





South Asia Regional Initiative for Energy Integration

Presentation

on

Cross Border Electricity Trade in SAARC Region: Current Status & Future Outlook

Presented by

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(Technical-Head, SARI/EI,IRADe)

SAARC Energy Centre's Webinar on "Cross Border Electricity Trade (CBET) in SAARC Countries"
11.30 AM (IST), Tuesday, 11th August 2020

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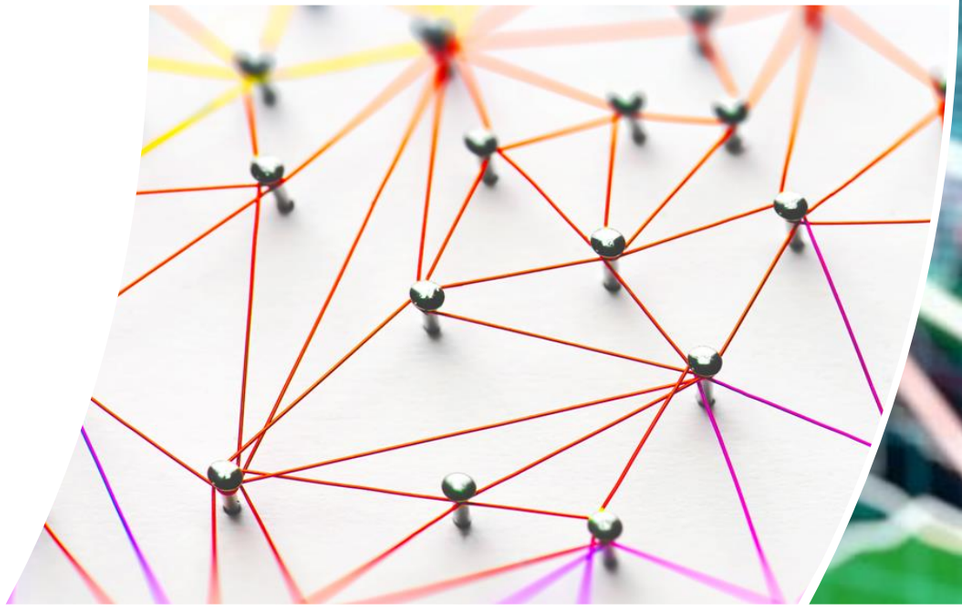
Marco-Economic Growth & Economic Integration of South Asia



