South Asia Regional Initiative for Energy Integration

Presentation on

Deepening Power System Integration & Cross Border Electricity Trade in SAARC Region: Current Status & Future Outlook

Presented by

Rajiv Ratna Panda
(Technical-Head, SARI/EI, IRADe)

SAARC Energy Centre’s Video Conference on “Roadmap for the Implementation of SAARC Framework Agreement on Energy Cooperation–Electricity (SAARC FAEC(E))
Tuesday, 22 September, 2020 from 11.30-15.00 hrs (IST).
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01 Marco Economic Growth & Economic Integration

02 Overview of South Asian Power Sector

03 Current & Future Scenario of Cross-border Electricity Trade (CBET)

04 Future Outlook for CBET

05 Enablers for accelerating CBET & Development Regional Power Market

06 SARI/EI Initiatives- Providing Actionability to articles of SAARC FAEC(E)*

07 Road Map & Action Plan

* SAARC FAEC (E) - SAARC Framework Agreement for Energy Cooperation (Electricity)
Marco-Economic Growth

&

Economic Integration of South Asia
South Asian Economic Growth Story: Dynamic & Vibrant

- South Asia: One of the most populous regions in the world
- China: 1.39 Billion (23% of the world's population)
- India: 1.35 Billion
- EU: 0.51 Billion
- US: 0.32 Billion

World: 7.5 Billion

- USA: US$ 21.43 Trillion
- China: US$ 14 Trillion
- Japan: US$ 5.15 Trillion
- Germany: US$ 3.8 Trillion
- South Asia: US$ 3.66 Trillion
- UK: US$ 2.7 Trillion

Data Source: World Bank Data Base

- USA: US$ 21.43 Trillion
- China: US$ 14 Trillion
- India: US$ 2.9 trillion
- Japan: US$ 5.15 Trillion
- Germany: US$ 3.8 Trillion
- South Asia: US$ 3.66 Trillion
- UK: US$ 2.7 trillion

Source: IMF - World Economic Outlook (October 2019)

- Real GDP Growth Annual Percent Change
- Source: World Economic Outlook (April, 2020)

South Asia: Fastest growing region in the world in recent past & expected to remain so in future

Data Source: World Bank Data Base


South Asia: One of the most populous regions in the world

China: 1.39 Billion (23% of the world's population)
India: 1.35 Billion
EU: 0.51 Billion
US: 0.32 Billion

World: 7.5 Billion

USA: US$ 21.43 Trillion
China: US$ 14 Trillion
Japan: US$ 5.15 Trillion
Germany: US$ 3.8 Trillion
South Asia: US$ 3.66 Trillion
UK: US$ 2.7 trillion

Source: IMF - World Economic Outlook (October 2019)
South Asia: Yet Least Integrated

Intra-regional Trade Share (%)
(Intra-regional trade to total trade of the region)

- **Intra-regional Trade Share (%) 2019**
  - **European**: 68.92
  - **Asia & the Pacific**: 57.36
  - **ASEAN+3**: 46.17
  - **East Asia**: 34.61
  - **North America**: 23.56
  - **Southeast Asia**: 23.37
  - **ASEAN**: 23.34
  - **Africa**: 15.88
  - **Middle East**: 14.34
  - **Latin America & Caribbean**: 14.26
  - **Central Asia**: 7.87
  - **South Asia**: 5.59

Source: The Integration Indicators Database [https://aric.adb.org/database/integration](https://aric.adb.org/database/integration). ASEAN+3 consists of the 10 ASEAN member economies, the People's Republic of China (including Hong Kong, China), Japan, and the Republic of Korea.


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Overview of South Asian Power System
South Asia Power System-Snapshot

Afghanistan
- #Very small power system (~0.6 GW)
- #High electricity imports high
- #Hydro and Oil dominated

Bangladesh
- #Mid size power system (~23 GW)
- #High gas dependence
- #Resource crunch

Bhutan
- #Small power system (~2.3 GW)
- #Large exporter of hydro power
- #Champion of hydro CBET in SA.

India
- #Very large system (~371 GW)
- #Coal dominated, RE -133 GW
- #Central to CBET in SA
- #Competitive power market (Only in SA)

Maldives
- #Fragmented & very small power systems (~4 GW)
- #Oil, Diesel dependent, Islands, Limited possibility of interconnection

Nepal
- #Very small power system (1.3 GW)
- #Underutilized hydro (82 GW)
- #Net importer of electricity now but potential to export in future

Pakistan
- #Mid sized (39 GW) power system
- #Gas and Oil dependent.

Sri Lanka
- #Small power system (~4 GW)
- #Hydro and Oil dominated
- #High peak – off peak differential

South Asia Power Sector Fuel Mix
- Fossil fuel dominance: Coal - 48%, Natural gas - 11%, Diesel - 3.9%, Total - 63.6% | RE - 19.6%, Hydro - 15.1%, Total - 34.7%

Rapid Power Capacity Addition (GW)
- Afghanistan: 190 (FY10-24 GW by 2020), Bangladesh: 2.3x (FY10-2010 to FY20), India: 443 (FY10-2010 to FY20), Pakistan: 21 GW - 2010 to 39 GW by 2020

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Yet Challenges Remain

Electricity Consumption (kWh per capita)*

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<tr>
<td>Afghanistan</td>
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<td>139</td>
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<td>red</td>
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<td>red</td>
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</table>


* Compiled from various Sources, For Afghanistan, Bangladesh, Bhutan, India, Nepal, Pakistan data is for year 2019, ASEAN-2017, World 2014, China (2017), EU-2014, OECD-2014, USA-2016, For Bangladesh, Per Capita Power generation is considered as per data available from Power Cell, ASEAN, per capita demand is considered as per data available.

