electricity supply from renewable energy sources by 2030. A study by Bloomberg New Energy Finance[106] ranked PNG in the top 10 for potential renewable resources, with about 2.5 GW renewable energy capacity, however only 2% of it has been exploited. The reason for lack of exploitation is inefficient policy mechanisms and the lack of private enterprise involvement within the nation's energy mix. Additionally, the fluctuating nature of democracy in the country has thwarted plans for renewable energy development for years.

---

103 World Bank (2021) Surface area (sq. km) – Papua New Guinea, World Bank. Available at: https://data.worldbank.org/indicator/AG.SRF.TOTL.K2?locations=PG

104 Meters, C. (2021) Papua New Guinea Population, Country Meters. Available at: https://countrymeters.info/en/Papua_New_ Guinea

105 ADB (2020a) Papua New Guinea Member Sheet

106 https://oxfordbusinessgroup.com/country/papua-new-guinea/energy

PNG has an ambitious program to provide electricity to 70% of its scattered population by the year 2030.[107]

PNG submitted their Intended Nationally Determined Contributions (INDC) to the UNFCCC Secretariat on the 30th of September 2015. The NDC targets are as follows:

» By 2030, annual emission from deforestation and forest degradation due to agriculture expansion and commercial logging is reduced by 10,000 Gg CO_2 eq compared to the 2015 level.

» LULUCF will be converted from net GHG source (1716 Gg CO_2eq) in 2015 to net GHG sink (–8284 Gg CO_2eq) by 2030 to mitigate emissions from other sectors.

In addition to this, there are certain other non-GHG qualitative targets with forestry and energy as the target sectors.

Energy Sector in PNG

The present electricity mix of the country is 580 MW with around 60% share being contributed by thermal and the rest 40% by hydro power installations. The share of renewables stood at around 11% of the total installed capacity[108] (Figure 7).

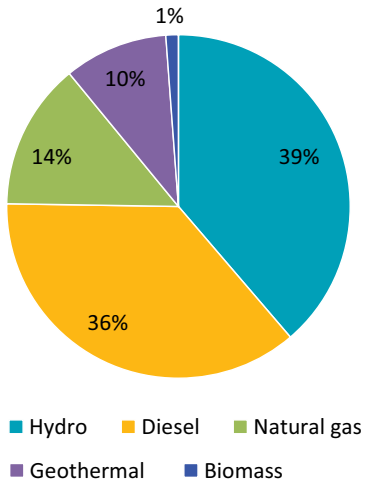


FIGURE 7: Total installed power capacity of PNG

107 Guinea, G. of P. N. (2020) Papua New Guinea's Enhanced Nationally Determined Contribution

108 SECTOR ASSESSMENT (SUMMARY): ENERGY, ADB https://www.adb.org/sites/default/files/linked-documents/41504-01-png-ssa.pdf

Renewable Energy Target

As per the National Energy Policy (2017–2027), the aim to achieve 70% electrification in PNG by 2030 and 100% by 2050 has been set by the Government of PNG. As per the PNG government target, the country is planning around 25% (500 MW) electricity capacity from renewable energy by 2030[109] including geothermal, wind, and biogas.

Existing Renewable Projects

Owing to the heterogeneous geography of PNG, renewable energy projects become crucial for ensuring energy access to major populations. Approximately 60% of the country's population is solely dependent on off-grid renewable products like solar PV for meeting their lighting demands and it is expected to increase in upcoming years. Currently, geothermal is the dominating renewable energy source in the country, followed by biomass-based projects. A 56 MW geothermal[110] based plant at Lihir Island is operated by Newcrest Mining Limited within its gold mines. There are two plants with capacity of 50 and 6 MW. In biomass category, biogas installations contribute up to 7 MW capacity.[111] Portable off-grid solar products for lighting, phone charging, and so on are quite popular in rural and urban areas.

Electricity Industry Structure

In PNG, Department of Petroleum and Energy (DPE), PNG Power Limited (PPL), and the Independent Consumer and Competition Commission (ICCC) are the main government bodies responsible for the energy development in the country. DPE is responsible for policy development, implementation, and regulation, while PPL is a state-owned utility and power company responsible for generation, transmission, distribution, and retailing of electricity. Traditionally, PPL had a monopoly over the energy sector; however, recent changes have allowed independent power producers (IPPs) to enter into power purchase agreements with PPL to supply. The key institutions in the country for planning, deployment, and distribution of electricity-related matters are shown in Figure 8.

---

109 Papua New Guinea Development Strategic Plan, 2010–2030. Port Moresby, < https://policy.asiapacificenergy.org/node/867>

110 https://pangea.stanford.edu/ERE/db/IGAstandard/record_detail.php?id=5851

111 Maxine et al. 2021< https://pangea.stanford.edu/ERE/db/WGC/papers/WGC/2020/01028.pd >

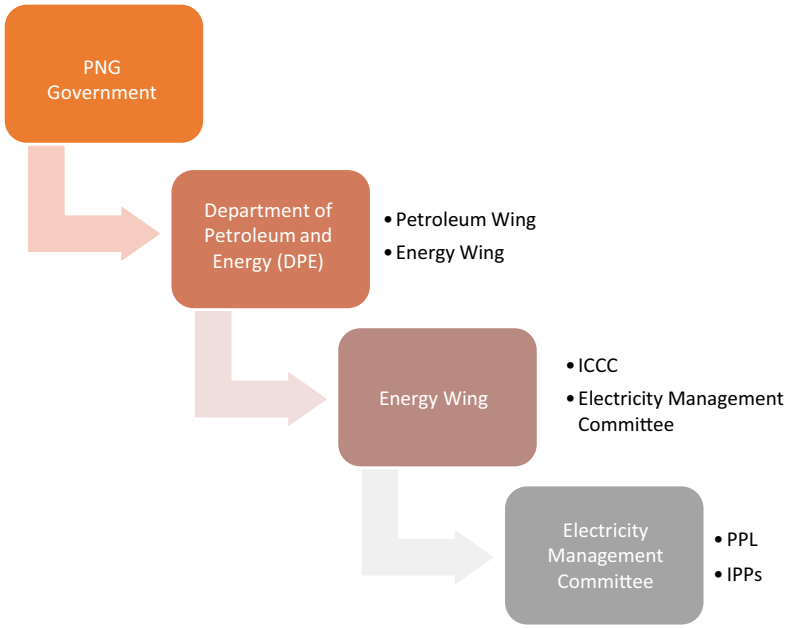


FIGURE 8: Institutional framework in PNG

Department of Petroleum and Energy (DP&E)

The energy sector in PNG is managed by Department of Petroleum and Energy (DP&E); it is further categorized into two parts: petroleum wing and energy wing. The energy wing is responsible for all the planning and implementation of the energy policy. Energy wing of DP&E handles the country's National Electrification Rollout Program (NEROP), which aims to achieve the target of 70% electricity by 2030.

PNG Power Limited (PPL)

The PPL is licensed under the Electricity Industry Act 2002 to generate, transmit, and sell electricity and it is regulated through the Electricity Regulatory Contract. The Regulatory Contract binds PPL and the Independent Consumer and Competition Commission (ICCC) pursuant to the provisions of the ICCC Act 2002 and Electricity Industry Act 2000.[112]

PPL manages approximately 300 MW of electricity generation. It also manages three main grids. Port Moresby is the largest grid that serves the National Capital District (NCD), the commercial and industrial centre of PNG with a demand of 73.5 MW.

[112] Implementing PNG's Electricity Industry Policy, national stakeholders consultation workshop, Port Moresby, Gateway Hotel, December 3-5, 2013

Ramu grid serves Lae, Madang, and the highland of PNG. Ramu grid also gets power from most of the hydro plants, especially from run-off river hydro plants in the highlands. Gazelle Peninsula grid serves East New Britain Province, the township of Rabaul, Kokopo, and Keravat.

Independent Public Business Corporation (IPBC)

IPBC is a state-owned entity that holds all the government-owned assets and manages those assets for commercial improvement and development of the economy. IPBC is now known as Kumul Consolidated Holding Limited (KCHL) and is also responsible for PPL's projects.

Independent Consumer and Competition Commission (ICCC)

ICCC is responsible to ensure fair competition in the market to regulate electricity generation and tariff. It also facilitates the license generation of electricity in PNG. ICCC, however, does not have sufficient capacity to carry out its mandate and cannot independently take decisions. Its energy-related functions such as electrical licensing and certification duties are all delegated to PNG Power.

ICCC still remains the regulator for electricity tariffs. ICCC employs a revenue cap regulation principle and sets license conditions for market participants. Other major donors and external actors that play a role in the investment, maintenance, and delivery of energy infrastructure and power generation in PNG are Asia Development Bank (ADB), Japan International Cooperation Agency (JICA), World Bank (WB), International Finance Cooperation (IFC), United States, Australia and New Zealand governments and industries.

Climate Change and Development Authority (CCDA)

Climate Change and Development Authority (CCDA) has been formulated under the Climate Change Act 2015 with an aim to mitigate greenhouse gas (GHG) emissions. Its mission is to provide climate resilience and climate-smart actions to PNG with awareness and empower people to use more sustainable technologies. A program named REDD (reducing emissions from deforestation and forest degradation) was introduced under CCDA for forest management.

Relationship Analysis: India–Papua New Guinea

India's bilateral trade relations with PNG from an economic standpoint have steadily declined. In 2015, our total bilateral trade with them stood at $209 million and in 2020 it stood at $75.33 million.[113] While there is a need to further foster the relationship and provide institutional stability to the country, PNG needs to avoid slipping down the road of democratic reversal. While military coups were last seen taking over countries, especially in the Southeast Asia block, countries such as Thailand, Myanmar, and Papua New Guinea are again experiencing similar repressive tendencies.

---

113 MEA (2020c) INDIA-PAPUA NEW GUINEA BILATERAL RELATIONS

The disenfranchisement of democratic structures and rise of populist economic stimuli have further jeopardized the business environment within the region. In 2020, days before executives from French oil major company Total were set to arrive in Papua New Guinea to seal a natural gas development deal worth $13 billion, Prime Minister James Marape's government was shaken by political crises as the opposition leaders tried to oust him through a no-confidence motion after his government tried to hurriedly pass controversial budget through the parliament.[114] Although the attempt to oust Marape failed, the incident is a representation of how politically unstable countries with weak institutional governance structures are a potential risk for capital investment.

