“Finding the investment proposal for NVVN

- **In International as well as National Solar Energy Market**

By
C K ANAND PRAKASH

NTPC Vidyut Vyapar Nigam Ltd.

ACKNOWLEDGEMENTS

I extend my profound gratefulness to my project advisors **Mr Kundan Lal (Mgr)**, and **Prof. G C. Tripathi** for providing all support throughout my project work. I feel fortunate enough to receive continuous encouragement from them graciously during my internship, which has made the project work with all its load of hard work an enjoyable experience for me. I would like to thank both of them for sparing their valuable time to discuss and evaluate the progress of my work.

I am thankful to **Mr Raj Kumar Jaiswal DGM (RE), Mr Sanjay Bodh Sr. Mgr (P&S), Mr Anshu Chadda NTPC (RE)** for giving their valuable information to carry out my work during the internship. I am also thankful to **Shri K. S. Bandyopadhyay CGM-NVVN, Shri P.K Jena AGM(BD)** for giving me valuable insights and encouragement for the work that I could get at NVVN. I would like to thank all other faculty member and staff of the institution as well as NVVN. I feel indebted to NSB for developing my corporate competency. I express my deep sense of appreciation for our parent organization, NTPC Limited, for permitting me to pursue my summer internship at NVVN office. The culture of continuous learning has been a source of inspiration for me to embark on a summer internship program. I feel indebted to my organization. I thank my peers for helping me during my project work.

I gratefully acknowledge the unfailing silent encouragement, emotional support, patience and understanding of my parents, who has driven me to complete this work. Finally, I thank every one who has contributed directly or indirectly to my work.

Table of Contents

PROJECT-1 (Finding the investment proposal for NVVN in National as well as International Solar Energy Market)

Project -1

Finding the investment proposal for NVVN in National as well as International Solar Energy Market

Executive Summary

- The Solar Potential for different sites has been calculated through Desktop Survey for finding the opportunity for NTPC Vidyut Vyapar Nigam Limited to invest in the International Market either through CAPEX or RESCO business model.
- Solar Potential for Myanmar came out to be quite high and also it receives a good amount of solar irradiation in compares to other countries as compared other countries for which desktop survey was conducted.
- Solar Potential for Nepal is quite low because of the hilly terrine of the country so the large-scale solar project is quite difficult to develop and also the weather condition is also not very much favourable for the same. Also, it has a high potential for Hydro Energy. Same is true for Bhutan as well. Solar irradiance is moderate in Bangladesh
- With the study of Foreign Direct Investment Policy of neighbouring countries along with the Renewable Energy policies which ultimately helped in the implementation of the Solar Projects from the outcomes of this project report
- FDI policies and RE for Nepal and Bangladesh is somewhat similar to India and various bilateral treaties has been signed with India to support FDI
- And with the development of a financial model for tariff determination for Solar Energy which is ultimately used by NVVN for competitive bidding and Power Purchase Agreement for different Solar Projects and tariff came out to be 4.41 Rs and project IRR- 9.34% and Equity IRR- 9.85% and with payback period of 8 years.

I. DESKTOP SURVEY FOR SOLAR POTENTIAL

The Solar Potential for different sites has been calculated through Desktop Survey for finding the opportunity for NTPC Vidyut Vyapar Nigam Limited to invest in the International Market either through CAPEX or RESCO business model.

Countries in which we are looking for the opportunity

- Nepal
- Bangladesh
- Myanmar
- Bhutan
- Sri-Lanka
- Mongolia

Sites Selected for the Desktop Survey

- Mandalay International Airport, Myanmar
- Naypyidaw (Nay Pyi Taw) Airport, Myanmar
- Bandaranaike International Airport, Sri Lanka
- Yangon International Airport Yangon, Myanmar (Burma)
- Paro International Airport, Bhutan
- Shah Amanat International Airport Chittagong, Bangladesh
- Gautam Buddha International Airport, Nepal
- Chinggis Khan International Airport Ulan Bator, Mongolia
- Tribhuvan International Airport, Nepal

Software Used for Desktop Survey

- Google Earth
- Helioscope

Assumptions

- Area required for 1kW installation 15 Sq. m.
- Solar installation for Cochin Airport is taken as a reference for the solar potential calculations.

Desktop Survey for Solar Potential

- **Targeted Site -** Mandalay International Airport, Myanmar
- **Coordinates**- 21.7056° N, 95.9707° E

Tentative Area Available • **Ground Area =** 915585.29 sq m	**Considering 50% area to be used for Solar Power Plant** Therefore, 915585.29 * 50% = 457792.645 sq m
Area required for 1kW installation	15 Sq. m
Tentative Potential Solar Capacity	30519.5 kW ~ 30.5195 MW

Ground Mounted Solar Potential

Tentative Area Available • **Terminal Rooftop =** 2587.44+13497.77 = 16085.21 sq m	**Considering 70% area to be used for Solar Power Plant** Therefore, 16085.21* 70% = 11259.647 sq m
Area required for 1kW installation	15 Sq. m
Tentative Potential Solar Capacity	750.64 kW~ 0.750 MW

Rooftop Solar Potential

Tentative Area Available • **Parking Area =** 24366.76 sq m	**Considering 70% area to be used for Solar Power Plant** Therefore, 24366.76 * 70% = 17056.732 sq m
Area required for 1kW installation	15 Sq. m
Tentative Potential Solar Capacity	1137.115 kW~ 1.137 MW
Note: Open parking space can be shaded and used for solar installation. The same has been considered.	

Parking Area Solar Potential

	Ground Area	***Parking Area***	***Terminal Rooftop***	***Total Area***
Tentative Area Available	457792.645 sq m	17056.732 sq m	11259.647 sq m	486109.024 sq m
Area required for 1kW installation	15 Sq. m	15 Sq. m	15 Sq. m	15 Sq. m
Tentative Potential Solar Capacity	30519.5 kW ~ 30.5195 MW	1137.115 kW~ 1.137 MW	750.64 kW~ 0.750 MW	**32.406 MW**

OVERALL SOLAR POTENTIAL

- **Targeted Site-** Naypyidaw (Nay Pyi Taw) Airport, Myanmar
- **Coordinates-** 19°36’54’’ N, 96°12’48’’ E

Tentative Area Available • **Ground Area =** 614096.79 sq m	**Considering 50% area to be used for Solar Power Plant** Therefore, 614096.79 * 50% = 307048.395 sq m
Area required for 1kW installation	15 Sq. m
Tentative Potential Solar Capacity	20469.89 kW~ 20.469MW

Ground Mounted Solar Potential

Tentative Area Available • **Parking Area =** 3718.96*2 = 7247.92 sq m	**Considering 70% area to be used for Solar Power Plant** Therefore, 7247.92 * 70% = 5073.544 sq m
Area required for 1kW installation	15 Sq. m
Tentative Potential Solar Capacity	338.23 kW~ 0.338MW
Note: Open parking space can be shaded and used for solar installation. The same has been considered.	

Parking Area Solar Potential

Tentative Area Available • **Terminal Rooftop =** 6911.2+28863.23 = 35774.43 sq m	**Considering 70% area to be used for Solar Power Plant** Therefore, 35774.43* 70% = 25042.101 sq m
Area required for 1kW installation	15 Sq. m
Tentative Potential Solar Capacity	1669.47 kW~ 1.669 MW

Rooftop Solar Potential

	• ***Ground Area***	• ***Parking Area***	• ***Terminal Rooftop***	***Total Area***
Tentative Area Available	307048.395 sq m	5073.544 sq m	25042.101 sq m	337164.04 sq m
Area required for 1kW installation	15 Sq. m	15 Sq. m	15 Sq. m	15 Sq. m
Tentative Potential Solar Capacity	20469.89 kW~ 20.469MW	338.23 kW~ 0.338MW	1669.47 kW~ 1.669 MW	**22.476 MW**

OVERALL SOLAR POTENTIAL

- **Targeted Site-** Bandaranaike International Airport, Sri Lanka
- **Coordinates**- 7.1802° N, 79.8843° E

Tentative Area Available • **Ground Area =** 152170.82 sq m	**Considering 50% area to be used for Solar Power Plant** Therefore, 152170.82 * 50% = 76085.41 sq m
Area required for 1kW installation	15 Sq. m
Tentative Potential Solar Capacity	5072.36 kW ~ 5.072 MW

Ground Mounted Solar Potential

Tentative Area Available • **Terminal Rooftop =** 65907.92 sq m	**Considering 70% area to be used for Solar Power Plant** Therefore, 65907.92 * 70% = 46135.544 sq m
Area required for 1kW installation	15 Sq. m
Tentative Potential Solar Capacity	3075.7 kW~ 3.075 MW

Rooftop Solar Potential

Tentative Area Available • **Parking Area =** 3585.24 sq m	**Considering 70% area to be used for Solar Power Plant** Therefore, 3585.24 * 70% = 2509.668 sq m
Area required for 1kW installation	15 Sq. m
Tentative Potential Solar Capacity	167.3 kW~ 0.167 MW
Note: Open parking space can be shaded and used for solar installation. The same has been considered.	