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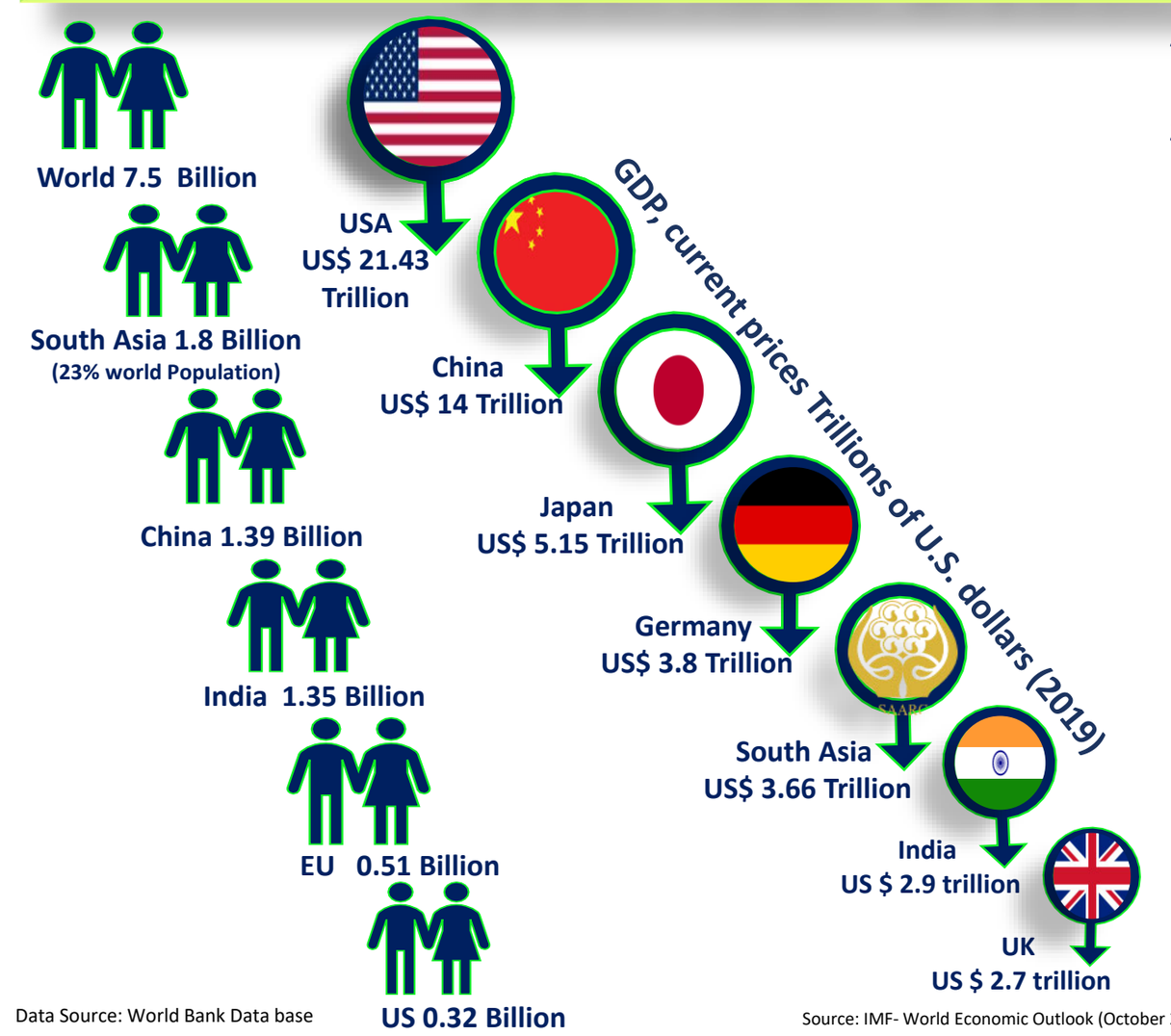
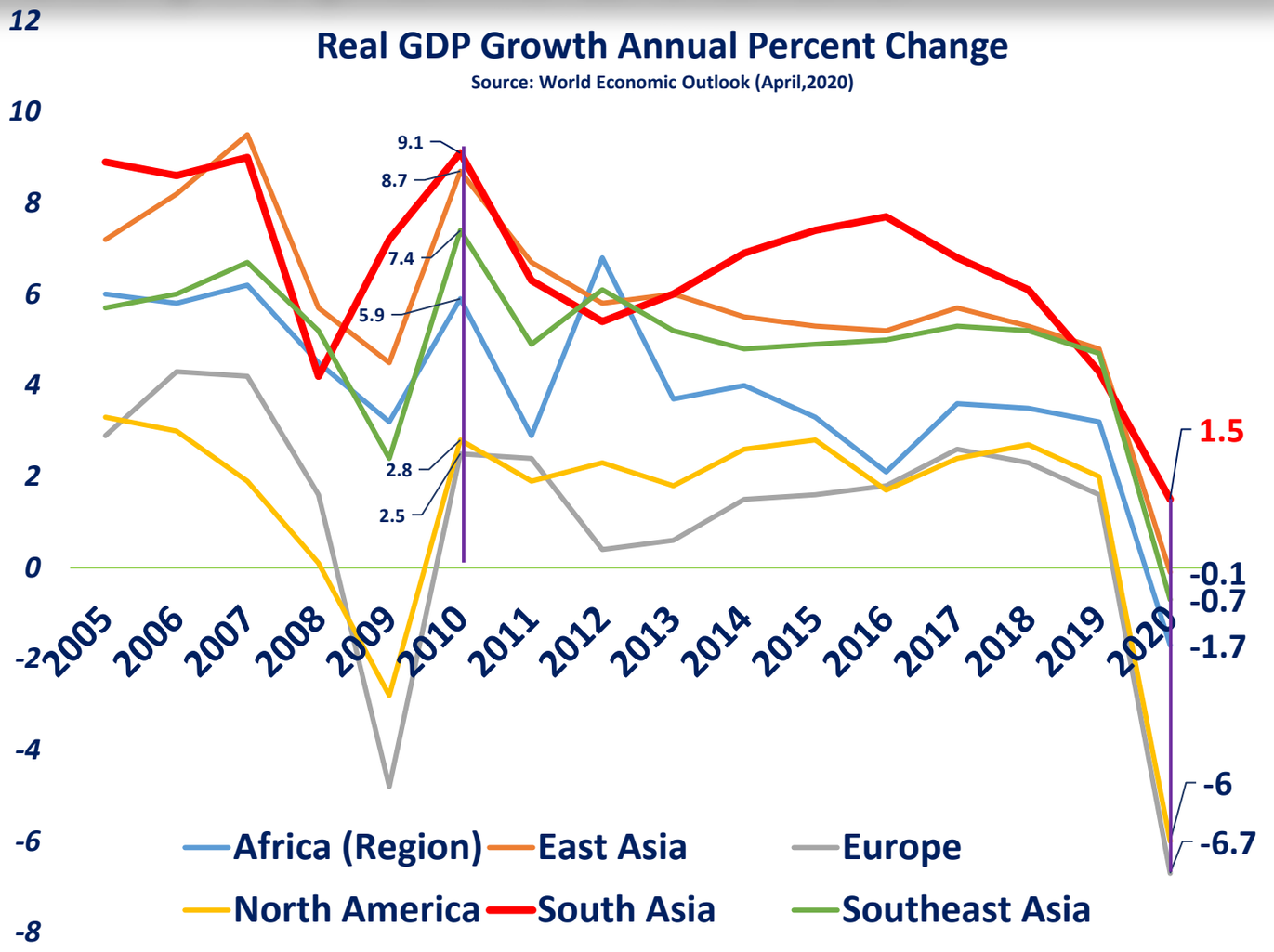
South Asian Growth Story : Dynamic & Vibrant