However, investments in PNG can prove to be a success given the new government's slogan 'Take Back PNG,' which would require a lot of local development, leaving room for growth in domestic GDP.[115] Over the years there have been several high-level meetings between the two governments; further, India has also provided aid for the development of the country's SME sector.

Inputs from Demand Convening

PNG has long-term strategic plans – Vision 2050 and Strategic Plan 2030. Both plans have targets for renewable energy to ensure that the country is carbon neutral. Towards the same, initiatives on energy efficiency would help. PNG has an APEC partnership on electrification with Australia, New Zealand, and Japan to assist PNG's transition to 70% households electrified, a goal in the country's 2030 plan. In Papua New Guinea, USAID initiatives include the Papua New Guinea Electrification Partnership (PEP). Partners in PEP include Australia, New Zealand, and Japan. The goal of this project is to ensure 70% electrification of PNG. PNG has several development partners that also work in supporting PNG reach its electrification goals. The immediate challenge in fostering bilateral partnerships remains the COVID pandemic and the inability to ensure in-person work. One major hurdle for PNG is the lack of trained personnel.

Gender and Social Inclusion in Energy Policy

The National Energy Policy 2016–2028[116] lays emphasis on gender and social inclusion through several of its provisions. Enhancing gender considerations in energy planning and promoting equal participation of gender and vulnerable communities are highlighted in the policy. Other more general provisions in the policy address community awareness and participation in rural electrification through renewable energy.

---

114 Jain, A. (2021) Papua New Guinea a warning for poor nations rich in natural resources, Nikkei Asia. Available at: https://asia.nikkei.com/Opinion/Papua-New-Guinea-a-warning-for-poor-nations-rich-in-natural-resources, last accessed on June 26, 2021

115 Bal Kama (2019) 'Take Back PNG': Prime Minister Marape and his audacious vision for PNG, Dev Policy Blog. Available at: https://devpolicy.org/take-back-png-prime-minister-marape-and-his-audacious-vision-for-png-20190808/

116 https://prdrse4all.spc.int/sites/default/files/national_energy_policy_-_2017_-_2027.pdf, last accessed on December 28, 2021

Recommendations for Papua New Guinea

There is an opportunity through the TriDeP initiative to strengthen the existing Indian-UN initiative for South-South Cooperation in PNG. Long-term programs over 3 years would be fruitful. Existing renewable energy programs in PNG have been affected by the pandemic and the lack of in-country expertise to implement the projects.

To start with, a joint stakeholder focused discussion would be useful to strategize the activities and develop a plan of action. Additionally, the following areas have emerged as priority areas for cooperation with PNG:

1. Remote area electrification planning
2. Clean cooking
3. Capacity building
4. Microgrid developments
5. Policies and regulations
6. Institutional infrastructure

A strong need is felt to focus on regional collaborations and consultative process to develop impactful programs for renewable energy implementation in light of climate change mitigation initiatives.

POLITICAL
Economic
Risk Factors

Over the course of this report, we have analyzed the potential areas of collaboration that can be forged between India and selected countries. However, political economic risk factors are some of the most potent barriers that can thwart all efforts for sustainability and renewable energy technology development. In this section we analyze some of the risks that exist in these countries.

» **Indonesia**

- Growing financial insertion with China on the Belt and Road Initiative (BRI) has changed energy policies from renewable energy towards fossil fuels to keep up with the growing infrastructure demand of the project.
- Indonesia has continued to benefit significantly from economic relations with China, and Beijing remains Jakarta's leading trading partner. Indonesian exports to China – including commodities such as petroleum, iron ore, and palm oil – rose from 2019 to 2020.[117]

» **Fiji**

- Three military coups have been staged in Fiji over the last 34 years, that is, in 1987, 2000, and 2006. The current Prime Minister Frank Bainimarama came to power after the 2006 military coup.
- The suspension of Data Bureau limited institutions has created a lack of information on the number of borrowers in the country, which increased the probability of more loans being declined or lengthened the loan approval process, thus contributing to Fiji's investment and growth slowdown.[118]

» **Papua New Guinea**

- Historically, PNG has been susceptible to conflict and violence mostly related to local grievances about the nature of foreign involvement in the economy. Recently landowner grievances about the Exxon Mobil co-venture, PNG LNG, and the Barrick Gold majority owned Porgera gold mine in the highlands have resulted in violent skirmishes.[119]
- The Southern Highlands of Papua New Guinea remains a centre of unrest. Roadblocks arising from local grievances have plagued the Highlands Highway since the 2017 election. Such disturbances prevent hundreds of trucks from reaching their destinations and do economic damage even as they discourage investors.[120]

---

117 Grossman, D. (2021) Indonesia Is Quietly Warming Up to China, Foreign Policy. Available at: https://foreignpolicy.com/2021/06/07/indonesia-china-jokowi-natuna-sea-military-bri-cooperation-biden-united-states/

118 Gounder, N. (2020) 'Fiji economic survey: Low growth the new normal?', Asia and the Pacific Policy Studies, 7(2), pp. 145–157. doi: 10.1002/app5.307

119 Wilson, C. (2020) NG and Covid-19: The costs of economic stress, The Lowy Institute. Available at: https://www.lowyinstitute.org/the-interpreter/png-covid19-costs-economic-stress

120 Firth, S. (2018) Instability in the Pacific Islands: A status report, Lowy Institute. Available at: https://www.lowyinstitute.org/sites/default/files/documents/Firth_Instability in the Pacific Islands_A status report_WEB.pdf

» **Philippines**

- In 2020, the Government of Philippines closed down a major broadcaster, arrested social media users for critical posts during the pandemic, and adopted a vaguely worded new anti-terrorism law that allowed people to be arbitrarily labelled as terrorists and detained without a warrant or charges, including for speech-related offenses.[121]

» **Thailand**

- Ruled and controlled by the military junta, which has now drafted a new constitution
- Dissolution of the opposition Future Forward Party in 2020 pushed the country deeper into the confines of an authoritarian regime

» **Cambodia**

Large-scale infusion of Chinese capital within the nation. Cambodia attracted US$3.6 billion in foreign direct investment in 2019, of which 43% came from China.[122]

121 Freedom House (2021) Regional Trends, Freedom House. Available at: https://freedomhouse.org/report/freedom-world/2021/democracy-under-siege/countries-and-regions, last accessed on June 26, 2021

122 Suy, H. and Penh, P. (2020) No simple solution to China's dominance in Cambodia, East Asia Forum. Available at: https://www.eastasiaforum.org/2020/12/26/no-simple-solution-to-chinas-dominance-in-cambodia/

WAY FORWARD Recommendations

Country-wise recommendations are covered in the above sections. Here we discuss the overarching approach and institutional arrangement for implementation of the TriDeP. It is recommended that the programmatic and regional approach be adopted with specific focus on country needs. A formal institutional arrangement under leadership of MNRE and USAID is, therefore, proposed.

Social acceptance and willingness to adopt changes: India has been at the forefront of RE development since 1970s. It has been through the development phase and has been flexible to adopt new technologies, learn from experiences, and improve processes and policies. In the process, it has gathered enormous knowledge, rich experiences, and many learnings. The demand countries lack these resources. To move faster on RE driven low carbon pathways, these countries would need to plan possible interventions, foresee the impacts of such interventions, and educate both decision-makers and common citizens to prepare them to adopt the changes. Experience sharing is an effective confidence building process especially when these changes impact lifestyles and traditional practices. New technologies, products, and processes need new financial models at the grassroots level. India's rich experience of solving grassroots issues with participatory approaches and social innovation processes will bring great benefits to the rural population and prepare them for the faster adoption of new RE technologies.

Lack of finance and capital required for adoption of RE: The second gap identified is the lack of finances and capital required for establishing RE technologies in rural areas. Rural development programs focusing on access to energy, gender equity, and just transition often suffer from lack of scale of economy and diversity of needs. This is a common challenge in many societies. Indian experience of raising capital is diverse. India started with capital subsidy program, which had limited success, but it soon switched the model to interest subsidy and soft finance by establishing IREDA as an exclusive Non-Banking Financial Company (NBFC) to finance RE and energy efficiency (EE) projects. This was supported by micro-finance schemes for establishing self-help groups of village women to raise local finance and create credible institutional models driven by the beneficiaries. This has made a significant impact on the lives of rural women and created new avenues for them in self-sufficiency and financial independence. These small steps have played a significant role in creating wealth for rural women through employment generation and skill development. Experiences of SELCO, Barefoot College and so on are testimony to this. These are unique experiences where wealth creation and just transitions were achieved within the resources available to the community. These valuable experiences could be impactful in demand countries with similar conditions.

Development of policies, regulations, and financial models: At the country level, the needs are entirely different. For impactful large-scale adoption of RE in various sectors of the economy, countries need long-term vision and strong policy and regulatory frameworks created by the government with buy-in. The Electricity Act 2003 and the National Solar Mission of India launched in 2008 have been game changer policy initiatives supported further by regulatory reforms. Indian government has taken initiatives to promote the local industry at all levels through 'Make in India', production-linked incentives, and so on. These were supported by schemes such as bundling of expensive

solar power with cheaper coal power to make it affordable (Power Bundling Scheme), Viability Gap Funding Scheme (VGF), and so on. These innovations have helped the Indian RE sector to leapfrog and attract international cheap finance at scale. A weak policy and regulatory environment is often seen as a major risk by the financing community. The Indian experience has found sound solutions to counter such risks and create an environment of confidence among the investing community. Our experience could be an effective tool to counter these barriers in the development of RE in the demand countries. RE has proved to be a game changer for livelihood generation in rural areas in India. Understanding this, the Government of India has promoted RE projects that focus on rural livelihood and economic activities.