Parking Area Solar Potential

	Ground Area	***Parking Area***	***Terminal Rooftop***	***Total Area***
Tentative Area Available	76085.41 sq m	2509.668 sq m	46135.544sq m	124730.622 sq m
Area required for 1kW installation	15 Sq. m	15 Sq. m	15 Sq. m	15 Sq. m
Tentative Potential Solar Capacity	5072.36 kW ~ 5.072 MW	167.3 kW~ 0.167 MW	3075.7 kW~ 3.075 MW	**8.314 MW**

OVERALL SOLAR POTENTIAL

- **Targeted Site-** Yangon International Airport Yangon, Myanmar (Burma)
- **Coordinates**- 16.9028° N, 96.1353° E

Tentative Area Available • **Ground Area =** 8256.5 sq m	**Considering 50% area to be used for Solar Power Plant** Therefore, 16513 * 50% = 8256.5 sq m
Area required for 1kW installation	15 Sq. m
Tentative Potential Solar Capacity	550.433 kW~ 0.550MW

Ground Mounted Solar Potential

Tentative Area Available • **Terminal Rooftop =** 74594 sq m	**Considering 70% area to be used for Solar Power Plant** Therefore, 74594* 70% = 52215 sq m
Area required for 1kW installation	15 Sq. m
Tentative Potential Solar Capacity	3481.053 kW~ 3.481 MW

Rooftop Solar Potential

Tentative Area Available • **Parking Area =** 44632 sq m	**Considering 70% area to be used for Solar Power Plant** Therefore, 44632 * 70% = 31242.4 sq m
Area required for 1kW installation	15 Sq. m
Tentative Potential Solar Capacity	2082.82 kW~ 2.082 MW
Note: Open parking space can be shaded and used for solar installation. The same has been considered.	

Parking Area Solar Potential

	Ground Area	***Parking Area***	***Terminal Rooftop***	***Total Area***
Tentative Area Available	8256.5 sq m	31242.4 sq m	52215 sq m	91713.9 sq m
Area required for 1kW installation	15 Sq. m	15 Sq. m	15 Sq. m	15 Sq. m
Tentative Potential Solar Capacity	550.433 kW~ 0.550MW	2082.82 kW~ 2.082 MW	3481.053 kW~ 3.481 MW	**6.113 MW**

OVERALL SOLAR POTENTIAL

- **Targeted Site-** Paro International Airport, Bhutan
- **Coordinates**- 27.4052° N, 89.4210° E

Tentative Area Available • **Ground Area =** 6702 sq m	**Considering 50% area to be used for Solar Power Plant** Therefore, 6702 * 50% = 3351 sq m
Area required for 1kW installation	15 Sq. m
Tentative Potential Solar Capacity	223.4 kW~ 0.2234MW

Ground Mounted Solar Potential

Tentative Area Available • **Terminal Rooftop =** 11256 sq m	**Considering 70% area to be used for Solar Power Plant** Therefore, 11256* 70% = 7879.2 sq m
Area required for 1kW installation	15 Sq. m
Tentative Potential Solar Capacity	525.28 kW~ 0.52528 MW

Rooftop Solar Potential

Tentative Area Available • **Parking Area =** 19242*2 = 38484 sq m	**Considering 70% area to be used for Solar Power Plant** Therefore, 38484 * 70% = 26938.8 sq m
Area required for 1kW installation	15 Sq. m
Tentative Potential Solar Capacity	1795.92 kW~ 1.79532MW
Note: Open parking space can be shaded and used for solar installation. The same has been considered.	

Parking Area Solar Potential

	Ground Area	***Parking Area***	***Terminal Rooftop***	***Total Area***
Tentative Area Available	3351 sq m	26938.8 sq m	7879.2 sq m	38169 sq m
Area required for 1kW installation	15 Sq. m	15 Sq. m	15 Sq. m	15 Sq. m
Tentative Potential Solar Capacity	223.4 kW~ 0.2234MW	1795.92 kW~ 1.79532MW	525.28 kW~ 0.52528 MW	**2.544 MW**

OVERALL SOLAR POTENTIAL

- **Targeted Site-** Shah Amanat International Airport Chittagong, Bangladesh
- **Coordinates**- 22.2457° N, 91.8147° E

Tentative Area Available • **Ground Area =** 34738 sq m	**Considering 50% area to be used for Solar Power Plant** Therefore, 34738 * 50% = 17369 sq m
Area required for 1kW installation	15 Sq. m
Tentative Potential Solar Capacity	1147.930 kW~ 1.147MW

Ground Mounted Solar Potential

Tentative Area Available • **Terminal Rooftop =** 11241 sq m	**Considering 70% area to be used for Solar Power Plant** Therefore, 11241* 70% = 7868.7 sq m
Area required for 1kW installation	15 Sq. m
Tentative Potential Solar Capacity	524.58 kW~ 0.52458 MW

Rooftop Solar Potential

Tentative Area Available • **Parking Area =** 15943*2 = 31886 sq m	**Considering 70% area to be used for Solar Power Plant** Therefore, 31886 * 70% = 22320.2 sq m
Area required for 1kW installation	15 Sq. m
Tentative Potential Solar Capacity	1488 kW~ 1.488MW
Note: Open parking space can be shaded and used for solar installation. The same has been considered.	

Parking Area Solar Potential

	Ground Area	***Parking Area***	***Terminal Rooftop***	***Total Area***
Tentative Area Available	17369 sq m	22320.2 sq m	7868.7 sq m	47407.65 sq m
Area required for 1kW installation	15 Sq. m	15 Sq. m	15 Sq. m	15 Sq. m
Tentative Potential Solar Capacity	1147.930 kW~ 1.147MW	1488 kW~ 1.488MW	524.58 kW~ 0.52458 MW	**3.160 MW**

OVERALL SOLAR POTENTIAL

- **Targeted Site-** Gautam Buddha International Airport, Nepal
- **Coordinates**- 27°30'20"N, 083°24'58"E

Tentative Area Available • **Ground Area =** 65378.62 sq m	**Considering 50% area to be used for Solar Power Plant** Therefore, 65378.62 * 50% = 32689.31 sq m
Area required for 1kW installation	15 Sq. m
Tentative Potential Solar Capacity	223.4 kW~ 0.2234MW

Ground Mounted Solar Potential

Tentative Area Available • **Terminal Rooftop =** 1537.35 sq m	**Considering 70% area to be used for Solar Power Plant** Therefore, 1537.35* 70% = 1076.145 sq m
Area required for 1kW installation	15 Sq. m
Tentative Potential Solar Capacity	71.743 kW~ 0.071743 MW

Rooftop Solar Potential

Tentative Area Available • **Parking Area =** 4142.25*2 = 8284.5 sq m	**Considering 70% area to be used for Solar Power Plant** Therefore, 8284.5 * 70% = 5799.15 sq m
Area required for 1kW installation	15 Sq. m
Tentative Potential Solar Capacity	386.61 kW~ 0.386MW
Note: Open parking space can be shaded and used for solar installation. The same has been considered.	

Parking Area Solar Potential

	Ground Area	***Parking Area***	***Terminal Rooftop***	***Total Area***
Tentative Area Available	32689.31 sq m	5799.15 sq m	1076.145 sq m	39540 sq m
Area required for 1kW installation	15 Sq. m	15 Sq. m	15 Sq. m	15 Sq. m
Tentative Potential Solar Capacity	2179.28 kW~ 2.179MW	386.61 kW~ 0.386MW	71.743 kW~ 0.071743 MW	**2.636 MW**

OVERALL SOLAR POTENTIAL

- **Targeted Site-** Chinggis Khan International Airport Ulan Bator, Mongolia
- **Coordinates**- 47.8522° N, 106.7619° E

Tentative Area Available • **Ground Area =** 222938 sq m	**Considering 50% area to be used for Solar Power Plant** Therefore, 222938 * 50% = 111469 sq m
Area required for 1kW installation	15 Sq. m
Tentative Potential Solar Capacity	7431 kW~ 7.431 MW

Ground Mounted Solar Potential

Tentative Area Available • **Terminal Rooftop =** 10537 sq m	**Considering 70% area to be used for Solar Power Plant** Therefore, 10537* 70% = 7375 sq m
Area required for 1kW installation	15 Sq. m
Tentative Potential Solar Capacity	491.72 kW~ 0.4917 MW

Rooftop Solar Potential

Tentative Area Available • **Parking Area =** 12605*2 = 25201 sq m	**Considering 70% area to be used for Solar Power Plant** Therefore, 25201* 70% = 17647 sq m
Area required for 1kW installation	15 Sq. m
Tentative Potential Solar Capacity	176.46 kW~ 1.176 MW
Note: Open parking space can be shaded and used for solar installation. The same has been considered.	

Parking Area Solar Potential

	Ground Area	***Parking Area***	***Terminal Rooftop***	***Total Area***
Tentative Area Available	111469 sq m	17647 sq m	7375 sq m	136480.5 sq m
Area required for 1kW installation	15 Sq. m	15 Sq. m	15 Sq. m	15 Sq. m
Tentative Potential Solar Capacity	7431 kW~ 7.431 MW	176.46 kW~ 1.176 MW	491.72 kW~ 0.4917 MW	**9.0987 MW**

OVERALL SOLAR POTENTIAL

- **Targeted Site-** Tribhuvan International Airport, Nepal
- **Coordinates**- 41′ 47″ N, 85° 21′ 32″ E

Tentative Area Available • **Ground Area =** 126407 sq m	**Considering 50% area to be used for Solar Power Plant** Therefore, 126407* 50% = 63203.5 sq m
Area required for 1kW installation	15 Sq. m
Tentative Potential Solar Capacity	4213.5 kW~ 4.2135 MW

Ground Mounted Solar Potential

Tentative Area Available • **Terminal Rooftop =** 17068 sq m	**Considering 70% area to be used for Solar Power Plant** Therefore,17068* 70% = 11947.6 sq m
Area required for 1kW installation	15 Sq. m
Tentative Potential Solar Capacity	796.5 kW~ 0.796 MW

Rooftop Solar Potential

Tentative Area Available • **Parking Area =** 14379	**Considering 70% area to be used for Solar Power Plant** Therefore, 14379* 70% = 10065.3 sq m
Area required for 1kW installation	15 Sq. m
Tentative Potential Solar Capacity	671.02 kW~ 0.671 MW
Note: Open parking space can be shaded and used for solar installation. The same has been considered.	