Low Per Capita Electricity Consumption, Affordable and Clean Energy Challenge

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Cross Border Electricity Trade in South Asia: 
Current Status and Future Scenario
**South Asia (SA) - Cross Border Electricity Trade (MW): Current Status & Future Scenario**

**SA CBET in MUs**

- **India- Bangladesh ~1160 MW**
  - 2020
  - ~3760* MW
  - 2018
  - ~2986 MW
  - 2015
  - ~2126 MW
  - 2012
  - ~1400 MW

**Nepal-India ~ 500 MW**

- **2020**
- **~1400 MW**
- **2012**

**Bhutan-India ~2100 MW**

- **2020**
- **~3000 MW**
- **2018**
- **~2986 MW**
- **2015**
- **~2126 MW**
- **2012**
- **~1400 MW**

**Source:** Compiled from various Sources, Country Authority Websites across the Region – India-Myanmar ~ 3.5 MW of CBET, Pakistan-Iran ~ 104 MW CBET, Afghanistan- Imports around 1000 MW collectively from Uzbekistan (326 MW), Iran (164 MW), Tajikistan (77 MW) ~ India-Maximum Peak Trade (FM Modi) Inaugurated Mangdechhu hydroelectric plant, Bhutan, Aug 17, 2019

**Rapid expansion is envisaged, 43.8 GW Cross Border Grid Interconnection by 2036/2040**

- ~1400 MW
- ~2986 MW
- ~2126 MW
- ~1400 MW

**Compiled from: India connection with Bhutan, Nepal, Pakistan, Sri Lanka as per the CEA-Perspective Transmission Master Plan, Bangladesh-PSMP-2016 of Bangladesh as per the PSMP-2016 of Bangladesh ~ India-Bangladesh via India (2030) Bongaigaon/Rangia - Jamarpur
  - Nepal-Bangladesh via India (2030)-Jhapa-Butwal
  - Bangladesh- Nepal via India (2025) - Bheramara (1000 MW by 2030, using Case 3 T/L (upgrade to 765kV AC) 2021)
  - India-Bangladesh: Rangpur/Rowta - Rangpur-Kutubdia 1,000 MW by 2023 & another 1000 MW by 2025 Power Import by using Case 2 T/L (~±800kV DC), Tripura – Comilla-400 MW by 2020, Bibiyana - Meghalaya (PSPP) 1,000 MW by 2030 PSPP in Meghalaya State, Existing 1160 MW
  - **Bhutan- Bangladesh via India (2030)-Bongaigaon/Rangia – Jamarpur**
  - **Nepal-India ~ 13800 MW**
Cross Border Electricity Trade in South Asia: 

Future Outlook
Cross Border Electricity Trade (CBET) in South Asia: Future Outlook

**CBET Outlook 1**
Transitioning from Bilateral to Trilateral CBET

**CBET Outlook 2**
Renewable Energy based CBET

**CBET Outlook 3**
Commercial form of CBET

**CBET Outlook 4**
Regional Power Market Development & Market Integration

CBET Outlook - 1
Transitionsing from Bilateral to Trilateral CBET
Power system Integration evolution across the Globe

Establishing Bilateral connections, bilateral market

Moving towards Trilateral/Quadrilateral Connection, Trilateral Market

Developing Sub regional Grids & Sub-Regional Power Market

Fully Interconnecting sub regional Grids & Creating Common Grid and Unified Market

SA CBET Outlook-1:-Moving from Bilateral to Trilateral
Gradual Transition to Trilateral Cross Border Power Trade

404 MW Nyera Amari HPP is envisaged as a trilateral project - sale to both India & Bangladesh.

(DPR under preparation)

$2 billion, 1125 MW Dorjilung Project

(The DPR of the project approved by RGoB)

Bangladesh will import 500 MW of electricity from 900 MW Upper Karnali (GMR) in Nepal @ 7.72 cents/unit for 25 years##

(Price Negotiation is Concluded, Discussion on transmission is under discussion)

Bangladesh Master Plan# envisaged to import from Bhutan (1 GW) & Nepal (3 GW) through India


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CBET Outlook-2

Renewable Energy based CBET
South Asia-Significant Environment/Climate Change Challenge

SAARC Countries-fossil_CO2_by_sector_in Mt CO2/yr (2018)

South Asia : Vulnerable to adverse impacts of climate change, De-Carbonising the Power Sector is crucial.


South Asia-Large Renewable Energy Potential

South Asia Hydro Power Potential in GW (%)

- Afghanistan: 30 (9%)
- Bangladesh: 150 (43%)
- Bhutan: 25 (7%)
- India: 83 (24%)
- Nepal: 59 (17%)
- Pakistan: 2 (0%)
- Sri Lanka: 0 (0%)

350 GW Hydro Potential

South Asia-Hydro Power Potential (GW) & % tapped so far

- Afghanistan: 6% developed
- Bangladesh: 86% developed
- Bhutan: 17% developed
- India: 8% developed
- Nepal: 59% developed
- Pakistan: 2% developed
- Sri Lanka: 0% developed

South Asia: Large Renewable Energy Resource within the Region-Potential for clean energy transition, sustainability & energy security

Large Solar & Wind Potential

- ~939 GW Solar Power Potential ~3.8% developed
- ~967 GW Wind Power Potential ~4% developed

Data Source: Complied by Author from Various Sources - SARI/EI Data Source, CEA-India, DHPS-Bhutan, Ministry of Energy, Nepal, CEB- Nepal, Energy Policy, Sri Lanka, NEPRA-Pakistan, EIA-Afghanistan
South Asia: Cross Border Electricity Trade From Renewable Energy Zones

South Asia: GW scale RE based trilateral CBET offers cost saving, clean energy transition:-leads to enhance energy affordability & sustainability

One Sun One World One Grid' (OSOWOG)-A grand Vision
One Sun One World One Grid' (OSOWOG)- A grand Vision

India-Idea Announced in October 2018

The “Sun Never Sets”, globally, at any given point of time.