Thus, the recommended focus areas for possible interventions include the following:

1. Projects focusing on access to energy including clean cooking and just transition in rural and remote communities
2. Community/village level projects
3. Projects focusing on reducing hardship and improving quality of life in rural areas including mobility for last mile connectivity, livelihood generation, and improving speed and efficiency of current handicraft/skill-based activities promoting local craft and traditional skills.
4. Developing plans and programs for large-scale integration of RE in the grid or completely changing fossil fuel based grid power generation to RE based power generation especially in remote and regional grids like in island areas.
5. Support to governments in developing policies, regulations, and financial models and creating low risk financial environments by studying, analyzing, and addressing the barriers and root causes.

Proposed RE TRC Support Mechanism

India's growth and experience in renewable energy deployment can benefit countries in the Indo-Pacific region to improve access to clean energy. Through NSM, India has launched national skill development programs in RE sector and institutions such as NISE and SCGJ have been instrumental in creating a skilled workforce and launching awareness programs. Taking the development of institutional framework, training, and skilled manpower into consideration, India can offer its support in the Indo-Pacific countries to develop their RE sector efficiently and effectively. Figure 9 shows the various focus areas where India can offer its capabilities and strengths to participating nations.

FIGURE 9: Outline of the focus areas for India's Triangular Cooperation activities

Policy Planning and Regulations

The major focus areas for activities in policy, planning and regulations include the following:

» Mix of strategies such as subsidy, purchase obligations, and fiscal incentives

» Sector-wise strategies and policies

- Renewable energies are increasingly finding applications beyond electricity into industrial heating, cooling, transport fuels, and so on

Various think tank institutes such as TERI, IRADe, CEEW and government institutes & organizations such as NISE, NTPC and training institutes can play an important role in this regard.

Technology, Products, and Services

Major players in technology transfer, products, and service sector would include manufacturing, EPC, and service industry. India has a thriving industry of global standards in wind, solar, hydro, and biomass sectors. Promotion of Indian industry and products/services through collaborative programs are

envisaged under this activity. An important role can also be played by test laboratories such as NISE, TERI and BIS approved labs in improving testing and quality control of RE products manufactured and supplied to the target countries. Services would include detailed project report studies, impact assessment studies, support for tender preparation, and so on. Further, expertise in providing quality and efficient services related to project management, contracting, implementation and operation and maintenance of plants, and so on could be promoted through the proposed collaborations.

RE Program Development

Planning is an important activity for effective implementation of any program. Planning is an effective tool for a just, equitable, gender neutral, and sustainable transition towards sustainable renewable energy based economies. This activity area will promote long-term planning and program development approach in the targeted countries. RE is a part of effective climate change mitigation strategies, and hence long-term program development support is essential for effective and faster adaptation of RE technologies.

Major institutions that can play an important role in program development and implementation include think tanks such as TERI, IRADe, CEEW. Focus could be on the following:

» RE planning

» NDC enhancement

» Industry and infrastructure development

» Educational curriculum

» Institutional development

Research and Training

Research collaborations are proposed as a focus area considering the need for building institutional capacities in renewable energy related research and development. Currently, research collaborations are handled by DST, DBT, and MNRE. The research areas initially identified are as follows:

» Analytical studies

» Resource assessment studies

» Technology assessment studies

» Community level intervention

Such collaborations can be facilitated between Indian institutes such as IITs, NISE, NIWE, AHEC among others. A joint program for research collaborations could be developed under the overall guidance of DST and MNRE with support from MEA.

Training and capacity building of local experts are key elements of any bilateral or multilateral collaboration initiative. We propose focused training and capacity building programs to be developed around the following areas:

» Technology

» Energy planning and forecasting

» Simulation studies

The platform of ITEC programs could be further explored for such training and capacity building activities and specialized institutes such as SCGJ, IITs, TERI, and IRaDe can be roped in to provide the training. The programs can be tailor-made to suit individual country requirements.

Implementation of RE TRC

These activities can be centralized under the International Relations (IR) Division of MNRE with DST and MEA as partner ministries. A special flagship initiative for international collaborations in RE could be launched by the IR division of MNRE in association with USAID. This initiative may be named India for Renewable Energy in the Indo-Pacific (I-REIP). This will focus on promoting Indian expertise in the Indo-Pacific.

A governing council under the joint chairmanship of Secretary MNRE and the US Ambassador is proposed. The governing council will have representatives from MEA, DST, CII, Indo-U.S. Science and Technology Forum (IUSSTF) and others. This structure will give focus and direction for international collaborations in the RE sector. The initiative can also explore associations/collaborations with Indian industry bodies such as CII and FICCI.

RE TRC support activities for selected Indo-Pacific countries can be categorized into the following types as per nature of the assignment:

1. Short-term TRC support activities (0–6 months)
2. Medium-term TRC support activities (6–36 months)
3. Large-term TRC support activities (>36 months)

Short-Term TRC Support Activities

Activities with a short duration of 0–6 months come under this category. This may include conducting small trainings, theme- based workshops, short duration feasibility studies, market studies, awareness programs for RE, campaigning programs in rural areas for promotion of programs on solar pumping, distributed renewable energy sources, creating self-help groups for encouraging women entrepreneurship, and need based assessments for the industrial sector. The existing capabilities and expertise of the Indian RE sector can be utilized in sensitizing capacity building, training programs, and skill development in these countries. Respective stakeholders such as energy department, financial institutions, manufacturers, and project developers can be a part these collaborations. India has done remarkable work in aggregating demands in the rooftop solar sector through various awareness

programs, comparative tariff mechanism, bringing down the cost of electricity through innovative reverse bidding process, and so on; therefore, quick mapping studies for understating the feasibility of implementing such arrangements in selected countries can be examined. Strong relations with countries in the Indo-Pacific can be leveraged and key reputed Indian institutions in RE-NISE, SCGJ, IITs, NIWE, and so on can support these countries in developing training modules, providing short-term courses, organizing collaborative workshops, student exchange programs, awareness programs, and so on. The basic areas of cooperation are indicated in Figure 10.

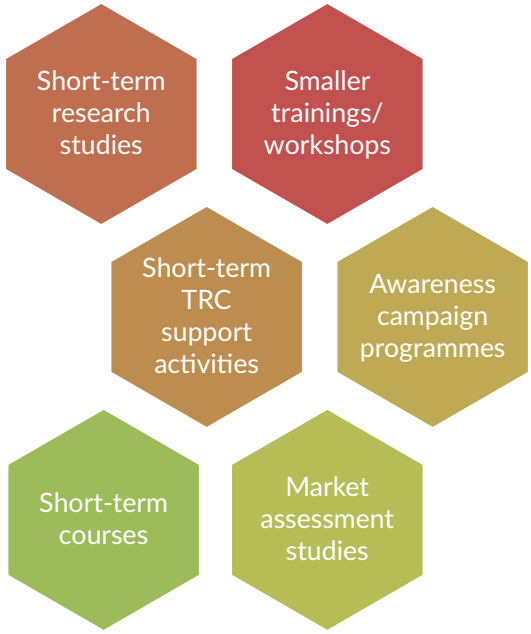


FIGURE 10: Short-term TRC support activities

Medium-Term TRC Support Activities

Medium-term TRC support programs may have a duration of 6–36 months. Medium-term activities may include certification activities for students/researchers in RE, developing policy briefs, capacity building programs, developing market models, policy and regulatory support to the government, resource assessments in clean energy projects, resource mapping, knowledge transfer workshops, energy transition or renewable energy road map preparations, technology transfer, and collaborative research and development of RE technologies with key institutions. The medium-term objective can also include studies covering initiatives for phasing out conventional resources from island locations by promoting mini/micro grids, rooftops projects, biomass plants, and integration of energy storage with RE. Since Indo-Pacific countries comprise many water bodies, the possibility of implementing offshore/onshore floating solar PV (FSPV) projects, studies exploring small hydro sites, integration of hydro projects with FSPV installations, utilization of discarded industrial ponds for FSPV, canal top for rooftop installations, and so on can be prioritized for accelerated deployment of RE. Activities at medium term can be summarized as per Figure 11.

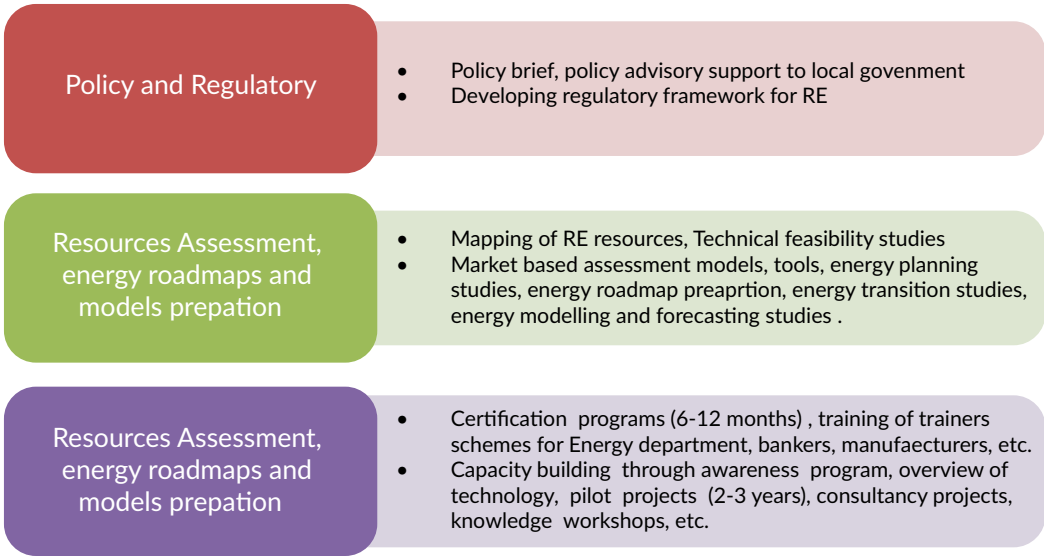


FIGURE 11: Medium-term TRC support activities

Long-Term TRC Support Activities

Long-term TRC support programs have a duration of more than 36 months. The potential activities include grid planning, RE integration planning, utility scale implementation projects, RE targets, zero emission targets, and so on (Figure 12). India has ongoing cross-border electricity trade with Nepal, Bhutan, and Bangladesh and similar interventions can be explored with other countries from the Indo-Pacific. Long-term technical assistance programs like the SUPRABHA schemes can be further adopted to Pacific countries to accelerate rooftops programs.