Parking Area Solar Potential

	Ground Area	***Parking Area***	***Terminal Rooftop***	***Total Area***
Tentative Area Available	63203.5 sq m	10065.3 sq m	11947.6 sq m	136480.5 sq m
Area required for 1kW installation	15 Sq. m	15 Sq. m	15 Sq. m	15 Sq. m
Tentative Potential Solar Capacity	4213.5 kW~ 4.2135 MW	671.02 kW~ 0.671 MW	796.5 kW~ 0.796 MW	**5.681 MW**

OVERALL SOLAR POTENTIAL

FINAL RESULTS OF DESKTOP SURVEY

Mandalay International Airport	**Myanmar**	32.406 MW
Naypyidaw (Nay Pyi Taw) Airport	**Myanmar**	22.476 MW
Bandaranaike International Airport	**Sri Lanka**	8.314 MW
Yangon International Airport Yangon (Burma)	**Myanmar**	6.113 MW
Paro International Airport	**Bhutan**	2.544 MW
Shah Amanat International Airport Chittagong	**Bangladesh**	3.160 MW
Gautam Buddha International Airport	**Nepal**	2.636 MW
Chinggis Khan International Airport Ulan Bator	**Mongolia**	9.0987 MW
Tribhuvan International Airport	**Nepal**	5.681 MW

OUTCOMES

- Solar Potential for **Myanmar** is quite **high** and also it receives a good amount of solar irradiation in compares to other countries as compared other countries for which desktop survey was conducted.
- Solar Potential for **Nepal** is quite **low** because of the hilly terrine of the country so the large-scale solar project is quite difficult to develop and also the weather condition is also not very much favourable for the same. Also, it has a high potential for Hydro Energy. Same is true for **Bhutan** as well.
- Solar irradiance is **moderate** in **Bangladesh**, whereas the suitable land for solar PV project development in **India** has **higher** irradiance and also weather condition of Bangladesh is also not good as it experiences cyclone in the southern region. And also having a plane terrain, it is more prone to flood

II. RENEWABLE ENERGY POLICY AND FDI POLICY STUDY OF NEIGHBOURING COUNTRIES

This part deals with the study of Foreign Direct Investment Policy of above-mentioned countries (in the 1st part) along with the renewable energy policies which will ultimately help in the implementation of the solar projects from the outcomes of 1st part of this project report

Countries of which FDI and RE policy has to found

Myanmar
Bangladesh
Sri-Lanka
Nepal

Sources Referred

- Electricity Policy documents for Solar Energy and Renewable Energy
- FDI policy documents

This part of the report mainly focuses on finding out the possibility and main contact point for investment in International Renewable Market based on various parameters:

- Recorded Solar Irradiation
- DTA Treaty
- Investment Protection Treaty
- Sovereign Guarantee
- 100% Ownership of Business Allowed in Electricity Business
- Land Ownership Allowed
- Regulatory Commission
- Authority to take permission to engage in Electricity generation related work
- Concerned Authority for FDI
- Political Stability Index
- Corruption Index (/100)
- Inflation
- Ease of Doing Business Rank among 190 countries
- Credit Rating

It also covers the RE targets, steps for FDI along with FDI laws
(Risks and Challenges also has been covered along with each Table for the above-mentioned countries)

RENEWABLE ENERGY POLICY AND FDI POLICY STUDY OF NEIGHBOURING COUNTRIES

PARAMETERS	• **MYANMAR**
Recorded Solar Irradiation	• More than 5 kWh/m2 /day
National RE Targets	• Renewable energy (only solar and wind) share would be 9% (2000MW) of installed capacity by 2030
Average Solar Energy Potential	• 51973.8 TWh per year
Current Installation figures	• 1,150 kWh/kWp to 1,600 kWh/kWp
MYANMAR ELECTRICITY LAW OF 2014	• **Authorizes the Ministry of Electric Power (MOEP), region and state governments**, and leading bodies of self-administrated zones and self-administrated divisions **the power to grant permits to entities to engage in electricity-related works** such as generation, transmission, and distribution. • In April 2017, MIC notification 15/2017 passed – **this allows 100% foreign investment in all electricity projects, irrespective of size**.
MYANMAR ENERGY MASTER PLAN 2015	• Energy Master Plan prepared under contract to the Asian Development Bank (ADB) and the Myanmar Ministry of Energy envisions total generating capacity rising from the present level of **4.4GW to 15GW** in 2030 - **of which 2% would be for solar and wind**
MYANMAR UNION TAX LAW 2016	• Exempts from commercial taxation of solar panels, solar charger controllers and solar inverters. • Tax Holiday according to zones**: Zone 1:** Less developed areas **Zone 2:** Moderately developed areas **Zone 3:** Developed areas
Exchange Rate and Inflation	• **Inflation**- 6.50% (2020 expected) • **Exchange Rate**- 1 USD= 1,524.15 Myanmar Kyat
Sovereign Guarantee	• Under World Bank Group's **Multilateral Investment Guarantee Agency** (MIGA) • The government is providing ***contractual sovereign guarantees*** for the Power Project (however, the creditworthiness of the MEPE will remain an issue when dealing on project financing, as the **sovereign guarantees on payment are merely contractual in nature without additional security in the form of bank guarantees provided by the government)**. **Note for investors**: *The sovereign guarantee is regarding payment obligations only*
Double Taxation	• India and Myanmar signed a **Bilateral Investment Promotion Agreement (BIPA)** and **Double Taxation Treaty (DTT)** in 2008.
Investment Laws	• Foreign investors **can incorporate a foreign-owned limited liability company**, **register a branch of a foreign company**, **operate as a sole proprietor or JV with local partner** (where the minimum share of a foreign entity is 35 per cent of total equity

	capital). Foreign investment is exempted from income tax for 3 years. • **Foreign investors can own 100%** of a limited liability company or partnership, depending on the business of the entity. Limited liability companies can either be registered under the Myanmar Foreign Investment Law *(MFIL), enabling a wide range of benefits* and incentives or under the Myanmar Companies Act *(CA), where these benefits are not available.* • Foreign investors can incorporate a foreign-owned limited liability company, register a branch of a foreign company, operate as a sole proprietor or JV with local partner (where the minimum share of a foreign entity is 35 per cent of total equity capital). Foreign investment is **exempted from income tax for 3 years.**
Ease of doing Business	• Myanmar is ranked 171 among 190 economies in the ease of doing business, according to the latest World Bank annual ratings.
Terrorism Index	• Terrorism Index in Myanmar increased to 5.92 in 2017 from 4.96 in 2016.
Political Stability	• Low
FDI Laws	• Myanmar welcomes both domestics and foreign investment. • Updated regulations, special economic zones, a reforming tax system and other investment-promoting reforms have opened the door for increased trade and investment in Myanmar. • The Myanmar Government is reforming the required regulations to create a more attractive and accessible regulatory climate for both domestics and foreign investors. The new Myanmar Investment Law came into effect on 18 October, 2016. • An overhaul of the Myanmar Companies Act to provide an updated and modern legal foundation was updated in 2017. This included eliminating and re-writing antiquated sections while adding much-needed clauses for a 21st Century global market; improving a long and complicated process of company registration and setting up an online company registration system. • 100% FDI is allowed in the power sector
Land Ownership	• Though the purchase of land is not permitted to foreigners, a real estate investor may apply for a 70-year leasehold with a Myanmar Investment Commission (MIC) permit. However, this would be restricted to larger investments and not the purchase of individual apartments or small plots of land.
Taxation	• Personal Income Tax Rate- 25.00 • Sales Tax Rate- 5.00 • Corporate Tax Rate- 25.00
Regulatory Authorities	• Deputy Director-General, Department of Rural Development, Ministry of Agriculture, Livestock and Irrigation
Risk and Challenges	Apart from High capital requirements and seasonal change factors and other potential risks and challenges include:

	• **Regulatory Uncertainty:** regulatory uncertainty is one of the main issues for investors in all industries. There are few detailed regulations for tariffs, legal terms and environmental aspects (*VDB-Loi).* • **Political risk**: Myanmar's political and religious risks are notable issues as they could affect the business operating environment. A secure environment is required to attract foreign investment. • **Low electricity price**: the country's low electricity price is one of the obstacles when investing in the country's power sector. • **Poor transmission and distribution facilities**: According to Myanmar's Electricity Supply Enterprise, poor quality of transmission and distribution facilities are the main factor causing 25 per cent losses of the power system