Data Source: World Bank Data base

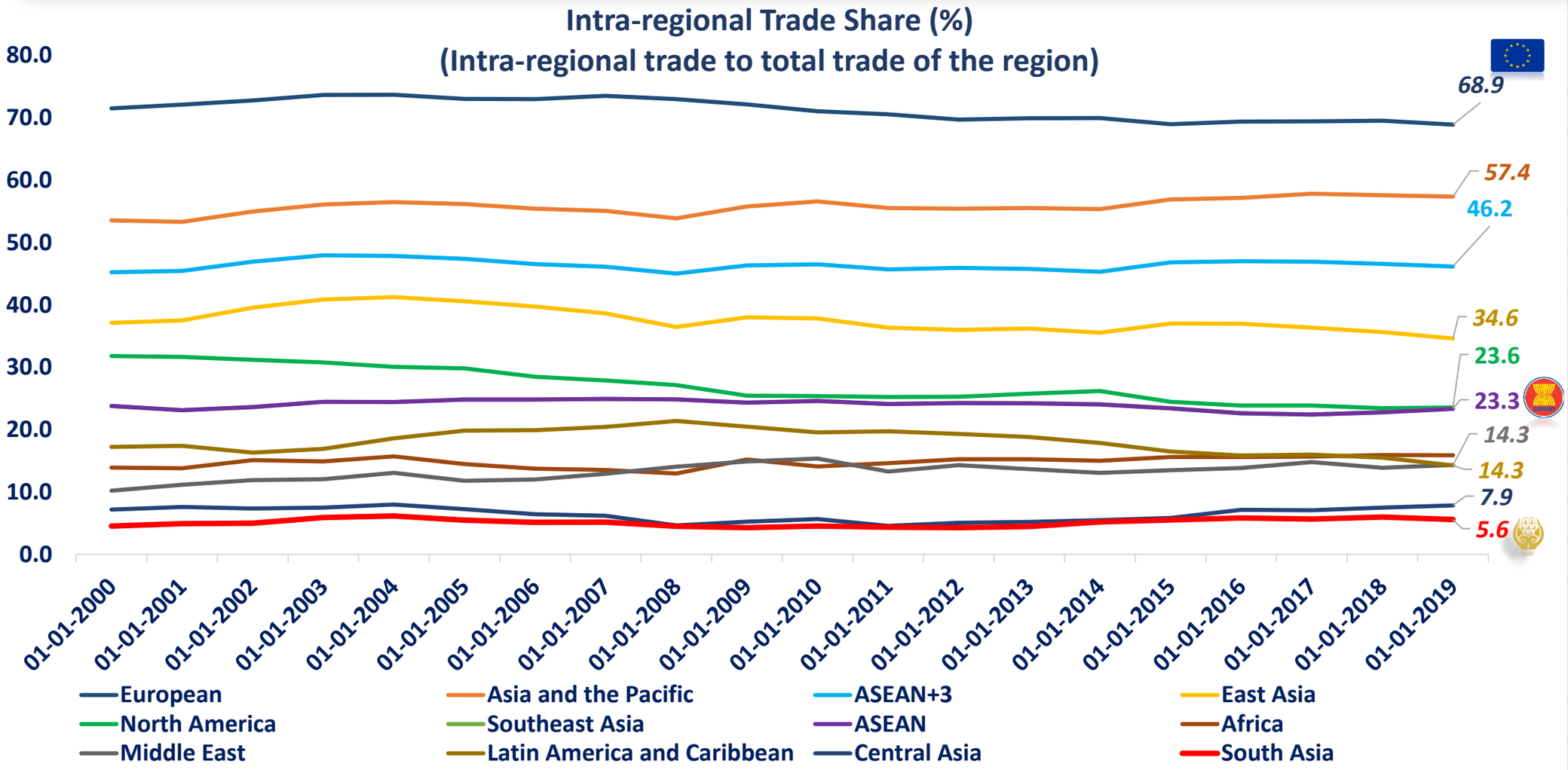
Source: IMF- World Economic Outlook (October 2019



Source: IMF- World Economic Outlook (April,2020), https://www.imf.org/external/datamapper/NGDP_RPCH@WEO/AFQ/EAQ/SAQ/SEQ/EUQ/NMQ