India proposed the One Sun One World One Grid (OSOWOG) initiative to set up a framework to facilitate global cooperation and build an ecosystem of easily sharable and interconnected renewable energy resources. The purpose of the project is to connect countries in Africa and Asia with a common region to harness solar power. Feasibilities for connecting local grids to this common grid to avail solar power can be planned. Additionally, projects serving the rural electrification goals in least RE developed countries, developing RE target programs/country specific RE mission preparation, and pathways of achieving net-zero emissions can be part of long-term goals. Many small countries such as Papua New Guinea (PNG) and Maldives are facing larger issues of sea level rise due to climate change, and hence working on RE deployments to mitigate climate issues is vital for these countries. Therefore, feasibility studies, strong policy push, and developing implementation strategies should be a long-term objective for these countries.

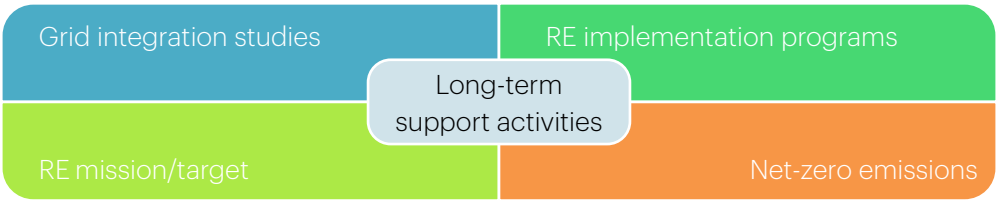


FIGURE 12: Long-term TRC support activities

Institutional Arrangement

It is proposed to set up a task force (India for Renewable Energy in the Indo-Pacific) under the leadership of MNRE and USAID to channelize the efforts under TriDeP. This task force is proposed to be housed in The Asia Foundation, which will be the coordinating agency.

The task force will have a governing council and advisory committee formed with representatives from Ministry of New and Renewable Energy, Ministry of External Affairs, Ministry of Power, Ministry of Environment, Forest and Climate Change and Ministry of Corporate Affairs. The task force will start functioning under the guidance of an Advisory Committee and Governing Council. Other donor agencies and multilateral agencies such as ADB, the World Bank, and UN organizations etc. can also be asked to join the Advisory Committee for coordinated efforts in the region.

Implementation Plan

It is proposed to start the implementation with a regional level convening for ASEAN and Indo- Pacific regions to bring local governments and other stakeholders on board. The convening can help kick-start the activities with local stakeholders on board. The task force then can work on designing short-term and long- term capacity building programs.

Annexure

Annexure 1.0: Details of the experts consulted as part of the Project under Asia Foundation TriDeP program

Sr. No.	Name of the expert	Designation	Organization	Interview date	Expertise
Indian Experts					
1	Mr Mudit Jain	Head Research	Tata Cleantech Capital Ltd	18 June 2021	RE finance expert
2	Dr Praveen Saxena	Chief Executing Officer	Skill Council of Green Jobs	21st June 2021	Skilling and Renewable Energy Expert, Ex Advisor, Ministry of New and Renewable Energy, Officials of the Skill Council
3	Arpit Sharma	Vice President– Strategy and Operations			
4	Deepak Rai	Associate Vice President- Standards and Research			
5	Dr Arun Kumar Tripathi	Director General	National Institute of Solar Energy	21st June 2021	Ex Advisor, Ministry of New and Renewable Energy
6	Dr Anshu Verma	Associate Professor	Indian Institute of Delhi	23rd June 2021	Electrical, RE Expert
7	Lt Col Manish Ahuja	Managing Director	Punjab Renewable Energy Systems Private Limited (PRESPL)	23rd June 2021	Biomass sector experts
8	Col Rohit Dev	Chief Operating Officer			
9	Col Sumeet Malhan	Chief Technical Officer			

Sr. No.	Name of the expert	Designation	Organization	Interview date	Expertise
10	Dr Geetika Srivastava	Director (Indo-Pacific)	Ministry of External Affairs, Government of India	17th August 2021	Ministry of External Affairs, GoI official
International Experts					
1	Paula Valencia	Program Consultant	New Energy Nexus Project Electronvibe, Philippines	19th August 2021	Low carbon development
2	Mr Beni Suryadi	Manager of Power, Fossil Fuel, Alternative Energy and Storage (PFS)	ASEAN Centre for Energy (ACE), Indonesia	20th August 2021	Power, Fuel and Alternate Energy officials of ACE
3	Mr Akbar Wahyono	PFS Officer			
4	Ms Gabriella Lenanto	Associate PFS Officer			
5	Ms Brenda Valeria	Country Manager	New Energy Nexus, Philippines	27th August 2021	Energy transition programs
6	Mr.Sovan Chandara Heng	Independent Consultant	Cambodia	9th September 2021	Renewable Energy and Power sector

Annexure 2.0: Supply convening

The Asia Foundation

India-U.S. Triangular Development Partnership

Virtual Convening on Renewable Energy (RE) Supply Analysis

July 2, 2021 – 10:30 a.m. to 12.30 p.m. (IST)

Proceedings Report

Introduction

India-U.S. Triangular Development Partnership (TriDeP) is a 3-year project of the Foundation in support of U.S.'s and India's mutual aims in the Indo-Pacific and beyond. The TriDeP will leverage India's expertise based on identified country and sectoral-specific demands. The TriDeP has proposed Renewable Energy (RE) as one of the three sectors where India has demonstrated policy leadership, practical experience, and sustainable results.

To inform the TriDeP's activities, The Asia Foundation has initiated a Supply - Demand diagnostic to identify India's leading RE capabilities and to match the same with identified need (demand) in third countries of the Indo-Pacific. On July 2, 2021, the Foundation conducted a virtual convening of technical experts from leading Indian institutions and regional collaborations working on Renewable Energy. Institutions included RE financing institutes, private sector, civil society organizations and academia. During the virtual convening, their views were collected to further augment observations made in an initial literature review and supply observations made in the diagnostic study.

The agenda of the discussions and the list of participants are mentioned in the Annexure.

The discussions were informed by a presentation on the research methodology and objectives; an overview of India's RE capacities; and international initiatives in RE led by India. The presentation highlighted the key stakeholders, mapped areas of potential Indian RE expertise, and lead agencies and suggestions on supply expertise that India can offer to third countries. The presentation also shared possible way forward.

In response to a synopsis of the RE study shared with participants prior to the convening and the observations highlighted in the presentation, participants shared their views as recorded below.

Introductory Session: Setting the Scene

Welcome Address

The virtual convening began with the Welcome Address by Nandita Baruah, Country Representative, The Asia Foundation – India. Ms Baruah shared that the objective of the RE diagnostic conducted by TriDeP is to strengthen India's development assistance and economic footprint in the Indo-Pacific region. Currently, TriDeP in partnership with TERI is undertaking a diagnostic to put together the background information essential for more direct interventions in the region. She also introduced the Foundation, including its footprints in South Asia, Southeast Asia, and the Pacific Islands where it has country offices.

She acclaimed India's leadership in supporting global renewable energy transitions through initiatives like the International Solar Alliance (ISA). The energy portfolio at the Foundation's India operations, and its regional convenings on renewable energy and the use of latest technologies such as the Pumped Hydro Energy Storage (PHES) Australian National University Atlas, which the Foundation shared with the Ministry of Power were also mentioned. To this program, India's experience of power trade was added in light of recent policy upgrades on the same.

India's and U.S.'s high level relationship in the TriDeP partnership was further emphasized in the comments made by USAID representative Ms Monali Hazra. Ms Hazra shared the U.S. government's multiple collaborations with India and countries of South Asia, initiatives such as Asia EDGE (Enhancing Development and Growth through Energy) to the US-India Strategic Energy Partnership (SEP), from South Asia Regional Energy Hub (SAREH) to South Asia Regional Initiative for Energy Integration (SARI/EI), and more recently to South Asia Regional Energy Partnership, in supporting transition to a high-performing, low-emission, energy secure economy by improving access to reliable and clean energy and growing the investment opportunities in India's energy market.

The TriDeP Chief of Party (COP) provided the participants with an overview of the initiative and the three sectors that the TriDeP will explore to support sustainable growth in the Indo-Pacific. It was also highlighted that in order to do so the TriDeP will partner with government, private sector, civil society, and academia. RE holds the key to address climate change and sustainable development in a composite manner. The main objective of the convening was to highlight India's successes in RE and to identify meaningful rollout strategies for the overall TriDeP program. The process of rollout will also consider third country demands and partnerships that will involve triangular cooperation among countries.

Session 1: Presentation of Key Findings – Supply Analysi

The TERI team presented the key findings of their supply study. The participants also received a more detailed synopsis of the study prior to the meeting.

The presentation highlighted four key areas, potential lead institutions/agencies in India, and the technical expertise they can offer.

Sr. No.	Potential Indian Expertise	Suggested lead Indian agencies	Suggested supply actions India can offer
1	Policy and regulatory	MNRE, MEA, CEA, TERI, CEEW, IRADe, CPR	Studies on policy and regulations, policy briefs preparation, training and capacity building of policy makers, politicians
2	Technology, products and services	Private & public sector companies, research institutes, educational institutes (IITs, IISc, universities, NITs) IREDA, NSDC, SCGJ, ISRO	Made in India RE products such as wind turbines, modules, BoS, gasifiers, cold storages, solar pumping systems, clean cooking devices, solar thermal collectors, solar dryers, biogas technologies, fuel cell technology, EPC and project management expertise and skills, biomass treatment technologies, RE financing, DPR and feasibility studies, raising of finance
3	RE program development	MNRE, TERI, CEEW, CSTeP, POSOCO, CEA, NIWE, NISE, SSS-NIBE, EESL	Technical assistance in RE planning, grid integration studies, grid management and extension planning, energy planning and integrated energy modelling studies, resource assessment and resource planning studies, procurement strategies, demand aggregation models
4	Research and training	IITs, IISc, NITs, SCGJ, Barefoot College, CSIR Labs	Joint R&D programs, skill development of engineers, technicians, managers, entrepreneur development training, standardization, technical collaborations for research infrastructure and testing and QC infrastructure, data analytics and modelling

The box below summarizes the RE initiatives that were shared as areas for possible future demand.