PARAMETERS	• BANGLADESH
Recorded Solar Irradiation	• 4.51-4.99 kWh/m2/day
National RE Targets	• The government has a target for 500MW of on- and off-grid solar in 2013-16 through various schemes. A program of the government to promote grid-connected and off-grid solar projects in Bangladesh through tenders and a solar irrigation financing scheme. • Projects are categorized as commercial, to be undertaken by the private sector (340MW) and "social sector" solar projects to be undertaken by different ministries and agencies of government (160MW). • Bangladesh has a target to install 3.1GW of renewable energy by 2021. These are broken down by technology under so-called RE Development Targets. Overall these are more extensive than the country's initial target to have 10% renewable electricity by 2020 under its renewable energy policy of 2008. • The following commercial solar projects are planned: -Utility-scale solar parks: 135MW -Solar irrigation: 150MW -Solar mini-grids: 25MW -Rooftop solar: 30MW (industrial (20MW) and residential (10 MW))
Average Solar Energy Potential	• Bangladesh is located between 200 30‟ and 260 45‟ north latitude and has a total area of 1.49E+ 11 m2. An average of 5 kWh / m2 solar radiation falls on this land over 300 days per annum.
Current-Installation figures	• Bangladesh has planned to produce 10% of total power generation by 2020 from renewable energy sources like wind, waste, and solar energy.
Exchange Rate and Inflation	• **Exchange Rate**- 1USD=84.28 Bangladeshi Taka • **Inflation**- 5.63
Sovereign Guarantee	• The Multilateral Investment Guarantee Agency (MIGA – the World Bank's insurance arm), will provide a **guarantee for US$69.5mn of the finance**, as part of its efforts to stimulate private investment in low-income countries. • The guarantee provides coverage for up to 15 years against the risk of non-honouring of sovereign financial obligations.
Political Stability	• In **political stability**, ranking is **Bangladesh** 172nd position with an index of -1.15. This indicates that **Bangladesh** is mostly affected by **political instability**
Ease of doing Business	• Bangladesh is ranked 176 among 190 economies, according to the latest World Bank annual ratings.
Terrorism Index	• Terrorism Index in Bangladesh decreased to 5.70 in 2017 from 6.18 in 2016.
Corruption Index	• Bangladesh scored 26 points out of 100 on the 2018 Corruption

Credit Rating	• Fitch BB- stable • Moody's Ba3 stable • S&P BB- stable
Double taxation and Investment treaties	• Bangladesh has concluded bilateral agreements for the avoidance of double taxation and investment treaties for promotion and protection of investment with India
Taxation	• Corporate Tax Rate 25.00% • Personal Income Tax Rate 30.00% • Sales Tax Rate 15.00%
Land Ownership	• Foreign persons or entities are not allowed to own real property but there are no restrictions on ownership of land by 100% foreign-owned companies.
FDI Laws	• FDI in industrial or development projects requires • **Registration with the Bangladesh Investment Development Authority (BIDA)**. The main objective of BIDA is to promote domestic and foreign investment as well as to enhance the international competitiveness of Bangladesh. • BIDA also provides the necessary **facilities and assistance** for setting up industries. • Determining the route to invest generally depends on the particular sector and the FDI policy implemented by the Government of Bangladesh. If a Bangladeshi company receives foreign investment and foreign funds, it **must notify the Bangladesh Bank**, the central bank of Bangladesh, through its local bank within a specific time period of receiving the investment, and documents evidencing the issuance of shares must also be submitted within 14 days of shares being issued to the foreign investor. • Foreign companies are **permitted to establish wholly-owned subsidiaries** in Bangladesh. Such companies may be established as a private limited or public limited company. Foreign equity ownership may be up to 100% in most sectors including construction, information technology and development. Foreign entities may acquire an existing Bangladeshi company or incorporate a new company complying with the requirements of the Registrar of Joint Stock Companies and Firms (RJSC). Subsidiaries are allowed to remit dividends declared on after-tax profits. • As with wholly-owned subsidiaries, foreign companies **may incorporate joint venture companies** with Bangladeshi partners. The equity ownership of the foreign company will depend on the sector being invested in. • Foreign companies can also set up a presence in Bangladesh through a representative office, liaison office or branches. Usually, foreign companies that do not have local earnings in Bangladesh may choose to set up representative, liaison offices or branches.

	The activities of these entities are restricted to those outlined in their approvals from the BIDA and they are required to adhere to the foreign exchange regulations stringently. Generally, no outward remittance of any kind from Bangladesh is allowed unless specifically permitted by the foreign exchange regulations of Bangladesh Bank. Such offices are required to bring inward remittance at least USD 50,000 within two months from the date of setup as establishment cost. • One of the required approvals for setting up is **that security clearance has to be obtained from the Ministry of Home Affairs**, Government of Bangladesh. • Foreign investors are free to invest in local companies in Bangladesh unless specifically prohibited (as mentioned above). Shares may also be issued to foreign investors against capital machinery brought into Bangladesh by them (subject to confirmation by the Customs and Excise authority of the import documents)
Regulatory Authorities	• Bangladesh Energy Regulatory Commission • All solar rooftop PV projects as may be approved by **SREDA (Sustainable and Renewable Energy Development Authority)** shall be eligible for availing Feed-in Tariff to be determined as per Regulations. • FDI in the industrial or development projects requires **registration with the Bangladesh Investment Development Authority (BIDA)**
Risk and Challenges	• Absence of efficient physical infrastructure which might create an issue for Solar rooftop project • The land issue for solar park projects in Bangladesh • Bureaucratic complexity to get registered or permission. • Absence of proper investment promoting agency. • Lack of professionals and sector-specific trained manpower • Poor imposition of IP (Intellectual Property) law. • Lack of project-specific proposals in hand to attract international investment. • Non-cooperation from relevant government agencies like the Board of Investment, Police, National Board of Revenue, Environment Authority etc. • Political unrest and blockades. • Absence of standardization/quality infrastructure in the home. • Absence of technology infrastructure. • Corruption. • Differential treatment with the change of government. • Lack of administrative coordination among different government bodies. • Delay to get services from support organizations

PARAMETERS	• SRI LANKA AIRPORT
Recorded Solar Irradiation	• 4.7kWh/ m2 per day
Double Taxation	• It has signed a bilateral double tax avoidance agreement (DTAA)
Authority	• Board of Investment (BOI) is the central facilitation point for the foreign investor. • It provides assistance and advice throughout the investment process from the initial point of inquiry through project approval, implementation, monitoring and aftercare facilities
Land Restrictions	• Foreigners/Foreign companies with foreign shareholding over 49% prohibited to purchase land on an outright basis.
National RE Targets	• Over the next 20 years, 200MW mini-hydro, 1.23GW solar, 1.21GW wind and 80MW biomass is to be added to the system • **Target:** 115 MW of solar power plants by 2020
SRI LANKA ROOFTOP SOLAR INCENTIVE POLICY	• It "Soorya Bala Sangramaya" (Battle for solar energy) program in 2016 to incentivize the deployment of rooftop solar systems. The program offers net-metering as well as 20-year feed-in tariffs if production exceeds consumption at 22 Sri Lankan rupees (14.11 U.S. cents)/ kWh for the first seven years, and 15.5 rupees thereafter. • Rooftop solar capacity reached 74MW in August 2017. • The Ministry of Power and Renewable Energy launched the scheme in collaboration with *Sri Lankan Sustainable Energy Authority*, *Ceylon Electricity Board and Lanka Electricity Company*. The target is to reach 200MW of rooftop solar by 2020 and 1,000MW by 2025 while expanding to cover 1 million households. • There are three options on offer for rooftop solar: ○ **Net-metering:** Consumer has to pay only for the net electricity consumed. Excess production can be carried forward for up to 10 years. ○ **Net accounting**: Excess production from the rooftop panel is paid at the above-mentioned rates. ○ **Net plus:** The total electricity generated by the rooftop system is purchased by the utility at the above-mentioned rates. The bill for electricity consumption is paid to the utility as usual. • Households installing solar have access to concessionary loans. • The Asian Development Bank approved a $50 million loan for Sri Lanka to help fund 50MW of rooftop solar in September 2017. • In the budget for 2018, the government announced a loan scheme with a subsidized **interest rate of 8%** for the generation of solar power by individuals and companies for their use. • In January 2017, the Public Utilities Commission of Sri Lanka directed Ceylon Electricity Board and Lanka Electricity Company to connect domestic **rooftop plants to the national grid** within two weeks from the date of application.

SRI LANKA SOLAR AUCTIONS POLICY	• Sri Lanka is moving away from feed-in tariffs to competitive bidding for solar projects of up to 10MW. The auction process is anchored by the Ceylon Electricity Board, which is also the off-taker of power from the projects. Winners of the bidding process for the 90MW solar plan – comprising 90 small solar projects of 1MW each – will be announced in 2H 2018. • The 90 plants are being offered on a build-own-operate basis for 20 years under Soorya Bala Sangramaya Phase II. The maximum tariff has been set at 18.37 Sri Lankan rupees per kWh (11.80 U.S. cents), with no escalation allowed. • Another project to be tendered soon - the 10MW Polonnaruwa project - will also be on BOO basis. • As per the bid guidelines, the project should be commissioned within 12 months of signing the power purchase agreement.
Exchange Rate and Inflation	• **Inflation - 6.5%** • **Exchange Rate -** 1 Sri Lankan Rupee = 0.0057 United States Dollar
Sovereign Guarantee	• **Bilateral investment protection agreement treaties (BITs)** provide good standards of FDI treatment and protection and guarantee investor protection against nationalization, expropriation or restrictions that amount to constructive expropriation, except for a public purpose, and in such an event they guarantee "prompt, adequate and effective compensation" based on the market value of expropriated property before the expropriation was affected or such an eventuality became public knowledge • Article 157 of Sri Lanka's constitution guarantees the safety of investment protection treaties and agreement. It has signed bilateral Investment Protection Agreements (IPA) with India. • It is a member of the **Multilateral Investment Guarantee Agency**
Political Stability	• In 2017, it was -0.6 which was low
Ease of doing Business	• Sri Lanka is ranked 100 among 190 economies in the ease of doing business, according to the latest World Bank annual ratings.
Terrorism Index	• Terrorism Index in Sri Lanka increased to 4.05 in 2017 from 2.91 in 2016.
Credit Rating	• S&P B stable • Fitch B stable • Moody's B2 stable
Taxation	• **Corporate Tax Rate** (%)- 28 • **Personal Income Tax Rate** (%)- 16
FDI Laws	• An overseas company operating a place of business such as a branch office, project office, or other similar office are required to invest a minimum of USD 200,000 (or an equivalent amount in other designated foreign currencies), channelled through an IIA. Further, the proof of such remittance should be given to the Department of Registrar of Companies within thirty days (30) of registration of the overseas company.