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

South Asia : Yet Least Integrated



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 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 Sector

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South Asia Power System-Snapshot

<2GW-very small , < 4GW-Small , < 50 GW-Mid size , < 200 GW-Large , < 500 GW-Vey Large

Afghanistan

#Very small power system (~.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

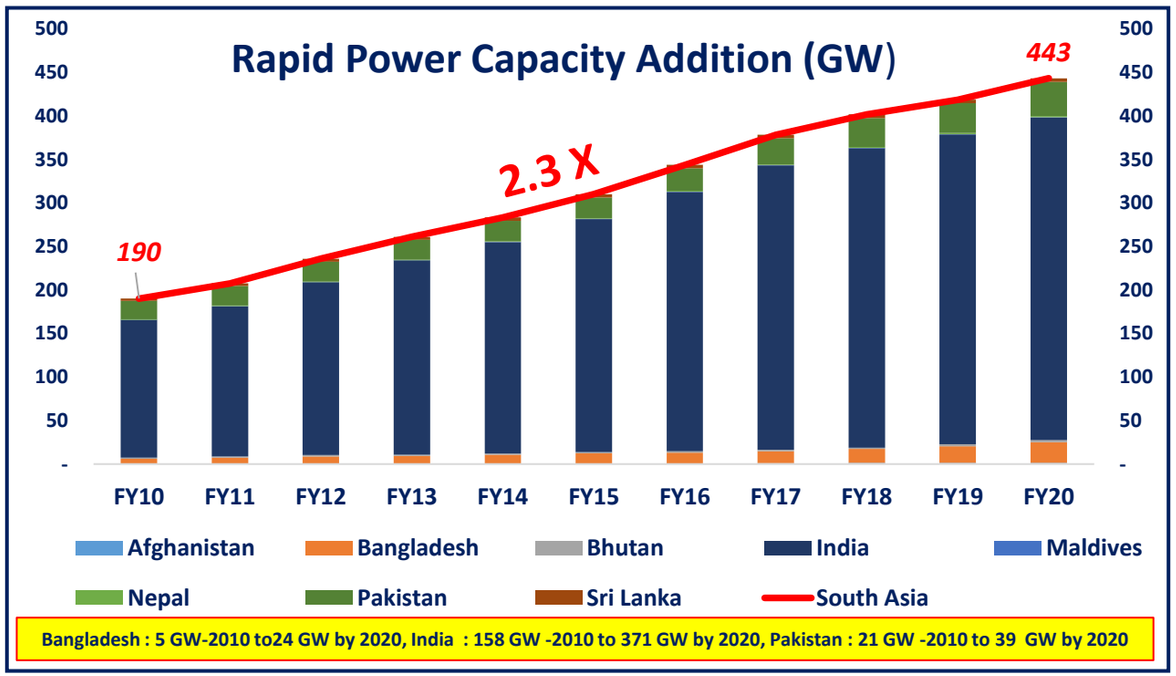
#Very Small power system (1.3 GW)
#Under utilized hydro (82 GW)
#Net importer of electricity now but potential to export in future

Pakistan

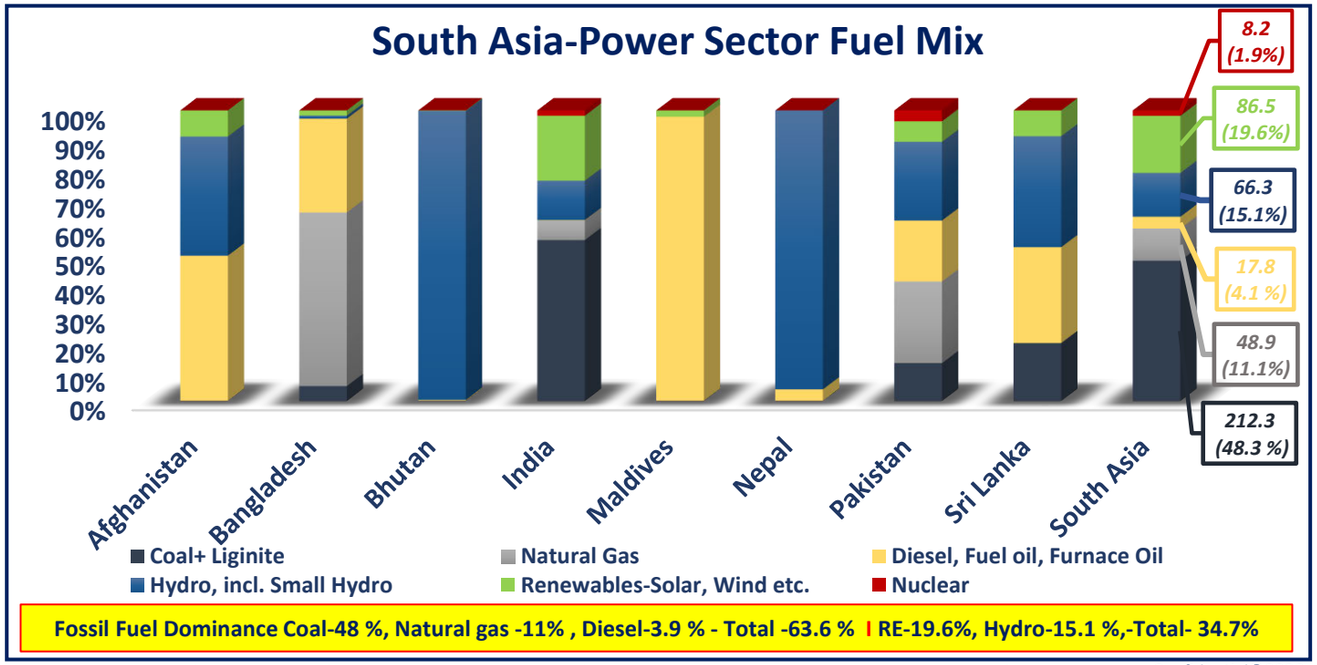
#Mid sized (39 GW) power system
#Gas and Oil dependent.