Potential areas of India's expertise

- Capacity building in India and in Third Countries: Consumer awareness of renewable energy, fund raising, virtual training, managing technical systems, immediate packages available (NISE, NIWE, and Skill Council initiatives)
- New/sector-specific renewable energy initiatives: Agri-renewables, Agri-PV, Waste to Energy, Green Hydrogen technologies, software solutions for grid management
- Renewable technology end of life management
- Indian manufacturing and testing of renewable technologies
- Financial capital required for a RE transition
- Inter-agency coordination mechanisms: Policy and regulation initiatives of intermediaries that have eased access to RE
- Grid Integration
- Business models: Public private partnerships (PPPs), corporate procurement policies, rooftop solar models
- Private sector readiness to deploy RE and in supporting entrepreneurship
- Diversified lead agencies – including developers, financers, traders (exchange)

Session 2: Discussion Session – Participant Responses

Participants at the discussion represented government research institutions, academic institutions, civil society organizations and regional energy exchange initiatives. Their key suggestions are mentioned below.

1. Capacity Building: India's expertise in training on specific capacities and the potential to train on institutional coordination mechanisms from the country's decades old experience was highly recommended as expertise that could be shared (including through virtual platforms) with third countries.

2. Potential trainings included consumer awareness on the benefits of RE (solar) and RE specific technology centres (hydro and wind). The digital models and tools for training can include India's experience of grid integration pilots and business models (Public-Private Partnerships) that engage with the private sector. Participants shared that Indian companies are at a stage where there is the knowledge and investment abilities to share with third countries to support RE deployment.

3. New Technologies in Renewable Energy: Participants shared that new RE technologies such as Green Hydrogen and related infrastructure, Agri Renewables - solarization of agricultural feeders, waste management (waste to energy systems) and India's power exchange are innovations in RE that would be of interest to third countries. Biogas was also shared as a cross-sectoral initiative that India could explore in third countries. Existing waste management models in India have been able to capture agricultural (animal husbandry) waste to produce biogas to electrify small home units and phosphate rich fertilizers. Feasibility of Pumped Hydro Energy Storage (PHES) is an option currently being explored in India and may have the potential for installation in third countries with support from India's private sector.

4. Manufacturing, Testing and End-of-Life Management of Renewable Energy Technologies: India is keen on solarization of agriculture and has well established rural solarization initiatives and rollout expertise in rooftop solar. While there are well established capacity building programs run by the Skills Council and by Indian CSOs such as Barefoot College on installation and maintenance of solar commodities and units, national solar industry bodies such as National Solar Energy Federation of India (NSEFI) are also actively engaging on putting together standards and regulations for solar waste management. It was emphasized that there was a need to involve the communities as equal partners and not only as beneficiaries in solar energy adoption programs. The solar engineers (solar mamas) from numerous countries trained by Barefoot College were cited as an example of this.

   In the wind sector, India has a strong indigenous manufacturing ecosystem. The National Institute of Wind Energy also has testing centres to test wind technologies for moderate wind conditions and special schemes that include end-of-life management. India's ability to introduce Green Hydrogen to its energy mix and the infrastructure required for the same is an opening for both the country and select third countries. Another area of manufacturing is in decentralized rural electrification, India also has experience in setting up of decentralized solar units and training on the same through its Indian Technical and Economic Cooperation (ITEC) program. India also has good capacities in biogas plants, including slurry management to produce phosphate rich

fertilizers that can be utilized in agriculture. This waste to energy model is also a possible solution that may be replicated in third countries with a sizable agriculture/animal husbandry sector.

5. India's RE Private Sector: Participants at the convening unanimously shared that the private sector in India is primed to replicate solutions in third countries. They provide expertise in operations, forecasting, scheduling, monitoring, and resource management. The thriving private sector in India has also supported an ecosystem of entrepreneurs in the RE sector. The sector provides Information Technology (IT) (grid codes, network analysis, system expansion, and integration – some examples of Indian IT solutions areas shared) and operating solutions that are highly customizable and of high value. India's RE private sector players are also well perceived globally for their skills, investment abilities, and abilities to deploy technologies quickly. Experts suggested that it was better to bundle the solutions and present the same as technical solutions that produce an outcome.

6. Diversity of Lead Organizations and Inter-Agency Coordination: India's regulatory environment was highly recommended as policies and stakeholder coordination mechanisms that third countries would benefit from replicating. Inclusion of lead agencies such as Central Electricity Authority (CEA), Power System Operation Corporation (POSOCO), and Indian Energy Exchange (IEX) should be included along with developers, financers, and traders. Specifically, India's experience of bringing together the institutions, regulations, and grid operations to integrate RE into the grid and also support energy exchange would be mechanisms that other countries would be interested in replicating. Existing initiatives such as Greening the Grid (GTG) also provide pilot options that can be case studies/replicated in third countries. National research centres, for example, national solar and wind energy centres, also play a key role in convening the private sector and advocating for regulations with the ministries. Their existing platforms and campaigns may also be leveraged.

ANNEXE 1 Participant List

Name	Organization
Dasappa Srinivasaiah	IISc
Rajesh Mediratta	IEX
Prashant Kanaujia	S B Energy
Mudit Jain	Tata Capital
Nishant Singh	Foreign and Commonwealth Office
Lasya Gopal	TERI
Soma Dutta	People Energy and Environment Development Association
Subrahmanyam Pulipaka	NISE
Amit Dhir	South Asia Regional Energy Hub
Karunesh Chaturvedi	Vector Green Energy Private Limited
Akhilan J R	Jindal Global University
Shloka Atul Dhavle	Tata Steel
Khushi Gupta	Jindal Global University
Hemant Mandal	IFC
Amit Jain	World Bank
Purnendu Kumar Chaubey	S B Energy
Rashmi Murali	TERI
Dev Kant Sharma	USAID
Jaison Thomas	Tata Steel
Lt Col Monish Ahuja	Punjab Renewable Energy Systems Pvt Ltd
Ishan Purohit	IFC
Hazra, Monali Zeya	USAID
Amit Kumar	Tata Steel
K Balaraman	National Institute of Wind Energy
Bunker Roy	Barefoot College
Vibhuti Garg	IEEFA

Name	Organization
Mishma Silvia S	IISc
Manu Maudgal	Shakti Foundation
Chandan Gadgil	BAIF
Tara Appachu Sharma	TriDeP Consultant
Richie Stephen	TERI
Prof Arun Kumar	IIT Roorkee
Saurav Kshirsagar	Shakti Foundation
Gayatri Ramanathan	Shakti Foundation
Chandrasekhar Atla	Power Research & Development Consultants Pvt. Ltd.
G Mini	TERI
Tushar Sud	Deloitte
Chinmaya Acharya	Foreign, Commonwealth and Development Office, United Kingdom
Anurag Mishra	USAID
R. Nagraja	Power Research & Development Consultants Pvt Ltd
Sarvesh Devraj	TERI
Nandita Baruah	The Asia Foundation
Atul Kaushik	The Asia Foundation
Ramesh Navaladi	The Asia Foundation
Ajay Kumar Singh	The Asia Foundation
Shruti Patil	The Asia Foundation
Apoorva Singh	The Asia Foundation

ANNEXE 2 Agenda

Welcome Address: Nandita Baruah, Country Representative, The Asia Foundation - India	10:30 am–10:35 am
Opening Remarks: Monali Zeya Hazra, Regional Energy Manager and Clean Energy Specialist, USAID	10:35 am–10:40 am
Introduction to the Project: Atul Kaushik, COP – TriDeP, The Asia Foundation	10:40 am–10:45 am
Presentation: Findings from Supply Study, Shirish S Garud, Senior Fellow – Renewable Energy Technologies, TERI	10:45 am–11:00 am
Discussion: Experts	11:00 am-12:00 pm
Concluding Remarks: Sunil Dhingra, Associate Director, Renewable Energy Technologies, TERI	12:00 pm–12:10 pm
Vote of Thanks: Ramesh Nalavadi, Deputy COP, TriDeP, The Asia Foundation	12:10 pm–12:15 pm

Annexure 3.0: Demand Convening

The Asia Foundation

India-U.S. Triangular Development Partnership (TriDeP)

Virtual Convening on Renewable Energy Demand Analysis

July 29, 2021 – 10:30 a.m. to 12.30 p.m. (IST)

Proceedings Report

Introduction

The Asia Foundation organized a virtual convening to discuss the supply and demand analysis for Indian expertise in renewable energy on July 29, 2021. Thirty-two participants, including several from international organizations and bilateral aid agencies gathered for the convening, provided a rich discussion on the subject. The highlights of the convening are summarized below. The India-U.S. Triangular Development Partnership (TriDeP) has proposed Renewable Energy (RE) as one of the three sectors where India demonstrates policy leadership, practical experience, and sustainable results. The TriDeP will leverage India's expertise based on identified country and sectoral-specific demands.

Country selection could also be influenced by where there is the highest potential to reduce carbon footprints. It is important to identify an entity within India to push forward trilateral and bilateral activities. India's deployment of all kinds of solar technology is well developed. There is a lot of knowledge in the country on de-centralized solar energy systems. More important are the changes in the country's regulatory framework. Those countries identified in the TriDeP project for their demand should be open to changes in the regulatory framework. This will also support the expansion of the private sector in these countries. Frameworks, forecasting, market design, including grid codes, battery and hydrogen should also be explored in demand countries.

There is an increasing concern that the focus on renewable energy is taking away the focus on decarbonization, which is the larger goal. Several technologies beyond renewable energy are being explored to decarbonize the power transition e.g., geo-thermal, carbon capture/storage etc. We should begin to also focus on a net-zero carbon agenda that integrates technologies with the needs and perspectives of the demand countries. Solution on Distributed Renewable Energy (DRE) technologies and off-grid solutions can also empower women and promote entrepreneurship, current programs of which are already being implemented in Vietnam and Cambodia. Overall, institutional mechanisms, regulatory frameworks, and the right technologies can support ease of transition.