Building a global ecosystem of interconnected RE, seamlessly shared for mutual benefits & global sustainability

Large Scale regional & trans-region cross border transmission interconnection

OSOWOG- Potential for regional & trans-region transmission interconnection, global sustainability

- Least Tariff [Rs./kWh] - Least Tariff [US Cents $/kWh]

* Cents Calculated based on 1 USD= 74.34 INR, Data Compiled from various sources

Phase I-Middle East-South Asia-South East Asia (MESASEA) interconnection

Phase II MESASEA grid interconnected with African power pools

Phase III (Global interconnection)
CBET Outlook -3

Commercial form of CBET
South Asia: Commercial form of Cross Border Electricity Trade

Initially all CBET, G-G negotiated tariff

Comml. CBET
2010-0 MW, 2020-1266 (~33%*)

Commercial approach brings business value

Competition, better price discovery

Foster mindset change, will help to transit to market

<table>
<thead>
<tr>
<th>Country</th>
<th>Source</th>
<th>Type</th>
<th>Trader</th>
<th>Tenure Years</th>
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<tr>
<td>Bhutan- India (~2262 MW) G-G-2136 Comm1-126</td>
<td>1020 MW Tala</td>
<td>G-G</td>
<td>PTC</td>
<td>35</td>
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<td>336 MW Chhukha</td>
<td>G-G</td>
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<td>60 MW Kurichhu</td>
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<td>720 MW Mangdechhu</td>
<td>G-G</td>
<td>PTC</td>
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<td></td>
<td>126 MW Dagachhu</td>
<td>Commercial</td>
<td>TPTCL</td>
<td>25</td>
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<tr>
<td>India – Bangladesh (~1160 MW) G-G-410 Comm1-790</td>
<td>250 MW NTPC</td>
<td>G-G</td>
<td>NVVNL</td>
<td>25</td>
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<td>160 MW Tripura</td>
<td>G-G</td>
<td>NVVNL</td>
<td>5</td>
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<td>250 MW Market</td>
<td>Commercial</td>
<td>PTC</td>
<td>3</td>
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<td>500 MW Market</td>
<td>Commercial</td>
<td>NVVNL/ Sembcorp</td>
<td>15</td>
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<td></td>
<td>40 MW Market</td>
<td>Commercial</td>
<td>PTC</td>
<td>2</td>
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<tr>
<td>India-Nepal (~587 MW) G-G-237 Comm1-350</td>
<td>237 MW India</td>
<td>G-G</td>
<td>Long Term</td>
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<td></td>
<td>80-190 MW Market</td>
<td>Commercial</td>
<td>PTC/NVVN</td>
<td>***</td>
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<tr>
<td></td>
<td>160 MW Market</td>
<td>Commercial</td>
<td>NVVNL</td>
<td>Renewed Every year</td>
</tr>
</tbody>
</table>

South Asia: Commercial form of CBET leads to the business case, help in fostering private sector engagement & investment
CBET Outlook -4

Regional Power Market Development & Market Integration
Regional Power Market & Power Exchange (PX)-Transitioning to Market form of CBET in SA

Demand Diversity- Daily, weekly, Monthly, Seasonal
PXs- Fair, Transparent, Neutral Market Place-
Competitive price discovery

PXs offers a platform for trilateral/multilateral CBET
SARI-Study on Gains from BBIN Multilateral electricity Trade (Capex reduces by USD 17 billion due to regional trade)

SARI/EI-Study- SARPEX- Pilot Market Exercise- DAM in PX Platform. Bangladesh, Nepal, Bhutan in PXs, the quantum of MCV increased in the range of 5-7% (2015-16).

New power market initiatives in India also offers an opportunity to leapfrog in Cross Border Front.

SARPEX- South Asia Regional Power Exchange- addition of BBIN to the Indian domestic market resulted in an increase of 1,918 MUs (5.3%) and 2,550 MUs (7.0%) in the MCV for the unified & sequential modes, respectively, over the Indian domestic market.

Seasonal complementarity- Monthly Electricity Load Profiles across South Asia

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<tr>
<th>Region</th>
<th>January</th>
<th>February</th>
<th>March</th>
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<td>Bangladesh</td>
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Regional Power Market Development

Possible Phases of Market development for CBET
- Continuous Trading
- Auction Markets
- Spot Markets on exchanges
- OTC Markets
- Deemed Trading Licence
- Nodal Agency

Level of Optimization
- Market Maturity
- Time

Level of Energy Cooperation & Harmonization among SACs
- SACs- South Asian Countries

High
- Derivatives, financial products etc.
- Level of Energy Cooperation & Harmonization among SACs

Low
- Possible Phases of Market development for CBET
- Continuous Trading
- Auction Markets
- Spot Markets on exchanges
- OTC Markets
- Deemed Trading Licence
- Nodal Agency

1 Source: World Bank Study
1 Government of India (GoI), Ministry of Power (MoP) guidelines- Import/Export Cross Border Electricity
SA Regional Power Market - Benefits of Regional Grid Balancing & RE Grid Integration