Sri Lanka

#Small power system (~4 GW)
Hydro and oil dominated
High Peak –off peak differential



Bangladesh : 5 GW-2010 to24 GW by 2020, India : 158 GW -2010 to 371 GW by 2020, Pakistan : 21 GW -2010 to 39 GW by 2020



Fossil Fuel Dominance Coal-48 %, Natural gas -11% , Diesel-3.9 % - Total -63.6 % I RE-19.6%, Hydro-15.1 %,-Total- 34.7%

Data Source: Complied by Author from Various Sources-SARI/EI Data Source, CEA-India, DHPS-Bhutan, Ministry of Energy, NEA-Nepal, CEB, Ministry Energy-Sri Lanka , NTDC, NEPRA-Pakistan , DABS-Afghanistan

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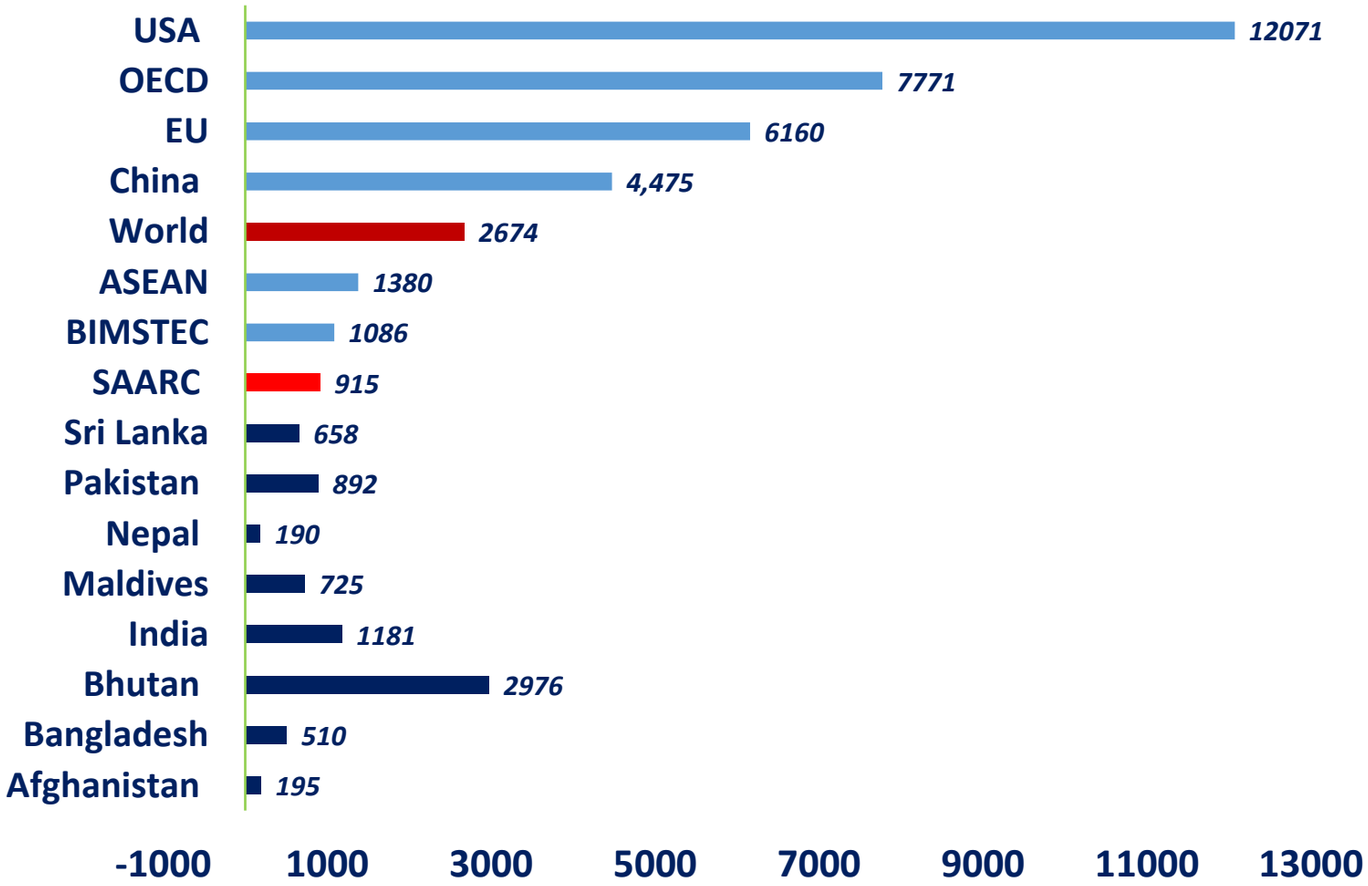
Yet Challenges Remain