	• Granted general permission to hold up to 100% of the issued share capital of Sri Lankan companies
Electricity Regulatory Authorities	• CEYLON ELECTRICITY BOARD
Risks and Challenges	• Political and Economic uncertainties worry investors. Sri Lanka's sizable external debt and twin current and fiscal account deficits signal very weak macroeconomic fundamentals. • A weak judiciary continues to undermine property rights, and perceived corruption is debilitatingly high.

PARAMETERS	• NEPAL
Recorded Solar Irradiation	• 4.7kWh/ m2 per day
National RE Targets	• 2.1GW of solar by 2030
Average Solar Energy Potential	• The commercial potential of solar power for grid connection estimated to be 2,100 MW.
Exchange Rate and Inflation	• **Inflation**- 5.3% • **Exchange Rate**- 1USD= 111.62 Nepalese Rupee
Bilateral Investment Promotion and Protection Agreement	• Agreement between the Government of Nepal and the Government of India for the Promotion and Protection of Investment Since 2011. • It has covered the provision which provides compensation to the investors whose investments suffer losses due to war, armed conflict and a state of national emergency.
National Treatment	• Industries established with foreign investment are entitled to enjoy all the facilities and incentives including income tax facilities as provided to the local investors.
Competent Authority (Regulator)	• **Nepal Electricity Authority (NEA)**, Ministry of Energy for FDI in Energy Generation with 100% allowable ownership.
Land Ownership	• Foreign individuals are not permitted to acquire property, but foreign companies can purchase and own land in Nepal.
Sovereign Guarantee	• By Member of Multilateral Investment Guarantee Arrangement (MIGA) of the World Bank Group.
Political Stability	• Low
Ease of doing Business	• Nepal is ranked 110 among 190 economies in the ease of doing business, according to the latest World Bank annual ratings.
Terrorism Index	• Terrorism Index in Nepal increased to 5.30 on a scale of 10 in 2017 from 4.39 in 2016. Terrorism Index in Nepal averaged 5.64 from 2002 until 2017, reaching an all-time high of 6.86 in 2004 and a record low of 4.39 in 2016.
Corruption Index	• Nepal scored 31 points out of 100 on the 2018 Corruption Perceptions Index reported by Transparency International. • Highly Corrupt
Credit Rating	• It is generally used as a live indicator of sovereign risk. Currently, **Nepal** ranks 135 (15 points up in ranking in the recent quarter) with a **score** of 31.89, which falls under the ECR Tier 5 category and corresponds to **credit rating** of D to B- (in other words, between high default risk and highly speculative)
Taxation	• Sales Tax Rate- 15.00%
Taxation System	• Hydro, solar and bioenergy operators that start generating by mid-April 2024 receive **100% corporate tax exemption for the first 10 years** and **50% for five years after that.** • Import duty reductions and exemptions are available under the country's 2015-2016 (and previous) customs tariffs. These include only **1% customs duty for a range of solar**, biogas and wind

	energy equipment, and the full exemption for components of electric vehicles. • **<u>0% VAT</u>** facility based on a recommendation from AEPC for batteries produced and supplied by Nepalese industries for use in solar energy-producing industries.
FDI Laws	• Foreign investors are allowed 100% ownership of a company in almost all sectors • Repatriation of capital and profits to the investor's home country is allowed • IBN providing a one-window service for foreign investors. • If the foreign investment capital is less than NPR 2 billion (approx. USD 20 million), the Director-General of the Department of Industry (DOI) has the authority to approve the project. • If the investment amount is NPR 2–10 billion (approx. USD 20–100 million), the Industrial Promotion Board, chaired by the Minister of Industry, has the authority to grant foreign investment approval • The projects IBN (Investment Board Nepal) is mandated to manage the construction of international and regional airports and the modernization and management of existing airports etc. • In the case of projects that are not put up for competitive bidding, direct negotiation with IBN is possible
Regulatory Authorities	• Nepal Electricity Authority (NEA)
Risk and Challenges	• Unstable Political Climate and Low Rate of Return. • Less Solar Potential and Bad Weather condition will be a challenge for Solar Projects • A burdensome approval process and a lack of transparency are other impediments. • Property rights are undermined by an inefficient judicial system that is subject to substantial corruption and political influence.

Definition

- **Solar irradiation** is the sun's radiant energy incident on a surface of unit area, expressed in units of kWh/m2.
- Solar irradiance is called solar irradiation, solar exposure, solar insolation.
- **SAZ** - Self Administered Zones and **SAD** - Self Administered Divisions
- **DTA**- Double Taxation Avoidance Treaty
- **MIC** permit - Myanmar Investment Commission
- **MIGA**- Multilateral Investment Guarantee Agency
- **ADB**- Asian Development Bank
- **BIPA**- Bilateral Investment Promotion Agreement
- **DTT**- Double Taxation Treaty
- **BIPPA**- Bilateral Investment Protection and Promotion Agreement (for compensations to investors whose investment suffers losses due to war or any national emergency)
- **IBN**- Investment Board Nepal (Mandated to manage construction at airports)
- **DOI**- Department of Industry (Depends upon the amount of investment)
- **BIDA**- Bangladesh Investment Development Authority (Also provides facilities and assistance)
- **Expropriation**- action by the state or an authority of taking property from its owner for public use or benefit.
- **BOI**- Board of Investment
- **CEB**- Ceylon Electricity Board
- **SREDA**- Sustainable and Renewable Energy Development Authority
- **Credit Rating**- Live Indicator for Sovereign Risk
- **Corruption Index** -**0 (highly corrupt) to 100 (very clean)-** The Corruption Perceptions Index ranks countries and territories based on how corrupt their public sector is perceived to be.
- **Political Stability Index** - **(-2.5 weak; 2.5 strong)**: The index of Political Stability and Absence of Violence/Terrorism measures perceptions of the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means, including politically-motivated violence and terrorism. The index is an average of several other indexes from the Economist Intelligence Unit, the World Economic Forum, and the Political Risk Services, among others.
- **Ease of doing business index-(1-20 (Simpler Regulations))** ranks countries against each other based on how the regulatory environment is conducive to business operation stronger protections of property rights. Economies with a high rank (1 to 20) have simpler and more friendly regulations for businesses

FINAL RESULTS AND OUTCOMES

Parameters	Myanmar	Bangladesh	Sri-Lanka	Nepal
Recorded Solar Irradiation	More than 5 kWh/m2 /day	4.51-4.99 kWh/m2/day	4.7kWh/ m2 per day	4.7kWh/ m2 per day
DTA Treaty	Yes	Yes	Yes	Yes
Investment Protection Treaty	Yes (Only under MIC permit)	Yes (Protection from Nationalization and Expropriation under BIPPA)	Yes (Under BIPA)	Yes (Under BIPPA)
Sovereign Guarantee	Yes (in form of bank guarantees) MIGA, ADB (Political risk insurance). It is regarding a payment guarantee only. No specific protection against material adverse government action.	Yes (Under MIGA)	Yes (Under MIGA)	Yes (by GoN & NEA, International Finance Corporation and ABD)
100% Ownership Allowed in Electricity Business	Yes	Yes	Yes	Yes
Land Ownership Allowed	Only through Lease	No restrictions	Foreign Shareholding over 49% prohibited to purchase land	Allowed to purchase and own Land
Regulatory Commission	Energy Regulatory Commission (ERC)	BERC	PUC (Public Utility Commission	NERC
Authority to take permission to engage in Electricity generation related work	MOEP, Regional and State government and SAZ and SAD leading bodies	DOE, SREDA	CEB (Ceylon Electricity Board)	NEA (Nepal Electricity Authority)
Concerned Authority for FDI	MOEP (for concession), MIC (for license), DICA (for	BIDA (for Registration)	BOI	IBN (for construction

	Company Registration)			of airport), DOI
Political Stability Index	-1.08 (Weak)	-1.15 (Unstable)	-0.6 (Weak)	-0.66 (Weak)
Corruption Index (/100)	29 (Highly Corrupt)	26 (Highly Corrupt)	38 (Highly Corrupt)	31 (Highly Corrupt)
Inflation	6.50%	5.52%	6.5%	5.3%
Ease of Doing Business Rank among 190 countries	171 (Difficult)	176 (Difficult)	100 (Less Difficult)	110 (Less Difficult)
Credit Rating	likely to be rated between 'B' and 'BBB' (Stable)	BB- (Stable)	B (Stable)	D to B- (High default Risk)

III. STUDY OF CERC TARIFF REGULATIONS AND DEVELOPING FINANCIAL MODEL FOR TARIFF DETERMINATION

This part of the report deals with the development of a financial model for tariff determination for Solar Energy which is ultimately used by NVVN for competitive bidding and Power Purchase Agreement for different Solar Projects.