The participants discussed energy initiatives in Southeast Asia and Pacific Island Countries. Prominent demands and existing platforms were largely shared from Philippines, Cambodia, and Papua New Guinea. Their recommendations are as follows:

Philippines

Energy projects supported by the United States in the Philippines include 'Energy Secure Philippines' in partnership with the Government of Philippines to help the country reach its power sector reform goals and support mobilization of resources for the energy sector. There are two levels of partnerships possible. India has existing MoUs with shortlisted countries and the Philippines too has certain cooperative agreements with some of these countries. The TriDeP project will need to engage government officials and COPs of existing energy programs to identify specific areas of collaboration. In the Philippines and PNG, 2022 is an election year and hence consideration will also need to be made on the priorities of the new governments for the energy sector.

Cambodia

The current COVID pandemic may impact immediate energy related policy priorities in Cambodia and the TriDeP needs to ensure that these scenarios too are considered. Existing initiatives to support clean energy uptake in Cambodia's power system include the 'Energy Lab'. Cambodia's energy policy commits to including renewable energy in its energy mix. The challenge is to ensure that there is a clear understanding among all stakeholders of the impact of renewable energy, being a large proportion of the energy market, including supporting political will where required. Following major droughts in 2019 in Cambodia impacting on energy production in the country, new contracts for coal- fired power plants have been signed, two are already in operation with a third expected to begin shortly. With these initiatives being implemented, there is a risk that Cambodia's INDCs will not be met as the main source of energy in the country will be coal. Knowledge building on renewable energy is an immediate need. In the region, engagement with ASEAN and the Mekong region will be helpful for Cambodia to make this transition as it imports 30% of its energy from countries in the region. While there are donors and stakeholders from civil society organizations working to promote renewable energy in Cambodia, there is a need for political will. Additionally, agencies such as Electricite du Cambodge (EDC), the firm that manages electricity in Cambodia, have been hesitant to include more renewable energy. There is preference among such private sector players to manage the national supply of electricity through one grid over an upgraded decentralized model that civil society is trying to facilitate and support.

Papua New Guinea

There is an opportunity through the TriDeP initiative to strengthen the existing Indian-UN initiative for South-South Cooperation in PNG. Long-term programs over 3 years would be fruitful. Existing renewable energy programs in PNG have been affected by the pandemic and by the lack of in-country expertise to implement the project. Projects therefore take time to get implemented based on the technology involved and the expertise required for the same. PNG has long-term strategic plans – Vision 2050 and Strategic Plan 2030. Both plans have targets for renewable energy to ensure that the country is carbon neutral. Towards the same, initiatives on energy efficiency would help. PNG has an APEC partnership on electrification with Australia, New Zealand, and Japan to assist PNG's transition to 70% households electrified, a goal in the country's 2030 plan. In Papua New Guinea, USAID initiatives include the Papua New Guinea Electrification Partnership (PEP). Partners in PEP include Australia, New Zealand, and Japan. The goal of this project is to ensure 70% electrification of PNG. PNG has several development partners that also work in supporting PNG reach its electrification goals. The immediate challenge in fostering bilateral partnerships remains the COVID pandemic and the inability to ensure in-person work. A dialogue with these initiatives can help identify further collaborations with the TriDeP.

ANNEXE 1: Agenda

Welcome Address: Nandita Baruah, Country Representative, The Asia Foundation - India	10:30 am – 10:35 am
Opening Remarks: Monali Zeya Hazra, Regional Energy Manager and Clean Energy Specialist, USAID India	10:35 am – 10:40 am
Introduction to the Project: Atul Kaushik, COP – TriDeP, The Asia Foundation	10:40 am – 10:45 am
Presentation: Findings from Study, Shirish S Garud, Senior Fellow – Renewable Energy Technologies, TERI	10:45 am – 11:00am
Discussion: Experts	11:00 am - 12:00 pm
Concluding Remarks: Sunil Dhingra, Associate Director, Renewable Energy Technologies, TERI	12:00 pm – 12:10 pm
Vote of Thanks: Ramesh Navaladi, Deputy COP, TriDeP, The Asia Foundation	12:10 pm – 12:15 pm

ANNEXE 2: Participant List

Name	Organization
Rahul Agnihotri	UNEP
Anneli Stutz	GIZ India
Delphine Energy Lab	The Energy Lab- Cambodia
Gretel Orake	UNDP – Papua New Guinea
Deepali Khanna	Rockefeller Foundation
Peter Godfrey	The Energy Institute, APAC
Kuldeep Sharma	GIZ India
Winfried Damm	GIZ India
Nguyen Thi Thanh Phuong	GIZ Vietnam
Sothira Seng	USAID Cambodia
Scott Bartos	USAID Thailand
Dhruba Purkayastha	Climate Policy Initiative, India
Lily Gutierrez	USAID Philippines
Monali Zeya Hazra	USAID India
Dev Kant Sharma	USAID India
Vikash Jaiswal	ASSOCHAM
Sandra Kraushaar	The Asia Foundation
Pavneet Kaur	The Asia Foundation
Malavika Thirukode	The Asia Foundation
Ramesh Navaladi	The Asia Foundation
Nandita Baruah	The Asia Foundation
Atul Kaushik	The Asia Foundation
Shruti Patil	The Asia Foundation
Ajay Kumar Singh	The Asia Foundation
Apoorva Singh	The Asia Foundation
Anthea Mulakala	The Asia Foundation
Sheikh Vakil	The Asia Foundation
Shirish S Garud	TERI
Kartikey Sharma	TERI
Dr Ria Sinha	TERI
Sunil Dhingra	TERI
Nitin Bajpai	TERI

Annexure 4.0: Details of Indian Institutions

Sr.No.	Name of institutions	Website details
1	Barefoot College, Rajasthan	https://www.barefootcollege.org/
2	Centre for Policy Research	https://www.cprindia.org/
3	Central Electricity Authority of India	https://cea.nic.in/
4	Council on Energy, Environment and Water	https://www.ceew.in/
5	Centre for Science and Environment	https://www.cseindia.org/
6	Council of Scientific and Industrial Research Labs.	https://www.csir.res.in/csir-labs
7	Center for Study of Science, Technology and Policy	https://www.cstep.in/
8	Energy Efficiency Services Limited	https://eeslindia.org/en/home/
9	Indian Institute of Technology	https://www.iitsystem.ac.in/
10	Indian Institute of Sciences	https://iisc.ac.in/
11	Indian Renewable Energy Development Agency Limited	https://www.ireda.in/home
12	Integrated Research and Action for Development	https://www.irade.org/
13	Indian Space Research Organization	https://www.isro.gov.in/
14	Ministry of New and Renewable Energy	https://mnre.gov.in/
15	Ministry of External Affairs	https://www.mea.gov.in/
16	National Institute of Solar Energy	https://nise.res.in/
17	National Institute of Wind Energy	https://niwe.res.in/
18	National Institute of Technology	http://www.nitcouncil.org.in/
19	National Skill Development Corporation	https://nsdcindia.org/
20	Punjab Renewable Energy Systems Private Limited	https://www.prespl.com/
21	Power System Operation Corporation Limited	https://posoco.in/
22	Sardar Swaran Singh National Institute of Bio-Energy	https://www.nibe.res.in/
23	Skill Council of Green Jobs	https://sscgj.in/
24	The Energy and Resources Institute	https://www.teriin.org/

Annexure 5.0: Details of ranking process adopted for selection of the countries

Weights of indicators for ranking Southeast Asian Countries

Indicators	Rank	0	1	2	3
Bilateral ties/trade related activities	20%	Imposition of additional tax	Moderate relation/ based on judgement	Moderate relation/ based on judgement	Strong ties
NDC targets	15%	Countries not signatories to Paris Agreement	Emission reduction target of 15% or less	Emission reduction target between 15%–30%	Emission reduction target greater than 30%
RE electricity share	15%	Greater than 50%	21%–50%	5%–20%	Less than 5%
Technology scope in solar and wind (based on solar and wind energy potential – installed capacity)*	15%	Gap of less than 10%	Gap b/w 11% and 40%	Gap b/w 51% and 70%	Gap b/w 71% and 100%
Trade dependence on China	10%	Greater than 20%	11–20%	1–10%	Zero trade
Access to electricity	10%	Greater than 90%	70–89%	50–69%	Less than 50%
Access to clean cooking	5%	Greater than 75%	51–75%	25–50%	Less than 25%
Cost of electricity	5%	Less than `5	Between 5 and 7	Between 8 and 10	Greater than `10
Gender inclusiveness (in economic participation and opportunity)***	5%	0.6 to 1.0	0.3 to 0.6	0.1 to .3	Less than 0.1

Annexure 6.0: Weights of indicators for ranking Pacific Island Countries

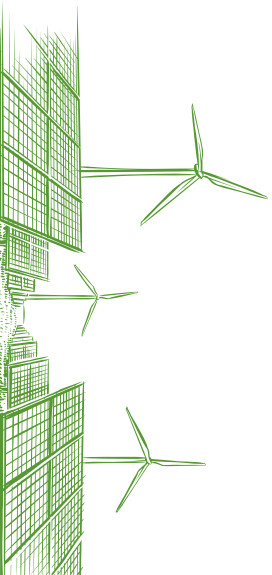
Indicators	Rank	0	1	2	3
Bilateral ties/trade related activities	20%	Imposition of additional tax	Moderate relation/ based on judgement	Moderate relation/ based on judgement	Strong ties
NDC targets	15%	Countries not signatories to Paris Agreement	Emission reduction target of 15% or less	Emission reduction target between 15% and 30%	Emission reduction target greater than 30%
RE electricity share	15%	Greater than 60%	41%–60%	20%–40%	Less than 20%
Technology scope in solar and wind (based on solar and wind energy potential – Installed capacity)*	15%	Gap of less than 50%	Gap b/w 50% and 75%	Gap b/w 76% and 90%	Gap b/w 91% and 100%
Trade dependence on China	10%	Greater than 10%	5–10%	1–5%	Zero trade
Access to electricity	10%	Greater than 90%	61–90%	30–60%	Less than 30%
Access to clean cooking	5%	Greater than 75%	51–75%	25–50%	Less than 25%
Cost of electricity	5%	Less than `5	Between 5 and 7	Between 8 and 10	Greater than `10
Gender inclusiveness (in economic participation and opportunity)***	5%	0.6 to 1.0	0.3 to 0.6	0.1 to .3	Less than 0.1