Electricity Consumption (kWh per capita)*



* 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

Sustainability Ranking -The Sustainable Development Report 2020

Country	2020 SDG Index Score	2020 SDG Index Rank	SDG-7: Affordable & Clean Energy	SDG 7 :Trend- Affordable & Clean Energy	SDG-6 : Clean Water and Sanitation	SDG-6-Trend- : Clean Water and Sanitation
Bhutan	69.27	80	yellow	↗	red	↗
Maldives	67.59	91	green	↑	orange	↑
Sri Lanka	66.88	94	red	→	red	↗
Nepal	65.93	96	red	→	red	↑
Bangladesh	63.51	109	orange	↗	red	↗
India	61.92	117	red	↗	red	↑
Pakistan	56.17	134	red	→	red	↗
Afghanistan	54.22	139	orange	↗	red	↗
green		Goal Achievement		↑	On track or maintaining achievement	
yellow		Challenges remain		↗	Moderately Increasing	
orange		Significant challenges		→	Stagnating	
red		Major challenges		↓	Decreasing	

Note: Highest Score-Sweden (84.7) , Total Countries covered 166, Citations: Sachs, J., Schmidt-Traub, G., Kroll, C., Lafortune, G., Fuller, G., Woelm, F. 2020. The Sustainable Development Goals and COVID-19. Sustainable Development Report 2020. Cambridge: Cambridge University Press.

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

India- Bangladesh ~1160 MW
Bhutan-India ~2100 MW
Nepal-India ~ 500 MW

~ South Asia CBET 2.6 X

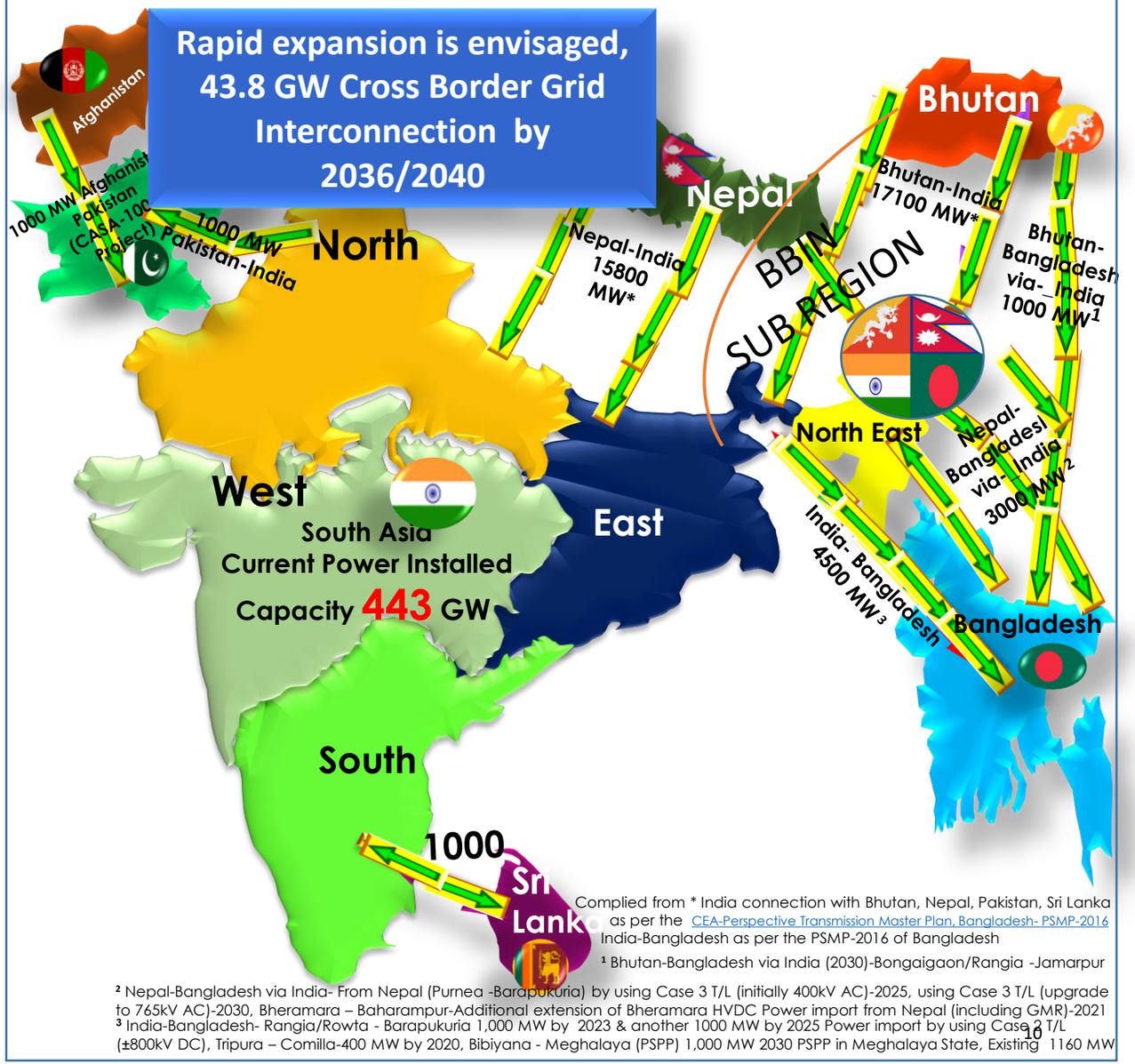
~3760* MW — 2020
~2986 MW — 2018
~2126 MW — 2015
~1400 MW — 2012