Rapid Renewable Energy Expansion in the horizon in SA

- 175 GW by 2022
- 450 Gw\(^1\) 2030

Bangladesh
- 7.9 Gw\(^2\) by 2041

Sri Lanka
- 50% Generation\(^4\) from RE by 2030

Pakistan
- 16 Gw\(^3\) by 2040

Hydro Power through CBET for optimised grid balancing

CBET as a tool for flexibility, managing RE Intermittency

Opportunity-Developing Regional Power Market
(Trading of balancing services, Ancillary Market)

One Sun One World One Grid' (OSOWOG)- A grand Vision

Successful 9 PM, 9 Minute-A generation flexibility of ~ 400 MW was achieved from hydropower plants in Bhutan\(^5\)

New power market initiatives in India also offers an opportunity to leapfrog

In 2016, 80% of Denmark’s wind generation\(^6\) was balanced through CBET through the utilization of Norway’s hydro resources

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\(^1\) http://www.niti.gov.in/pages/other-planning-irp/9tpwpv-generation-wpa-report.pdf


\(^5\) https://posoco.in/download/report-on-pam-india-lights-off-event-9pm-9-minutes-on-5th-april-2020/?wpdmdl=28819


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Enablers for accelerating CBET & Development of Regional Power Market
Enablers for accelerating CBET & Development of Regional Power Market

**Political**
- Regional Outlook/Vision
- Political Consensus
- Intergovernmental agreement(s)
- Implementation Mechanism
- Power Market Reform

**Regulatory**
- Permissibility to use intermediary transmission network under open access
- Rules for identification of transmission capabilities & congestion
- Rules for measurement of imbalance and settlements
- A conducive & friendly ecosystem for investors

**Technical and Commercial**
- Harmonisation of grid codes & standards, Grid Connectivity
- Transmission pricing & transit charge
- Co-ordinated Regional Transmission Grid Planning
- Settlement & payment mechanism
- Dispute resolution mechanism

**Institutional**
- Institutional arrangements
- Regional Coordination Forums are desirable
- Will foster long term sustainability
SARI/EI Initiatives- Providing Actionability to articles of SAARC FAEC (E)
Article 12 - Transmission Access:
(Member States shall, for the purpose of electricity trade, enable non-discriminatory access to the respective transmission grids as per the applicable laws, rules, regulations and applicable inter-governmental bilateral trade agreements.)

Framework & Guidelines for Non-discriminatory Open Access in Transmission for Facilitating Cross Border Electricity Trade in SA

Article 13 - Facilitating Buying & Selling Entities:
(Member States shall enable Buying and Selling Entities to engage in cross-border electricity trading subject to the laws and regulations of the concerned Member States.)

Model Framework for Trading Licence Regime and Guidelines for grant of trading licence to facilitate CBET in SA Region

Article 7 - Planning of Cross-Border Interconnections, Article 10 - Electricity Grid Protection System & Article 11 - System Operation & Settlement Mechanism

Harmonisation of Grid codes, Operating Procedures and Standards to facilitate/promote CBET in SA Region: Framework Grid Code Guidelines


Article 15 - Regulatory Mechanisms: Member States shall develop the structure, functions and institutional mechanisms for regulatory issues related to electricity exchange and trade.

- Report Suggested a Regional Regulatory Guidelines covering 9 key regulatory areas.
- Suggested Regional Regulatory Institutional Mechanism (SAFER)
- Implementation of RRGs

- Key ingredients for CBET
- Clause/section wise suggested changes/amendments in EL&R&P framework-Country Wise

- Report Suggested a detailed Model SAARC Electricity Regulation for Regional Power Trade (SERRPT)
- Addressing all the Regulatory aspects of CBET.
- Regulatory Changes for SERRPT Implementation.
- Conducted as a part of SAARC Council of Experts of Energy (Electricity) Regulators.

- Model set of electricity regulations for implementation of the SAARC Framework Agreement for Energy (Electricity) Cooperation & for advancing CBET in SAARC countries

- Regional Energy/Electricity Regulatory Institutional Mechanism in SA: South Asia Forum of Electricity/Energy Regulators (SAFER)

Coordinated Regional Generation & Transmission Master Plan (CRGTMP)

Model Regional Framework for Trilateral & Multilateral Power Trade (MRFTMP)

South Asia Energy Knowledge Resource Database (SAEKRD)

Article 7 Planning of Cross-border interconnections

{Member States may enable the transmission planning agencies of the Governments to plan the cross-border grid interconnections through bilateral/trilateral/mutual agreements between the concerned states based on the needs of the trade in the foreseeable future through studies and sharing technical information required for the same.}

Article 2 Objective

{Member States may enable cross-border trade of electricity on voluntary basis subject to laws, rules and regulations of the respective Member States and based on bilateral/trilateral/mutual agreements between the concerned states.}

Article 5 Data updating and sharing

{Member States may share and update technical data and information on the electricity sector in an agreed template.}
Institutionalizing the Process of CBET: SARI/EI Initiatives

South Asia Forum of Electricity Regulators (SAFER)
Technical Support to SAFIR Working Group & SAARC council of experts of energy (electricity) Regulators

South Asian Forum of Transmission Utilities (SAFTU)

South Asian Forum of System Operators (SAFSO)

South Asian Forum for Electricity Market (SAFEM)

South Asian Forum for Energy Investment (SAFEI)
Road Map and Action Plan
10 Point Roadmap & Action Plan for Deepening CBET in SAARC Region

01. Focus on Implementation of articles of various intergovernmental agreements (bilateral, trilateral, multilateral)

02. Strengthening & facilitating the process of Policy & Regulatory Harmonisation/Coordination

03. Focusing on Complementary Regulatory framework development for CBET in each SA country

04. Transitioning to Regional System Planning - Generation and Transmission Master Plan

05. Instrument/Tools for De-Risking CBET Projects; enhancing bankability, Investment mobilisation

06. Focusing on power market development including ancillary service market

07. Institutionalizing the Process of CBET-SAFER, SAFTU, SAFSO, SAFEM, SAFEI

08. Valuing CBET for Clean Energy Transition, Decarbonisation & Sustainability, CC Mitigation

09. Strengthening Institutional Capacity, Technical Assistance & Training

10. Annual Review of SAARC FAEC(E) implementation and Annual status Report

CC: Climate Change
CBET: Cross Border Electricity Trade
### Key Articles of SAARC Framework Agreement for Energy Cooperation

**Article 12: Transmission Access**
- Member States shall, for the purpose of cross-border trade, enable non-discriminatory access to the respective transmission grids as per the applicable laws, rules, regulations and applicable inter-governmental bilateral trade agreements.