Sources Referred for Development of a financial model

- CERC tariff regulation document for RE
- MERC tariff regulation document for RE etc

Software Used

- EXCEL

This part of the report covers about

- Solar Rooftop System
- Components required for Solar Power Plant,
- Cost Estimation of Solar Power Plants,
- Business Models for Solar Rooftop installation and
- Financial Modelling for tariff determination, finding IIR, payback period, Sensitivity Analysis

> **What is a Solar Rooftop System?**

- In a solar rooftop system, the solar panels are installed on the roof of any residential, institutional, social, Government, commercial, industrial buildings etc. This can be of two types
  (i) Solar Rooftop System with storage facility using a battery, and
  (ii) Grid Connected Solar Rooftop System.

> **What is a Grid Connected Solar Rooftop System?**

- In grid-connected rooftop or small SPV system, the DC power generated from SPV panel is converted to AC power using power conditioning unit/Inverter and is fed to the grid either of 440/220 Volt three/single phase line or of 33 kV/11 kV three-phase lines depending on the capacity of the system installed at residential, institution/commercial establishment and the regulatory framework specified for respective States. These systems generate power during the day time which is utilized by powering captive loads and feed excess power to the grid as long as the grid is available. In case, where solar power is not sufficient due to cloud cover etc., the captive loads are served by drawing balance power from the grid.

> **What are the main components?**

- **Solar PV Modules/Solar Panels** – The Solar PV modules/Solar Panels convert solar energy to electrical energy. They are available in different technologies such as crystalline, thin film, CIGS, CdTe, HIT, etc. Crystalline Solar PV panels are most common in use on rooftops.
- **Inverter** – Inverter converts DC output of Solar PV panels into AC power.
- **Mounting structure** – The mounting structure, is the support structure that holds the Solar PV panels
- **Balance of System** – These consist of cables, switchboards, junction boxes, meters, structures, tracking system (if required), earthing system, circuit breaker, fuses etc.

> **What are the models for the implementation of Rooftop PV systems?**

- **CAPEX Model**: Here, the entire system is owned by the rooftop owners and he bears the cost of the Solar system.
  Responsibility of O&M for the system lifetime (25 years) is also with the rooftop owner. A developer is responsible for installing the system and initial 2 years O&M and five years warranty.
- **RESCO Model**: Here, the entire system is owned by the developer.
  Responsibility of O&M for the system lifetime (say about 25 years) is also with the developer. Rooftop owners may consume the electricity generated, for which they have to pay a pre-decided tariff every month. Excess generation may be exported to the grid, subject to availability of requisite state regulations.

> **Which model is best for the consumer?**

- For consumers that have adequate manpower/expertise for O&M, rooftop access concerns, availability of funds upfront, CAPEX model is better.
- Consumers in states that have net metering regulations can take benefit of the same in case they have substantial excess generation.
- On the other hand, consumers who prefer not to take responsibility for the system O&M, do not have rooftop security concerns and prefer to pay every month rather than bulk upfront payment may choose to go for RESCO model.

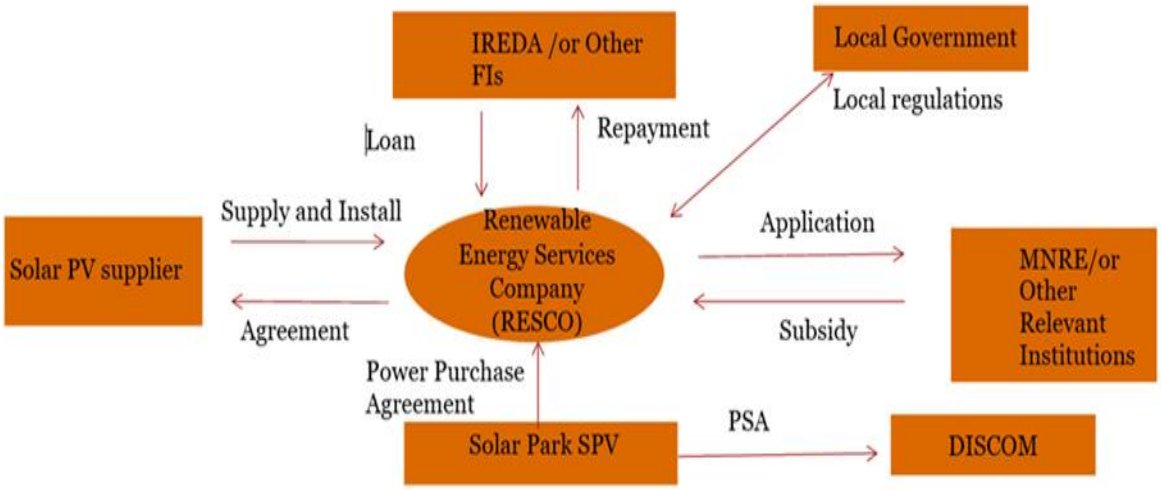
Benefits under RESCO mode:

- RESCO Model is different from CAPEX model where the entire system is owned by the developer. Rooftop owners consume the electricity generated, for which they must pay a pre-decided tariff monthly. Thus, for consumers, it is a low-cost intensive option as compared to CAPEX model where the entire system is owned by the rooftop owners.
- RESCO Solar model has experts in the field, the system runs efficiently for longer duration and results in the incremental generation as compared to CAPEX model.
- To meet the goal of Rooftop capacity, in some special category states up to 70% subsidy is given to RESCO solar developers. Since the cost of solar panels fluctuates drastically due to uneven demand, customers are reluctant to opt for CAPEX model. Therefore, Resco model is better than Capex

Capex Agreement /PPA:

- In the case of CAPEX mode, the agreement is signed between the beneficiary/customer and the project developer/installer.
- In case the beneficiary want to install the system in RESCO mode (i.e. investment is made by the project developer), a long term Power Purchase Agreement needs to be signed between RESCO project developer and the beneficiary (say up to 25 Years) agreeing to the tariff at which the power will be procured by the beneficiary from the project developer which need to be determined by bidding process by the State Nodal Agency.

RESCO mode


IREDA /or Other FIs
Local Government
Local regulations
Loan
Repayment
Supply and Install
Solar PV supplier
Renewable Energy Services Company (RESCO)
Application
MNRE/or Other Relevant Institutions
Agreement
Subsidy
Power Purchase Agreement
Solar Park SPV
PSA
DISCOM

DEFINITIONS

Levelised tariff:

- Levelised tariff is the Sum of the Present value of all the tariff calculated over the tariff period w.r.t. the inception of the project upon the sum of the discount factors.
- **Levelised Tariff**: (Sum of P.V of Tariff over the life of the plant)/Sum of Discount Factors

CUF/ PLF:

- It is the ratio of actual energy generated, to the energy the plant would have generated if it was operating at its maximum capacity. It is given as a percentage and is usually calculated for a period of one year.
- **CUF/PLF:** (100* Energy Generated in a year)/Maximum energy generated in a Year

Discount factor:

- The discount factor is the factor by which a future cash flow must be multiplied to obtain the present value.

Debt-Equity Ratio:

- It is the ratio of debt and equity employed in any business. It is a measure of a company's financial leverage calculated by dividing its total liabilities by stockholders' equity. It indicates what proportion of equity and debt the company is using to finance its assets.
- **D/E Ratio:** Total Long-Term Loan/Owner's equity

Net Present Value:

- The difference between the present value of cash inflows and the present value of cash outflows. NPV is used in capital budgeting to analyze the profitability of an investment or project. NPV analysis is sensitive to the reliability of future cash inflows that an investment or project will yield.
- **NPV = $\sum F_n$ / [(1 + i) ^n] – F_o**

Internal Rate of Return:

- The discount rate often used in capital budgeting that makes the net present value of all cash flows from a particular project equal to zero. Generally speaking, the higher a project's internal rate of return, the more desirable it is to undertake the project.

Return on Equity:

- The amount of net income returned as a percentage of shareholders equity. Return on equity measures a corporation's profitability by revealing how much profit a company generates with the money shareholders have invested. It is expressed as a percentage of the total equity investment in the project.
- **RoE**: Net Income/Shareholder's Equity

Financial Analysis and Considerations:

Project Finance:

- Project Finance is long term financing of infrastructure and industrial projects based on projected cash flows of the project rather than the balance sheet of the project sponsor.
- Usually, a project financing structure involves several equity investors, known as sponsors or promoters, as well as a syndicate of banks or other lending institutions that provide loans to the operation.
- The loans are most commonly non-recourse loans, which are secured by the project assets and paid entirely from project cash flow, rather than from the general assets or creditworthiness of the project sponsors, a decision in part supported by financial modelling.
- The financing is typically secured by all of the project assets, including the revenue-producing contracts. Project lenders are given a lien on all of these assets and can assume control of a project if the project company has difficulties complying with the loan terms.
- Generally, a special purpose entity is created for each project, thereby shielding other assets owned by a project sponsor from the detrimental effects of a project failure.
- As a special purpose entity, the project company has no assets other than the project.
- Capital contribution commitments by the owners of the project company are sometimes necessary to ensure that the project is financially sound, or to assure the lenders of the sponsors‟ commitment.
- Project finance is often more complicated than alternative financing methods.
- Traditionally, project financing has been most commonly used in the extractive (mining), transportation, telecommunications and energy industries.
- More recently project financing principles have been applied to other types of public infrastructure under the public-private partnerships (PPP)

- Project finance models are usually built as Excel spreadsheets and typically consist of the following interlinked sheets
  - ✓ Data Input Sheet
  - ✓ Capital Cost Sheet
  - ✓ Assumption Sheet
  - ✓ Determination of Tariff Sheet
  - ✓ Interest on debt Calculation Sheet
  - ✓ Profit & Loss Statement Sheet
  - ✓ Cash flow, Payback and IRR Calculation Sheet

Terminologies:

CAPITAL COST

- Capital expenditure or CAPEX is the amount of money spent on a project before it gets operational. All expenses incurred for the project like design, engineering, procurement, construction, installation, commissioning, duties and taxes etc. contribute to capital expenditure. It composes a Debt and an Equity component.