SA CBET in MUs

2014	2015	2016	2017	FY18	FY19	FY20
7705	9379	10681	12304	12809	13146	15672

2X

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



Complied from * India connection with Bhutan, Nepal, Pakistan, Sri Lanka as per the CEA-Perspective Transmission Master Plan, Bangladesh- PSMP-2016 India-Bangladesh as per the PSMP-2016 of Bangladesh

¹ Bhutan-Bangladesh via India (2030)-Bongaigaon/Rangia -Jamarpur

² Nepal-Bangladesh via India- From Nepal (Purnea -Barapukuria) by using Case 3 T/L (initially 400kV AC)-2025, using Case 3 T/L (upgrade to 765kV AC)-2030, Bheramara – Baharampur-Additional extension of Bheramara HVDC Power import from Nepal (including GMR)-2021

³ India-Bangladesh- Rangia/Rowta - Barapukuria 1,000 MW by 2023 & another 1000 MW by 2025 Power import by using Case 3 T/L (±800kV DC), Tripura – Comilla-400 MW by 2020, Bibiyana - Meghalaya (PSPP) 1,000 MW 2030 PSPP in Meghalaya State, Existing 1160 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 (433 MW) ,Turkmenistan (77 MW) I *~ Maximum Peak Trade I PM Modi inaugurated Mangdechhu hydroelectric plant, Bhutan, Aug 17, 2019

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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

Transitioning from Bilateral to Trilateral CBET

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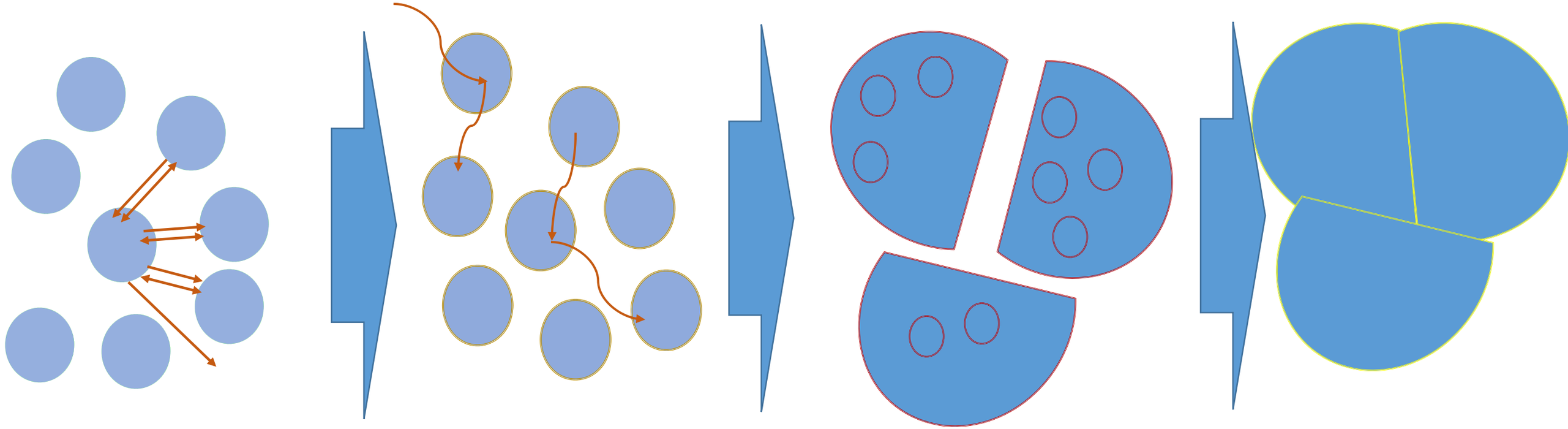
Power system Integration evolution across the Globe