**Article 6: Promoting Competition**
- Member states will encourage the process of opening up the electricity sector, guided by the respective national priorities with the aim of promoting competition.

**Article 13: Facilitating Buying and Selling Entities**
- Member states shall enable Buying and Selling Entities to engage in cross-border electricity trading, subject to the laws and regulations of the concerned member states.

**Article 9: Transmission Service Agreements**
- Member States may facilitate authorized Buying and Selling Entities to enter into transmission service agreements with the transmission service providers for the purpose of cross-border electricity trade.

### SARI-EI Study: Open Access Desirable pre-requisites availability in South Asia power sector

<table>
<thead>
<tr>
<th>Institutional Framework</th>
<th>Afghanistan</th>
<th>Bangladesh</th>
<th>Bhutan</th>
<th>India</th>
<th>Maldives</th>
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<tr>
<td>Power Market Structure</td>
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<td>Legal Provision</td>
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<td>Independent regulator</td>
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<td>Technical Standards</td>
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<td>Commercial – Tariff, etc.</td>
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<tr>
<td>Detailed Process for open access</td>
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<td>Open access in domestic</td>
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<td>Open access in CBET</td>
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**Notes:**
- **Very low**
- **Low**
- **Moderate**
- **High**
- **Very High**

---

## SARI-EI Study: Summary of model Framework & guidelines for open access regime in South Asia

<table>
<thead>
<tr>
<th>Introduce enabling provisions for open access</th>
</tr>
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<tbody>
<tr>
<td>• Introduction of <strong>open access in the legislative framework</strong> for electricity where it does not exist</td>
</tr>
<tr>
<td>• Treatment of open access for cross border trade</td>
</tr>
<tr>
<td>• Introducing <strong>changes in the power market structure</strong> to aid and enable open access</td>
</tr>
<tr>
<td>• <strong>Enable system operators</strong> to co-ordinate cross border power flows</td>
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<table>
<thead>
<tr>
<th>Define features and eligibility criteria for connectivity and open access</th>
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<tbody>
<tr>
<td>• <strong>Types</strong> of open access</td>
</tr>
<tr>
<td>• <strong>Tenure and priority</strong> of various types of open access</td>
</tr>
<tr>
<td>• Eligibility <strong>criteria for connectivity and open access</strong></td>
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<tr>
<th>Fixation of open access charges</th>
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<tr>
<td>• <strong>Segregation and fixation</strong> of transmission &amp; system operation charges</td>
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<tr>
<td>• Application <strong>fees</strong></td>
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<tr>
<td>• <strong>Relinquishment</strong> charges for open access</td>
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<tr>
<th>Terms and conditions, and information system for open access</th>
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<tr>
<td>• <strong>Terms and conditions</strong> for open access</td>
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<tr>
<td>• Open access register and other information systems</td>
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</table>

<table>
<thead>
<tr>
<th>Procedure for grant of connectivity and open access</th>
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</thead>
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<tr>
<td>• <strong>Procedure</strong> for connectivity</td>
</tr>
<tr>
<td>• Procedure for STOA, MTOA and LTOA</td>
</tr>
<tr>
<td>• <strong>Nodal agencies</strong>, processing time lines, required documents etc.</td>
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<table>
<thead>
<tr>
<th>Establishing the operational and commercial mechanisms</th>
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<tbody>
<tr>
<td>• Approval of <strong>detailed procedures</strong> for open access</td>
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<tr>
<td>• Committee to prepare <strong>monthly energy accounts</strong></td>
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<tr>
<td>• <strong>Standard agreements</strong>.</td>
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<table>
<thead>
<tr>
<th>Encouraging regional mechanisms for co-ordination in CBET</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Ensuring co-operation and support in the operationalization of <strong>regional forums</strong> for collaboration in CBET</td>
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</tbody>
</table>
Trader are important market intermediaries.

In SA, CBET is transacted through Trading Licenses.

CBET through PXs through Traders of India in future.

Act as counter party in the transactions.

Transparency, reduce information asymmetry.

Increase liquidity market, facilitate competitive discovery of price, Offer risk mitigation options.

Aiding in wholesale competition & power market development.