DEBT

- It is the total amount of Long-term fixed liabilities. Generally, a bank or a Financial institute Issues debenture to the developing party for a fixed period (maturity period) at a fixed rate of interest.

EQUITY

- Equity is the amount of owner's share capital put up in the total capital cost.

DISCOUNT RATE

- The interest rate used in discounted cash flow analysis to determine the present value of future cash flows. The discount rate takes into account the time value of money.

PROFIT & LOSS STATEMENT

- An accounting sheet that displays the flow from total earnings to earnings after tax or the actual earnings of the company

O&M EXPENSES:

- The annual fixed cost incurred for maintenance, repairs and operation of the plant. A Normative O&M Expense is taken with a certain escalation price. Escalation price is an assumed per annum percentage increase in the O&M costs.

FINANCIAL MODELLING

- The process by which a firm constructs a financial representation of some, or all, aspects of the firm or given security. The model is usually characterized by performing calculations and makes recommendations based on that information. The model may also summarize particular events for the end-user and provide direction regarding possible actions or alternatives.

- Financial Indicators Used in the Model:
  - ✓ Internal Rate of Return
  - ✓ Payback Period
  - ✓ Net Present Value Calculation

- Purpose of Financial Models:
  - ✓ to demonstrate the size of the market opportunity
  - ✓ to explain the business model
  - ✓ to show the path to profitability
  - ✓ to quantify the investment requirement
  - ✓ to facilitate the valuation of the business

- Basic Idea behind Building a financial model is to answer the following questions:
  - ✓ Determination of tariff for Power Purchase agreements for Solar Project.
  - ✓ Also, to know the volatility of the project viz. what changes would occur in the tariff, in earnings, in Cash flow if we certain variables factors change.

(*Note:* The Components for calculation of tariff in a solar project has been taken as per the CERC guidelines.)

- Components are based on Single part Tariff and compose only of the fixed.
  - ✓ O & M expenses
  - ✓ Depreciation
  - ✓ Interest on Loan
  - ✓ Interest on Working Capital
  - ✓ Return on Equity

- All the above except Return on Equity are costs incurred by the developer and thus are included in the tariff. RoE gives a picture of the profit margin of the developer.

ASSUMPTIONS AND INPUT DATA

(Most of the Assumptions which has been taken into consideration while building the model has been taken as per the CERC Guidelines and some common practices by NTPC)

Terminologies:

- **SOLAR PV POWER:** means the Solar Photo Voltaic power project that uses sunlight for direct conversion into electricity through Photo Voltaic technology.

- **TARIFF PERIOD:** the period for which tariff is to be determined by the Commission based on norms specified under these Regulations.

- **CONTROL PERIOD:** the period during which the norms for determination of tariff specified in these Regulations shall remain valid;

- **INSTALLED CAPACITY:** the summation of the nameplate capacities of all the units of the generating station or the capacity of the generating station (reckoned at the generator terminals), approved by the Commission from time to time

PETITION AND PROCEEDINGS FOR DETERMINATION OF TARIFF

- The Commission shall determine the generic tariff based on Suo Motu petition at least six months in advance at the beginning of each year of the Control period for renewable energy technologies for which norms have been specified under the Regulations.
- Notwithstanding anything contained in these regulations, the generic tariff determined for Solar PV projects based on the capital cost and other norms applicable for any year of the control period shall also apply for such projects during the next year
- Provided the PPAs in respect of the Solar PV projects as mentioned in this clause is signed on or before last day of the year for which generic tariff is determined and the entire capacity covered by the PPAs is commissioned on or before 31st March of the next year in respect of Solar PV projects.

TARIFF STRUCTURE

- The tariff for Solar PV Technologies shall be single part tariff consisting of the following fixed cost components:
  - ✓ Return on equity;
  - ✓ Interest on loan capital;
  - ✓ Depreciation;
  - ✓ Interest on working capital;
  - ✓ Operation and maintenance expenses;

Financial Principles

CAPITAL COST

- The norms for the Capital cost as specified in the subsequent technology-specific chapters shall be inclusive of all capital work including plant and machinery, civil work, erection and commissioning, financing and interest during construction, and evacuation infrastructure up to interconnection point.

DEBT TO EQUITY RATIO

- For generic tariff to be determined based on Suo-Motu petition, the debt-equity ratio shall be 70:30.
- **For Project-specific tariff, the following provisions shall apply:** - If the equity deployed is more than 30% of the capital cost, equity over 30% shall be treated as a normative loan. Provided that where equity deployed is less than 30% of the capital cost, the actual equity shall be considered for determination of tariff, provided further that the equity invested in foreign currency shall be designated in Indian rupees on the date of each investment.

INTEREST RATE

- The normative loan outstanding as on April 1st of every year shall be worked out by deducting the cumulative repayment up to March 31st of the previous year from the gross normative loan.
- For the computation of tariff, the normative interest rate shall be considered as average State Bank of India (SBI) Base rate prevalent during the first six months of the previous year plus 350 basis points.
- Notwithstanding any moratorium period availed by the generating company, the repayment of loan shall be considered from the first year of commercial operation of the project and shall be equal to the annual depreciation allowed.

DEPRECIATION

- According to Regulation 15 of the RE Tariff Regulations provides for computation of depreciation in the following manner:
  - "(1) The value base for depreciation shall be the Capital Cost of the asset admitted by the Commission. The Salvage value of the asset shall be considered as 10% and depreciation shall be allowed up to a maximum of 90% of the Capital Cost of the asset.
  - (2) Depreciation per annum shall be based on 'Differential Depreciation Approach' over loan period beyond loan tenure over useful life computed on 'Straight Line Method'. The depreciation rate for the first 12 years of the Tariff Period shall be 5.83% per annum and

the remaining depreciation shall be spread over the remaining useful life of the project from 13th year onwards.

- (3) Depreciation shall be chargeable from the first year of commercial operation. Provided that in case of commercial operation of the asset for part of the year, depreciation shall be charged on pro-rata basis".

ACCELERATED DEPRECIATION

- For Projects availing the benefit of accelerated depreciation, the applicable Corporate Income Tax rate of 34.61% (30% Income Tax rate + 12% surcharge + 3% Education Cess) has been considered. As per the Circular dated 7 November 2016 of the Income Tax Department, the accelerated depreciation rates have been revised to 40% for FY 2017-18.
- For determining the net depreciation benefits, depreciation @ 5.28% as per the Straight-Line Method (book depreciation as per Companies Act, 2013) has been compared with depreciation as per the Income Tax Act, i.e., 40% under the Written Down Value Method. Moreover, an additional 20% depreciation in the initial year is proposed to be extended to new assets acquired by Generation Companies vide amendment to Section 32 (1) (ii-a) of the Income Tax Act.
- Depreciation for the first year has been computed at the rate of 100% of 40%, and 100% of the AD of 20%, assuming the Project to be capitalized for the full financial year as per the *CERC for FY 2017-18* second proviso to Regulation 24.
- The tax benefit has been worked out as per the Corporate Income Tax rate on the net depreciation benefit. The 'per unit levelised accelerated depreciation benefit' has been computed considering the weighted average cost of capital as a discounting factor, as detailed in para 1.6 of this Order. The detailed computation of benefit of accelerated depreciation in respect of each RE technology has been covered under the technology-specific Sections.

MAT & TAX BENEFIT

- As per IT Rule, the Solar project developing companies like any other company is liable to pay Minimum Alternative Tax (MAT). A solar financial model should cover calculation of corporate tax, MAT, MAT credit available and MAT credit utilized over 25 years of the project life cycle.

RETURN ON EQUITY

- The value base for the equity shall be 30% of the capital cost or actual equity (in case of project-specific tariff determination)

INTEREST ON WORKING CAPTIAL

- ✓ Operation & Maintenance expenses for one month.
- ✓ Receivables are equivalent to 2 (Two) months of energy charges for the sale of electricity calculated on the normative CUF.
- ✓ Maintenance spare @ 15% of operation and maintenance expenses

DISCOUNT RATE CALCULATION

- Discounting factor is calculated by incorporating the new MAT rate for initial 10 years and then new Income Tax rate for the rest of the years, as follows: **{(Interest on loan * Debt Ratio % * (1-Income Tax) + (RoE % * Equity Ratio %)}**

O&M EXPENSES

- Operation and Maintenance or O&M expenses" shall comprise repair and maintenance (R&M), establishment including employee expenses and administrative & general expenses.
- Operation and maintenance expenses shall be determined for the Tariff Period based on normative O&M expenses specified by the Commission subsequently in these Regulations for the First Year of Control Period.
- Normative O&M expenses allowed during the first year of the Control Period (i.e. FY 2017-18) under these Regulations shall be escalated at the rate of 5.72% per annum over the Tariff Period.

FINANCIAL MODELLING

- Financial Modelling of the project has been done considering assumptions after data collection and is contained in the accompanying Excel file.

- Modelling was done on Excel worksheet utilizing various tools and formulas of excel. Most of the data is soft coded and hard coding is limited to a bare minimum. The first sheet is the Input sheet, where the peach coded cells denote the variable input cells, changing which would change the model's result.