Annexure 7.0: Final rankings of Southeast Asian Countries

CIM	Bilateral relations with India	NDC targets	RE electricty share	Technology scope in solar and wind (based on solar and wind energy potential–installed capacity)*	Trade dependence on China	Access to electricity	Access to clean cooking	Cost of electricity	Gender inclusiveness	Final score	Ranking
Bangladesh	0.6	0.15	0.45	0.15	0	0.1	0.15	0	0.05	1.65	5
Bhutan	0.4	0.45	0	0.45	0.3	0	0.1	0	0.05	1.75	3
Brunei	0.2	0.3	0.45	0.15	0.3	0	0	0	0	1.4	13
Cambodia	0.4	0.45	0	0.3	0.1	0.2	0.15	0.15	0	1.75	3
Indonesia	0.6	0.3	0.3	0.3	0.2	0	0.05	0.05	0	1.8	2
Maldives	0.4	0.3	0.45	0.3	0	0	0	0.15	0.05	1.65	5
Nepal	0.6	0.45	0	0.3	0.1	0	0.1	0.05	0	1.6	8
Sri Lanka	0.6	0.3	0.15	0.3	0	0	0.1	0.05	0.05	1.55	9
Thailand	0.4	0.3	0.3	0.3	0.2	0	0.05	0.1	0	1.65	5
Vietnam	0.6	0.3	0.15	0.15	0.2	0	0.05	0.05	0	1.5	11
Laos	0.4	0.3	0.3	0	0.3	0.1	0.15	0	0	1.55	9
Philippines	0.6	0.45	0.15	0.45	0.2	0	0.1	0.15	0	2.1	1
Timor-Leste (East Timor)	0.2	0	0.45	0.15	0.2	0.2	0.15	0.1	0	1.45	12

Annexure 8.0: Final rankings of Pacific Countries

CIM	Bilateral relations with India	NDC targets	RE electricity share	Technology scope in solar and wind (based on solar and wind energy potential– installed capacity)*	Trade dependence on china	Access to electricity	Access to clean cooking	Cost of electricity	Gender inclusiveness	Final score	Ranking
Fiji	0.4	0.15	0	0.15	0.1	0	0.1	0.15	0.05	1.1	2
Papua New Guinea	0.4	0.3	0.3	0	0.2	0.3	0.15	0.15	0	1.8	1



Annexure 9.0: Project proposals from the College of Engineering, Science and Technology, Fiji National University

Possible RE Projects/Activities for Discussion with TERI

College of Engineering, Science and Technology

Fiji National University

Dr. Ravita Prasad

Project/Activity 1: Comparative analysis of Solar PV in Namaka and Ba campuses of FNU

Project team:

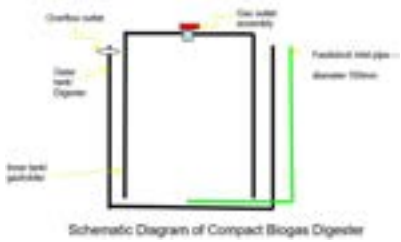
- Mr. Naveendra Reddy
- Mr. Mohammed Khan
- Dr. Ravita Prasad

- Background: Most FNU campus is heavily dependent on grid power. Outages in power supply have adverse effects on operation of the university. Also, with the frequency of cyclones nowadays, it is time to plan for a power service which would minimize or even eradicate the disruptions in power supply. FNU in an effort towards cleaner and greener campus and achieving the nations SDG goal, are installing Grid-connected PV system in majority of its campuses.
- This project would:
  - Study technical performance of 250kW PV system installed at Namaka Campus.
  - Recommend best possible PV system design for Ba Campus.
  - Performance a comparative analysis of the solar resource available and power output from PV system at both campuses.
- Project Budget: USD8,000 (site visits and journal publication)

Project/Activity 2:
Compact Biogas Digestor

Project lead: Dr. Dellena Alagcan

- The prototype of compact biogas digestor has been build at Mechanical Engineering School.
- It is operational and technical performance has been conducted.
- The next phase of the project is to:
  - Piloting for rolling over the project to rural communities/villages for clean cooking fuel
  - Build on the existing model and use the gas produced for electricity generation to power lights of a small home.
- Estimated cost – USD20,000 (to cover the cost of materials and incidental expenses.



Schematic Diagram of Compact Biogas Digester

Project/Activity 3:
Sustainable Microgrids (RE or retrofits) : A Possibility for Rural and Remote Island Electrification in Fiji

Project Lead: Mr. Pranesh K. Dutt

- This potential project seeks to prove the relevance of the concept of a "sustainable micro-grid or mini-grid" while also:

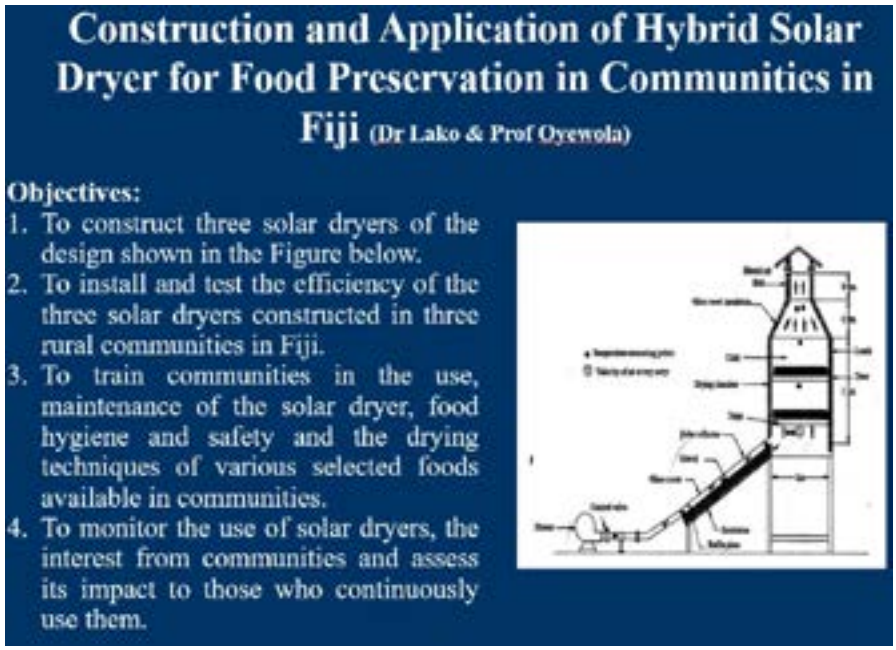
  (1) analyzing the cost and benefits associated with implementing such as system in remote and rural islands of Fiji.

  (2) focusing on simulation of the system under normal and faulted conditions. To accomplish this, system would be designed in a manner so that it is able to differentiate between a normal and faulted condition, maintain operation under islanded conditions, fully integrate renewable energy sources that help to reduce carbon emission, and comply with specific regulations.

- The outcome of this project would facilitate decision makers' to opt for isolated microgrid (RE or retrofit) as an electrification option which should not only be economically attractive and efficient but also acceptable from various aspects.

Project/ Activity 4:

Budget=$US30,000



Project/Activity 5: Fabrication of highly efficient and stable carbon based HTM free-perovskite solar cells

Project Lead: Dr. Kiran Kumar K

- **Objectives:**

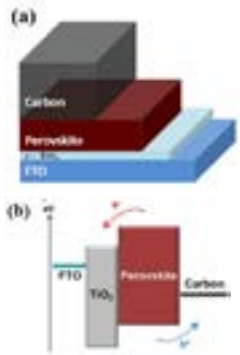
❑ **Enhancement of the efficiency and stability of low cost paintable Carbon electrode-based HTM free planar perovskite solar cells.**

- ➢ Investigations of carbon electrode based low-cost HTM free PSCs employing mixed cation based perovskite layers at full ambient conditions.
- ➢ **Fabrication of the perovskite cells**: **(To furnish FNU laboratory):**
  - Price ~ 13500 USD (Approximate estimation including consumables- These equipment can also be used to synthesize nano materials for other PV and photocatalytic applications)
- ➢ **Efficiency measurements: (To furnish FNU laboratory):**
  - Solar simulator- IVS-KA6000 (Enlitech) – Price ~ 30000 USD
  - Keithley 2400 meter- Price ~ 3000 USD,

(No funding is received so far. However these equipment will be used for PGd, Masters program, and PhD so list of the equipment required (~ 13500 USD) to fabricate solar cells and synthesize and nano materials is submitted to school to purchase on CAPEX- for 2022)

❖ **Collaboration:**

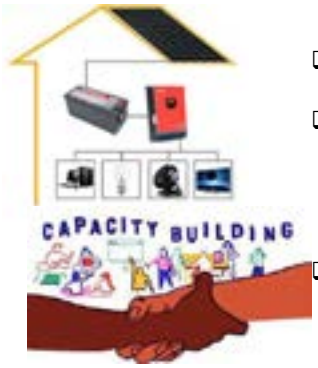
- ➢ Other electrical studies of the solar cells and structural characterization of perovskite layer would be carried out in **collaboration**.
  - o Incident photon-to-current conversion efficiency (IPCE), Photo-induced absorption spectroscopy; Morphology: SEM (Scanning electron microscopy), Time resolved photoluminescence (PL), Structure: XRD (X-ray diffraction studies), and HRTEM (High resolution transmission electron microscopy).