---

### Trading license framework in South Asian countries

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<tr>
<td>Afghanistan</td>
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<td>Bangladesh</td>
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<td>Sri Lanka</td>
<td>✗</td>
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</table>

- **✓** - Yes  
- **✗** - No  
- **●** - Partial

---

SAARC Energy Centre's Video Conference on “Roadmap for the Implementation of SAARC Framework Agreement on Energy Cooperation (Electricity), Tuesday, 22 September, 2020 from 11:30-15:00 hrs (IST), Presentation on "Deepening Power System Integration & Cross Border Electricity Trade in SAARC Region: Current Status & Future Outlook” by Rajiv Ratha Panda, Technical Head (SARI/EI)/IRADE, Confidential©2020
## SARI-EI Study: Summary of model Framework & guidelines Trading License

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
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</table>
| Operationalization of legal and regulatory framework for trading licensees | - Introduce trading as a defined & allowed activity under statutory legislation.  
- Empower national electricity regulators to exercise market oversight & price control through measures such as trading margin cap and emergency provisions. |
| Extending the trading license framework in the context of cross border trade | - Introduce the concept of “authorization for cross border trade”, so that domestic trading license regime can be extended to cover cross border trade. |
| Categories of trading licensees and qualification criteria | - Categorization of trading licensees; based on annual trading volume.  
- Authorization for CBET initially, only traders falling in highest category. |
| Grant and revocation of trading licence | - Clearly define the procedures for issue, renewal, amendment and revocation of trading licenses. |
| Terms, conditions and obligations of trading licensees | - Trading licensees to be made responsible for fair, transparent and competitive market operations and safe grid operation through terms & conditions & obligations specified in legal/regulatory framework. |
| Market development | - Hurdles against the introduction and participation of power traders in the power market may be removed through legal/regulatory changes. |
| Regional forum for coordination of trading license | - All efforts to operationalize the proposed regional electricity regulatory forum. SAFER can issue non-binding recommendations on regulatory harmonization for CBET trading licensees. |
Regional Regulatory Guidelines

Purpose of the guidelines

- Establish clear regulatory environment for cross-border trading
- Provide roadmap for action and decision making in respective country
- Provides consistency in CBET transactions and certainty to stakeholders
- The flexible nature of the guidelines and focus on specific aspects of CBET, would permit both the guidelines and the national regulatory framework to co-exist for a reasonable period of time.

Specific aspects requiring consensus through common operating principles

1. Licensing for cross border trading
2. Open access to Tx network
3. Transmission pricing regime
4. Transmission planning
5. Imbalance settlement mechanism
6. Harmonization of Codes
7. Dispute Resolution
8. Duties and tax regimes
Brief Summary of Regional Regulatory Guidelines

1. Licensing for CBET: (Important Regulatory Tool for Trading)
   - Recognition of Trading as a *separate licensed business activity*
   - Grant of license for CBET *through a well defined process*
   - *License requirements* and the underlying rules/limitations

2. Open access to transmission system: (Competitive Market)
   - Setting of *fair rules and procedures* for non-discriminatory open access
   - Modification/amendment of applicable regulations and gradually legally binding provisions
   - Defining *application process, eligibility criteria, priority order* and nodal agency for OA

3. Transmission Pricing: (cost reflective & efficient)
   - Transmission pricing mechanism based on a country’s requirement and acceptability
   - Setting up *principles and mechanism for determination of economically efficient transmission pricing regime* and gradually adopting methods based on the concept of location specific pricing
   - Adoption of *tariff framework in respective country power system through enabling regulations*

4. Transmission Planning: (coordinated Regional Planning)
   - Development of a regional coordination forum of National Transmission Utilities to coordinate between Member Countries on transmission planning aspects
   - Development of a *database of information that enables coordination* and cooperation towards transmission planning
   - National Transmission Plans to also *include details of cross border transmission lines* (specifically for CBET) & associated infrastructure
   - Sharing of the national transmission plan at the regional level and progress towards developing a *regional level master plan*
**Brief Summary of Regional Regulatory Guidelines**

**5. Imbalance Settlement:** (transparent common procedure)
- Member Countries to **develop a common set of procedures for Imbalance Settlement for CBET transactions**
- This will include **preparation of scheduling, dispatch, energy accounting and settlement procedures** for both AC-AC & AC-DC interconnections in the region

**6. Harmonization of codes:** (safe and reliable regional integrated system operation)
- **Harmonization through formulation of guidelines on technical standards for interconnection of power systems** on aspects related to voltage standards, frequency tolerance, thermal limits etc.
- **Sharing of technical characteristics and system specific data** among the member countries
- **Rules on metering standards, communication technologies, Protection Schemes etc.**

**7. Dispute Resolution:** (transparent and fair legal framework)
- Dispute Resolution process should primarily be in accordance with the **agreements or through amicable settlement**
- Referring the disputes to the SAARC Arbitration Council in case the member countries are unable to resolve disputes through amicable settlement.

**8. Taxes & Duties:** (for fostering investment and removing trade barriers)
- Countries to **gradually move towards a zero tax regime**
Framework Grid Code Guidelines (FGCG)

Purpose of the guidelines

Establish a clear technical framework and Grid code & related regulatory environment for smooth, reliable, secure Electricity trading

Framework Grid Code Guidelines (FGCG)

Provides consistency across technical parameters, grid codes, standards, operating procedures in CBET transactions

Provide roadmap for action & decision making for Relevant Authorities/Regulators through FGCG

The flexible nature of Framework Grid Code Guidelines and focus on specific aspects of CBET only, would permit both the Framework Grid Code Guidelines and the national regulatory framework and Grid codes to co-exist.