- The Sheets included in the Model are
  - ✓ Data Input Sheet
  - ✓ Capital Cost Sheet
  - ✓ Assumption Sheet
  - ✓ Determination of Tariff Sheet
  - ✓ Interest on debt Calculation Sheet
  - ✓ Profit & Loss Statement Sheet
  - ✓ Cash flow, Payback and IRR Calculation Sheet
  - ✓ Sensitivity Analysis

INPUT SHEET

Tender Participation+ Processing Cost		Rs Lacs	1
Insurance Premium Cost		% Of CAPEX	0.35%
BG Cost		Rs Lacs	0

INPUT PARAMETER				RANK
Capacity Installation		MW	1	
Capacity Utilization Factor		%	13.5	1
Degradation factor/year		%	0.7%	
Technical Loss/Year		%	0.0%	
Subsidy		%	0%	
Capital Cost/MW		Rs Lacs/MW	350	2
O&M Expenses/MW		Rs Lacs/MW	4	
O&M Expenses Escalation		%	5.72	
Total Land Lease Payment/year		Rs Lacs	0	
INFLATION (For Land+O&M+Insurance)		%	0%	
Debt		%	80	3
Repayment Period (Including Moratorium) Interest		Years	13	
Rate		%	9.5	4
Pre-Tax ROE for the first 10 years	10	% p.a	17	
Pre-Tax ROE from 11th year onwards	15	%p.a	22	
Weighted Average of Post Tax ROE		%	14.0%	5
Plant Capitalized in the 2nd half of the 1st Year (YES/NO)			NO	

Levelized Tariff	4.41 Rs/Unit
Revenue/year	52.17 Lakh Rs/Year

Levelized Tariff with AD	4.00 Rs/Unit
Revenue/year with AD	47.30 Lakh Rs/Year

	Project IRR	Equity IRR
CERC Tariff	9.34%	9.85%
CERF Tariff with AD	9.58%	10.79%

CAPITAL COST SHEET

Particulars	Capital cost norm proposed for (Rs. Lakh/MW), for Solar PV projects
PV modules	210
Land Upfront Cost	0
Civil and General Work	30
Mounting Structure	35
Power Conditioning Unit	25
Evacuation Cost up to Interconnection Point (Cables and Transformers	30
Preliminary and Pre-Operative Expenses including IDC and Contingency	20
Total Capital Cost (Lakh/MW)	**350**
Insurance charges are typically 0.15% of BOOK VALUE, modelled every year throughout the lifetime of the plant with no escalation.	
Tender Participation+ Processing Cost	1
Total project cost (Lakh/MW)	**351**
BG Cost	0.00
Total Cost (Lakh/MW)	**351.00**
O&M cost (Lakh/MW)	4

ASSUMPTION SHEET

Sub-Head	Sub-Head (2)	Unit	Assumptions
Capacity	Installed Power Generation Capacity	MW	1
	Auxiliary Consumption	%	0.00%
	Capacity Utilization Factor	%	13.5
	Degradation factor/year	%	0.7%
	Technical Loss/Year	%	0.0%
	Useful Life or (Tariff Period)	years	25
Capital Cost/MW	Subsidy	%	0%
	Power Plant Cost	Rs Lacs	351.00
	Power Plant Cost after subsidy	Rs Lacs	351.00

Debt: Equity		%	
	Debt	%	80
	Equity	Rs	20
	Total Debt	Lacs	280.8
Debt Component	Amount Total	Rs	70.2
	Equity Amount	Lacs	
	Loan Amount	Rs	280.8
	Moratorium Period	Lacs	0
	Repayment Period(Including Moratorium)	Years	**13**
Equity Component	Interest Rate	Years	**9.5**
PRE-TAX ROE		%	
	Equity Amount		70.2
10	**Return on Equity for first 10 years**	Rs Lacs	**17**
15	**Return on Equity 11th year onwards**	% p.a	**22**
	Weighted Average of ROE	%p.a	**20**
		%	
	Weighted Average POST TAX ROE	%	**14%**
	Discount Rate for 10 years	%	**8.63%**
	Discount Rate for the rest of the years	%	**7.85%**
	Weighted Average Discount Rate	%	**8.16%**
	Annuity factor for plants life	%	**10.12**

Fiscal Assumptions			
	Income Tax	%	34.61%
	MAT Rate	%	21.55%
	80 IA benefits	Yes/No	
	DEPRECIABLE AMOUNT	**90%**	**315.9**
Depreciation (Salvage Value 10 per cent)	Depreciation Rate for first mentioned periods	%	5.83
	Depreciation Rate year onwards	%	1.18
	Plant&Machinery Income Tax Depreciation		15%
For Fixed Charges			
O&M Charges		Months	1
Maintenace		%	15
Spare Receivables for Debtors	(% of O&M Expenses)	Months	2

For Variable Charges		%	
Interest on working capital			11.00
O&M Expenses **O&M Expenses Escalation**		Rs Lacs %	**4** **5.72**
Levelized FIT	5	MW	7.06
The tariff set via the bidding process	more than 5	MW	6
	Tax Holiday Start Year **Tax Holiday** **Duration MAT** **Setoff Start Year** **MAT set off allowed u/s 115JAA (3A)** **MAT Setoff Duration**	Years Years Years Years Years	**1** **0** 16 **10** 5

NOTE: - DATA IN THE PEACH COLOURED CELLS ARE EDITABLE

Financial Analysis

Financial analysis of the project has been done considering above assumptions after data collection and is contained in the accompanying Excel file.

Link: https://drive.google.com/file/d/1EHtbLwQN2ymwNYjf-3fVmmB8UvRXJUTs/view

RESULT SHEET

	Tariff (Rs/Unit)	*Project IRR*	*NPV @ Interest Rate*	*Payback Period*	*Equity IRR*	*NPV@ InterestRate*	*Payback Period*
CERC Tariff	**4.41**	9.34%	30.11	8	9.85%	19.82	14
CERF Tariff with AD	**4.00**	9.58%	31.50	8	10.79%	21.22	14
User-Provided FIT	**7.06**	17%	254.50	5	35%	244.21	2

EMI= 3.14 Lac/Month

	CERC Tariff	CERC Tariff with AD
Subsidy	4.41	4.00
15%	3.85	3.50
20%	3.66	3.33
25%	3.47	3.16
30%	3.28	3.00
35%	3.10	2.83

CONCLUSION

- The project involves the study of CERC tariff regulation document for RE, MERC tariff regulation document for RE etc
- Financial viability of the project has been checked by calculating the Levelised tariff, profit & loss, cash flow statement, NPV and IRR.
- Levelised tariff (under the given assumptions) comes out to be Rs 4.41/kwh
- Project IRR (post-tax) comes out to be 9.34%, Equity IRR (post-tax) comes out to be 9.95%.
- It can be concluded that the development of the project is beneficial for both the developer, considering Project IRR is comparable with other projects. Thus, investing in the project would be beneficial for the lender.

REFERENCE

- https://mnre.gov.in/file-manager/UserFiles/Tentative-State-wise-break-up-of-Renewable-Power-by-2022.pdf
- https://solarrooftop.gov.in/pdf/faq.pdf
- http://www.cercind.gov.in/2016/orders/SORE.pdf
- http://pvcalc.org/global-irradiation-map
- http://visionofhumanity.org/indexes/terrorism-index/
- https://www.heritage.org/index
- http://global-climatescope.org/policies
- https://www.duanemorris.com/site/static/powering_myanmar_forward.pdf
- http://www.vdb-loi.com/wp-content/uploads/2017/09/The-Legal-and-Regulatory-Framework-of-Foreign-Investment-in-Myanmar%E2%80%99s-Power-Sector.pdf
- https://www.investingmyanmar.com/blog/guide-for-foreign-investors-seeking-to-invest-in-the-myanmar-power-sector
- https://www.jica.go.jp/priv_partner/case/field/ku57pq00002azzsvatt/invest_mya_env03.pdf
- http://www.myanmar-embassy-tokyo.net/2018/Doc/InvestmentGuide.pdf
- https://www.infrastructureasia.org/en/projects/sembcorp-myingyan-power-plant
- https://www.stockbiz.vn/Handlers/DownloadReport.ashx?ReportID=8613
- https://assets.kpmg/content/
- https://www.ey.com
- https://www.pwc.com
- https://www.eurocham-myanmar.org/uploads/686fc-eb95c-business-2019-draft-11-page.pdf
- https://www.adb.org/projects/48368-001/main#project-pds
- http://global-climatescope.org/policies/3969
- http://www.itd.or.th/wp-content/uploads/2018/08/21.DFDL-Bangladesh-Foreign-Investment-Guide-2018-2-1.pdf
- https://www.undp.org/content
- http://berc.portal.gov.bd/sites
- http://www.saarcenergy.org/wp-content/uploads/2016/12/Net-Metering-Final-Report.pdf
- https://www.aiib.org/en/projects/approved/2019/_download/bangladesh/document/power-system.pdf
- https://www.omicsonline.org/open-access/foreign-direct-investment-fdi-in-bangladesh-trends-challenges--recommendations-2162-6359-1000276.php?aid=58480
- https://www.sciencedirect.com/science/article/pii/S2211467X19300239
- https://uk.practicallaw.thomsonreuters.com
- https://www.bb.org.bd/investfacility/invesfac.php
- https://www.gtreview.com/news/asia/another-big-loan-signed-in-bangladeshs-power-sector/
- http://ibn.gov.np/uploads/files/
- https://energypedia.info/wiki/Nepal_Energy_Situation
- http://www.indembkathmandu.gov.in/docs/1547216794A%20hand%20Book%20for%20Indian%20Investors%202018-19.pdf