Low cost paintable Carbon electrode-based HTM free planar perovskite solar cells

Project/activity 6: NODA SOLA INITIATVE

A GRASSROOT EMPOWERMENT PROJECT



Project Lead: PAULA TUIVANUYALEWA

- ❑ **This is a solar home installation project planned for rural communities in Fiji.**
- ❑ **The project objective is to enable rural dwellers in the "last mile" to acquire efficient energy systems that they can afford, own, operate and generate income from instead of the current trend of relying on government assistance all the time.**
- ❑ **This is a unique project that will partner with stakeholders in the empowering of rural dwellers and building them up for the sustainability of their energy needs through SME activities.**
- ❑ **Key activities will involve resource mapping, business training, technical training and PV installation, evaluation and monitoring.**

The name: NODA = means ours in the i-taukei language of Fiji and SOLA stands for solar or photovoltaic energy. Therefore the project will be built around the concept of everyone in the community working together for our (noda) common good.

NODA SOLA INITIATVE

A GRASSROOT EMPOWERMENT PROJECT

CURRENT TRENDS IT WILL ADDRESS

1. Lack of clean energy sources.
2. Poor light sources.
3. Poverty.
4. Urban drift.
5. Crime and juvenile delinquency.

SOLUTIONS IT WILL PROVIDE

1. empower the rural dwellers through business opportunities.
2. end life time of dependency on government.
3. end the continuous payment of energy needs to government.
4. enhance the rural economy discourage urban drift.
5. provide opportunities for the youth to engage in legal business activities rather than dealing marijuana cultivation as is prevalent now.

PROJECT BUDGET

Training & infrastructure = $USD34, 359.00

Solar Home Systems = $USD41,867.00

Total **$USD76,226.00**

PROSPECTIVE DONORS

Application for funding assistance have been sent to the following organisations:

- ✓ Private Funding Assistance Network (Climate Funds agency)
- ✓ Sheik Sayed Mohammed Sustainability Funds – UAE.

PAULA TUIVANUYALEWA

NODA SOLA INITIATVE

A GRASSROOT EMPOWERMENT PROJECT

PROJECT BENEFITS

1. **Contributes to the national clean energy target of 90% renewables by 2030.**
2. **Empowers rural dwellers to go into business that can be marketable to the world.**
3. **Will reduce the urban drift.**
4. **Provides employment and income to rural dwellers.**
5. **Will change the mindset of rural young people thus creating better citizens of Fiji, reducing crime and its associated costs to the nation.**

✓THANK YOU

PAULA TUIVANUYALEWA

Project 7: The Influence of Fijian Climate on the Performance of 250.25 kilowatts photovoltaic (PV) grid-connected system at Fiji National University – Namaka Campus

Background **Project lead: Professor Abdul Malik**

A 250 kilowatts solar photovoltaic system was installed at Fiji National University, **Nadi Campus** which is a golden step towards green power generation and to reduce the emission of greenhouse gasses. The system consists of six invertors. The size of this system is based on the Standard Temperature Conditions (STC) also know as laboratory conditions. Multicrystalline TSM – 275PD05 PV panels are used. The system consists of roof-mounted as well as ground mounting PV panels.

Aim

The energy produced by a grid-connected photovoltaic system depends on localized climatic conditions, mainly the incident solar global radiation on the modules and the working temperature of the system, which is a function of mainly the global radiation and the ambient temperature. This proposed project aims to provide information on the operational performance of the PV system under the Western Fijian climatic conditions.

Project Data

A real-time data is required on this project either from the date of operation or from any fixed day/date for at least two consecutive years.

Project – example of a sustainable project

- 100 kW micro hydro system in Bukuya, Viti Levu
- UNDP with Department of Energy had revived the system that was not working.
- Here the community were engaged from the beginning of the project.
- Community has a corporative set up that looks after the operation and maintenance of the Bukuya Hydro Power project.
- More details can be found at:
- https://www.youtube.com/watch?v=E59Rgk5pPT0 and
- https://www.equatorinitiative.org/2020/04/24/solution10994/

Annexure 10.0: Political and economic risk analysis and their mitigation

Country	Risk	Areas of collaboration
Indonesia	» Growing financial insertion with China on the Belt and Road Initiative (BRI) has changed the energy policies from renewable energy towards fossil fuels in order to keep up with the growing infrastructure demand of the project » » Indonesia has continued to benefit significantly from economic relations with China, where Beijing remains Jakarta's leading trading partner. Indonesian » exports to China – including commodities such as petroleum, iron ore, and palm oil – rose from 2019 to 2020 (Derek Grossman, 2021)	» Increasing need to establish strong foundations in the maritime domain under SAGAR (Security and Growth for All in the Region) as both countries are major maritime entities and want to use that to ascend on their domestic, regional, and global aspirations » Strengthening collaborations with India in the maritime domain not only help Indonesia move away from its recent economic reliance on China (Derek Grossman, 202161), but will also help establish links around the augmentation of blue economy related sustainability measures and collaborative progression towards newer renewable energy aspects such as floating solar

Country	Risk	Areas of collaboration
Fiji	» Three military coups have been staged in the country over the last 34 years, in 1987, 2000, and 2006. Current Prime Minister Frank Bainimarama came to power after the 2006 military coup (Schieder, 2016) » The economy of Fiji is highly reliant on remittances and FDI.[123] However, it has been found that politically unstable nations attract lower FDI inflows than politically stable nations.[124] Political instability has cost Fiji 3.2% in annual growth rate between 1970 and 2011.[125] » The suspension of Data Bureau limited institutions has created a lack of information on the number of borrowers in the country, which increased the probability of more loans being declined or lengthened the loan approval process, thus contributing to Fiji's investment and growth slowdown[126]	» While no high level meeting between India and Fiji has happened since 2014 focusing on the aspect of renewable energy, India has entered into an agreement for cooperation in the field of agriculture and allied sectors with Fiji to help combat the implications of climate change[127] » Given its commitment towards helping Fiji to combat the implications of climate change, India must help strengthen the country's democratic institutional structures by entering into partnerships that focus on knowledge sharing and technology transfers to help diversify their industrial portfolio and equip them with the developmental tools to move forward

123 Makun, K. K. (2018) 'Imports, remittances, direct foreign investment and economic growth in Republic of the Fiji Islands: An empirical analysis using ARDL approach', Kasetsart Journal of Social Sciences, 39(3), pp. 439–447. doi: 10.1016/j.kjss.2017.07.002

124 Rashid, M., Looi, X. H. and Jye, W. S. (2017) 'Political stability and FDI in the most competitive Asia Pacific countries', Journal of Financial Economic Policy, 9(2), pp. 1–20

125 Gong, X. and Rao, M. (2014) The Economic Impact of Prolonged Political Instability: A Case Study of Fiji, Policy Studies. doi: 10.1080/01442872.2016.1157856

126 Gounder, N. (2020) 'Fiji economic survey: Low growth the new normal?', Asia and the Pacific Policy Studies, 7(2), pp. 145–157. doi: 10.1002/app5.307

127 Businessworld (2021) India, Fiji Sign MoU for Cooperation in Agriculture, Businessworld. Available at: http://www.businessworld.in/article/India-Fiji-Sign-MoU-For-Cooperation-In-Agriculture/23-06-2021-394058/

Country	Risk	Areas of collaboration
Papua New Guinea (PNG)	» Democratic reversal is a largely prevalent phenomenon. Further, it is highly politically unstable. In 2020, opposition leaders tried to oust the Prime Minister James Marape. » Historically, PNG has been susceptible to conflict and violence mostly connected with local grievances about the nature of foreign involvement in the economy. Recently, landowner grievances about the Exxon Mobil co-venture, PNG LNG, and the Barrick Gold majority owned Porgera gold mine in the highlands have resulted in violent skirmishes[128] » The Southern Highlands of Papua New Guinea remain a centre of unrest. Roadblocks arising from local grievances have plagued the Highlands Highway since the 2017 election. Such disturbances prevent hundreds of trucks from reaching their destinations and do economic damage even as they discourage investors[129]	» India must help strengthen PNG's existing democratic structures. The nation moved ahead on this notion earlier last year when India's Election Commission signed an MoU with PNG, for cooperation in the field of electoral management and administration[130]. Additionally, given PNG's economic history of dealing with the phenomenon of Dutch Disease, diversification of its industrial portfolio away from natural resources is important. As a member of ISA and given its large-scale potential in solar energy, India needs to carve out strategic collaborative missions for PNG to help realize its potential

128 Wilson, C. (2020) NG and Covid-19: The costs of economic stress, The Lowy Institute. Available at: https://www.lowyinstitute.org/the-interpreter/png-covid19-costs-economic-stress

129 Firth, S. (2018) Instability in the Pacific Islands: A status report, Lowy Institute. Available at: https://www.lowyinstitute.org/sites/default/files/documents/Firth_Instability in the Pacific Islands_A status report_WEB.pdf

130 Outlook (2020) India, Tunisia, Papua New Guinea to sign MoU on elections, Outlook. Available at: https://www.outlookindia.com/newsscroll/india-tunisia-papua-new-guinea-to-sign-mou-on-elections/1714974

Country	Risk	Areas of collaboration
Philippines	» Gradual diminishing of institutional forbearance » Continual breakdown of civil liberties. In 2020, the Government of Philippines shut down a major broadcaster, arrested social media users for critical posts during the pandemic, and adopted a vaguely worded new anti- terrorism law that allowed people to be arbitrarily labelled as terrorists and detained without a warrant or charges, including for speech- related offenses	» Philippines has been susceptible to matters of election fraud and interference. Like the MoU signed by India's election commission with Tunisia and PNG, steps need to be taken to restore citizen confidence within the government and the democratic institutions
Thailand	» Ruled and controlled by the military junta which has now drafted a new constitution » Dissolution of the opposition Future Forward Party in 2020 pushed the country deeper into the confines of an authoritarian regime	» Given the current scenario, India can modify the terms and agreements of its trade deals, laying particular focus on economic recovery, institutional cooperation and abolishing digital repression within the practice of the particular trade to enhance democratic alliances

TERI
Darbari Seth Block, IHC Complex,
Lodhi Road, New Delhi 110 003, India
Tel.: +91 11 2468 2100 or 2468 2111 |
Fax: +91 11 2468 2144 or 2468 2145
Email: pmc@teri.res.in | Web: www.teriin.org

The Asia Foundation
114, Jor Bagh (First Floor),
New Delhi-110003, India
Tel.: +91-11-47363100
Web: www.asiafoundation.org