Planning Guidelines

Connection Guidelines (including metering & protection guidelines)

Operational Guidelines

Scheduling & Dispatch Guidelines

FGCG in the form of draft Codes are in line with various articles of SAARC Inter-Governmental Framework Agreement (IGFA) for Energy Cooperation with a view to provide actionability to these articles:

- Article 7 (Planning of Cross-border interconnections), Article 11 (System Operation and Settlement Mechanism)
- Article 10 (Electricity Grid Protection System), Article 8 (Build, Operate and Maintain)
- Article 9 (Transmission Service Agreements), Article 12 (Transmission Access)
SARI-EI Study: Formulation of Model set of electricity regulations for implementation of the SAARC Framework Agreement for Energy (Electricity) Cooperation (SFAEC) and for advancing electricity trade in the SAARC countries

1. Develop Model set of SAARC Electricity Regulation for Regional Power Trade (SERRPT) from the perspective of implementation of SAARC framework agreement of Energy Cooperation

2. Identify a set of regulatory changes required in each of the SAARC member states, in order to support the suggested Model set of SAARC Electricity Regulation for Regional Power Trade (SERRPT)

3. Formulate a roadmap (regional and country wise) to implement the suggested Model set of SAARC Electricity Regulation for Regional Power Trade (SERRPT)

Key entities and their responsibilities as per Framework Agreement

- **Member States**
  - Set up regulatory and institutional framework for enabling 'Buying and Selling entities' to participate in CBET

- **SAARC Arbitration Council**
  - Resolution of disputes referred to it by the Member States

- **Buying and Selling Entities**
  - Participate in CBET subject to obtaining permission from the Member State in which it is registered, and subject to relevant laws and regulations

- **Transmission Service Providers**
  - Enter into transmission service agreements with Buying and Selling Entities

- **Transmission Planning Agencies**
  - Plan the cross-border grid interconnections through bilateral/trilateral/mutual agreements and share technical information for the same

- **National grid operators**
  - Jointly develop coordinated procedures for the secure and reliable operation of the interconnected grids
Key Policy & Regulatory Enablers in SA

SAARC Framework Agreement for Energy Cooperation (Electricity) *(Nov, 2014)*

MoU on BIMSTEC Grid Interconnection *(August 2018)*

Guidelines for Import/Export (Cross Border) of Electricity *(Dec, 2018)*

Draft Electricity (amendment) Bill, 2020 defines “CBTE” *(April, 2020)*

CERC (Cross Border Trade of Electricity) Regulations *(March, 2019)*

One Sun One World One Grid’ (OSOWOG)- A grand Vision *(May, 2020)*

One Sun One World One Grid’ (OSOWOG)- A grand Vision *(May, 2020)*

Ministry of New and Renewable Energy Government of India

CBTE-Cross Border Trade of Electricity

1 Emphasized the need to promote regional power trade, Enables CBTE based on bilateral, trilateral & mutual agreements

2 Encourages Cross Border Energy Trade, Enables cross border grid interconnection based on bilateral/trilateral/multilateral mutual agreements

3 Comprehensive regulation- address connectivity, open access, planning, system operation, Metering, Energy Accounting & Settlement etc.

4 “CBTE” means transactions involving import or export of electricity between India and any other country and includes transactions related to passage of electricity through our country in transit between two other countries

5 India’s Prime Minister called for connecting solar energy supply across borders Hon’ble Prime Minister Shri Narendra Modi during first assembly of the International Solar Alliance on October 2018.

6 On OSOWOG which Envisages large scale trans-regional grid integration Phase-I Middle East-South Asia-South East Asia (MESASEA) interconnection; Indian Grid Interconnection with MESASEA, Phase-II MESASEA grid with Africa Power Pools, Phase-III (Global interconnection): to achieve the OSOWOG vision

Confidential©2020
India-CERC (Cross Border Trade of Electricity) Regulations, 2019

- First of its Kind dedicated Regulations on CBET in the Region.

- Comprehensively address various aspects of Cross Border Trade of Electricity

- Provides clarity, transparency, consistency and predictability in regulatory mechanism

- Can be learning process & starting point towards development of Regional Regulatory Framework

A comprehensive and detailed regulation, covers all possible regulatory aspects of CBET
**History of evolution of Energy Cooperation, CBET - Key Policy & Regulatory Development**

- **1954**: Kosher treaty between Nepal & India
- **1961**: Jaldhaka agreement - Indo-Bhutan hydropower cooperation
- **1971**: Indo-Nepal Power exchange - 5 MW in initial Years
- **Mar 1974**: Agreement between Govt. of India and Royal Govt. of Bhutan on Chuka hydro power project to India (Plant Inaugurated on October 21, 1988)
- **1992**: Agreement between Govt. of India and Royal Govt. of Bhutan on Tala Hydro Power Project - 1020 MW - first unit commissioned on July 31, 2006 & last unit on March 30, 2007
- **5th Mar 1996**: Agreement between Govt. of India and Royal Govt. of Bhutan on cooperation in Hydroelectric Power
- **Jul 2006**: Agreement between Govt. of India and Royal Govt. of Bhutan on cooperation in Hydroelectric Power

* http://www.mea.gov.in/bilateral-documents.htm?dtl/6349/agreement

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Significant Developments in Energy Cooperation, CBET- Key Policy & Regulatory Development

- MoU between Govt. of India and Govt. of Bangladesh, on cooperation in power sector (500 MW trade started on 5th October, 2013)
  - Jan 2010

- MoU for carrying out a feasibility study for interconnection of the India-Sri Lanka electricity grids (Signed among GOISL, GOI, CEB & PGCIL)
  - June 2010

- MoU on CASA 1000 Project signed among 4 participating countries* (Project was conceived in 2008)
  - 20th Sept 2011

- Inter-Governmental Agreement between Bhutan and India on development of JV Hydropower Projects
  - Apr 2014

- Indo-Nepal Power Trade Agreement
  - Sept 2014

- MoU on BIMSTEC Grid Interconnection
  - Aug 2018

- MoU between Nepal & Bangladesh, on co-operation in power sector
  - Aug 2018

- NEPRA (Import of Electric Power Regulations)
  - June 2017

- CERC draft notification on CBET Regulations
  - Feb 2017

- Guidelines on Cross Border Electricity Trade (CBTE) issued
  - Dec 2016

- Ministry of Power Designates Nodal agency for CBTE
  - Dec 2016

- MoU on Cooperation in the field of Power Sector Myanmar & India
  - Oct 2016

- Sub-Regional Cooperation Bangladesh, Bhutan, India and Nepal (BBIN)
  - Oct 2015

- SAARC Inter-governmental Framework Agreement on Energy Cooperation
  - Nov 2014

- New CBTE Guidelines Issued (Repealed 2016 Guideline)
  - Dec 2018

- CERC Notifies (Cross Border Trade of Electricity) Regulations, 2019
  - March 2019

- CEA-Draft Conduct of Business Rules (CBR) for CBTE
  - April 2019

- Mangdechhu hydroelectric power plant (720 MW) inaugurated
  - 17th Aug, 2019

- Draft Electricity (amendment) Bill, 2020 defines “CBTE”
  - April, 2020

- One Sun One World One Grid’ (OSOWG)-A grand Vision
  - May, 2020

- Indo-Bhutan joint venture hydroelectric project Concession Agreement for 600MW Kholongchhu
  - June 29, 2020

10 Years

Regional Hydro Power can help in Renewable Integration and Grid Balancing

Role of Cross Border Hydro in Renewable Integration and Grid Balancing.

- India RE Target - 175 GW by 2022
- India: 450 GW of renewable energy by 2030 *
- Hydro share in India has been declining over the years (45% in 1970 to Apprx 12 % in 2020)
- National Electricity policy (GoI), spinning reserves at 5%**.
- Developing Regional Ancillary Market- India has started ancillary market.

## Very Important Recent Development: Innovative Model to Address RE Intermittency and Ensure RE Grid Integration

<table>
<thead>
<tr>
<th>BIDS</th>
<th>BUSINESS MODEL</th>
<th>Result</th>
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<tbody>
<tr>
<td>• SECI -Bids called to develop 1200 MW ISTS Connected RE Projects* with assured Peak Power Supply in India i.e. with Energy Storage System • (01.08.2019)</td>
<td>• Provided a flat tariff payment of Rs. 2.70/kWh (Off Peak power ) • peak power tariff through e-Reverse Auction</td>
<td>• Reenko-awarded 900 MW peak power tariff - rate of Rs 6.12 (<del>$0.086)/kWh, • ReNew Power - 300 MW, peak tariff Rs 6.85 (</del>$0.096)/kWh on 31.01.2020</td>
</tr>
</tbody>
</table>

* "WIND-SOLAR HYBRID POWER PROJECT" means the wind-solar hybrid power project where the rated power capacity of one resource is at least 25% of the rated power capacity of the other resource | PEAK HOURS" shall mean the energy scheduling hours between ( & including) 06:00 hrs up to 09:00 hrs, and between ( & including) 18:00 hrs to 24:00 hrs of the same day. For the purpose of scheduling, a ‘day’ shall commence from 00:00 hrs and end at 24:00 hrs; minimum 6-hour Peak Power supply, on daily basis, during the Peak Hours, SO

[Source: * https://presidentofindia.nic.in/speeches-detail.htm?798, https://economictimes.indiatimes.com/small-biz/productline/power-generation/india-to-have-450-gw-renewable-energy-by-2022-presидент/articleshow/73804463.cms?from=mdr, https://www.livemint.com/politics/policy/india-confident-of-adding-450-gw-of-renewables-by-2030-raj-kumar-singh-115711784129.html, While the timing is sometimes unclear; recent government reports indicate 2030 as the latest year for the 450 GW target. CEA's National Electricity Plan (NEP) 2018 had already projected a higher share of renewables (14%) compared to coal (8%) in 2017. CEA's draft report on 'Optimal Generation Capacity Mix for 2029-30' projects that renewable energy sources (solar + wind) installed capacity will become 440 GW by the end of year 2029-30 which is more than 50% of total installed capacity of 831 GW. **with 775 GW generating capacity and nearly 150 GW peak demand. Technical Committee for Large-Scale Integration of Renewable Energy, net for balancing, Deviation Settlement Mechanism (DSM) and associated issues.]

*Note: Images and diagrams have been included to enhance understanding of the text. The text outlines the role of cross-border hydro in renewable integration and grid balancing, emphasizing the importance of developing regional ancillary markets and the recent advancements in the Indian renewable energy sector. The table highlights the innovative model developed to address renewable energy intermittency and ensure grid integration.*
De-Risking of Energy Projects: Risk mitigation instruments

Regional energy projects will benefit from access to low cost finance from development partners. However, support is required for regional energy projects, not just for financing, but also for risk mitigation.

Typical providers of risk mitigation instruments

Political risk insurance
- Risk insurance against events such as nationalization by the Government, breach of contract by the Government, currency transfer restrictions, war, terrorism and civil unrest.

Partial risk guarantee
- Partial risk sharing between the insurer and the Government, typically through a dedicated fund. This lowers the moral hazard associated with 100% insurance.

Partial credit guarantee
- Covers part of the debt service default by the borrower regardless of the cause of default.

Examples:
- Bangladesh - Sirajganj 220MW CCPP – MIGA guarantee of $70 million against risk of non-honoring of sovereign financial obligations.
- Bangladesh – Sembcorp 414 MW CCPP – MIGA guarantee for equity, against risk of breach of contract.
- Sri Lanka – ADB’s Partial Risk Guarantee for $31 million and Partial Risk Insurance for $21 million for 163 MW diesel plant of AES. The Guarantees provided protection to the local commercial lenders of the project.
- Maldives - $16 million of IDA (World Bank Group) guarantees for solar projects under ASPIRE program. The guarantee provides backstopping for payment delays under PPA and ensures compensation in case of contract termination by Government.