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)

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

$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)

[#] Power System Master plan 2016 (Final)-https://powerdivision.gov.bd/site/page/f68eb32d-cc0b-483e-b047-13eb81da6820/Power-System-Master-Plan-2016

[##] https://kathmandupost.com/money/2020/02/09/bangladesh-issues-letter-of-intent-to-purchase-500-mw-from-upper-karnali-hydro-project

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CBET Outlook-2

Renewable Energy based CBET

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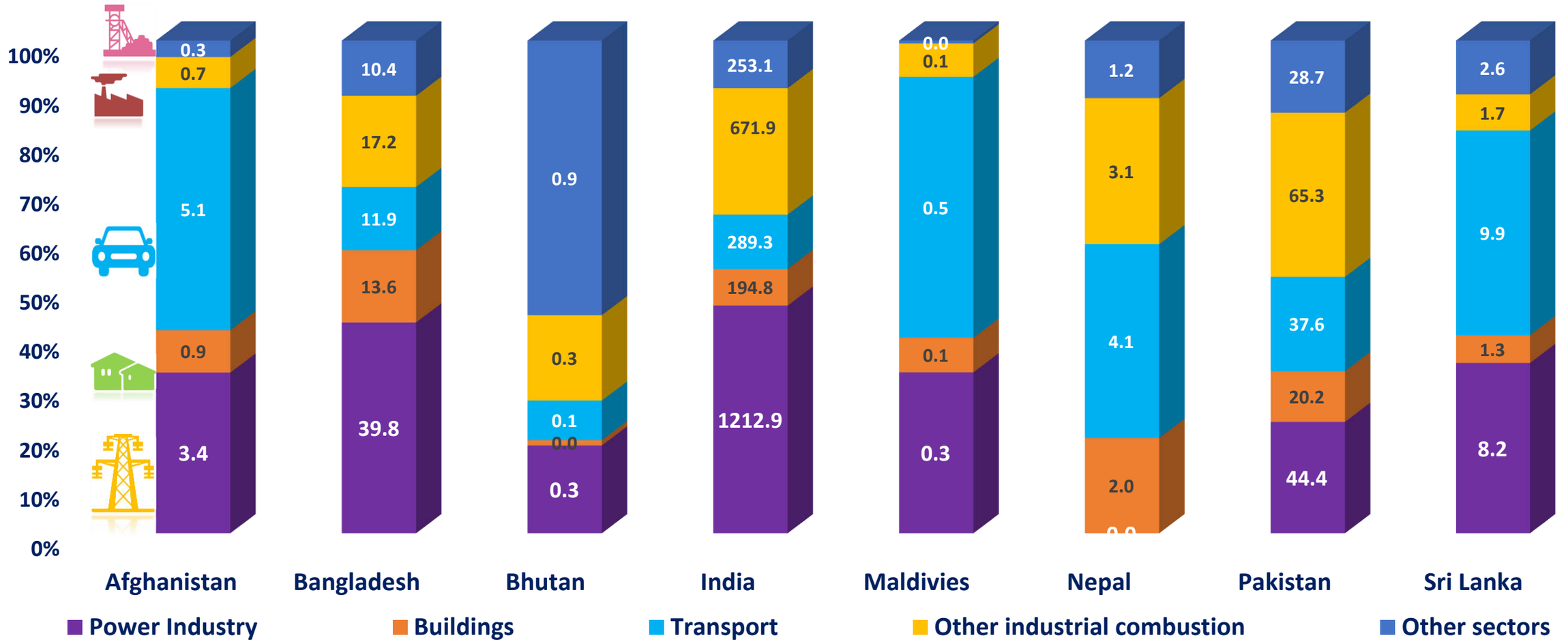
South Asia-Significant Environment/Climate Change Challenge

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.

source: Climate Emergency CoP 25: India is the only major economy to be '2 degree compatible' , Fossil CO2 and GHG emissions of all world countries 2019 Report-JRC SCIENCE FOR POLICY REPORT https://edgar.jrc.ec.europa.eu/booklet2019/Fossil_CO2andGHG_emissions_of_all_world_countries_booklet_2019report.pdf

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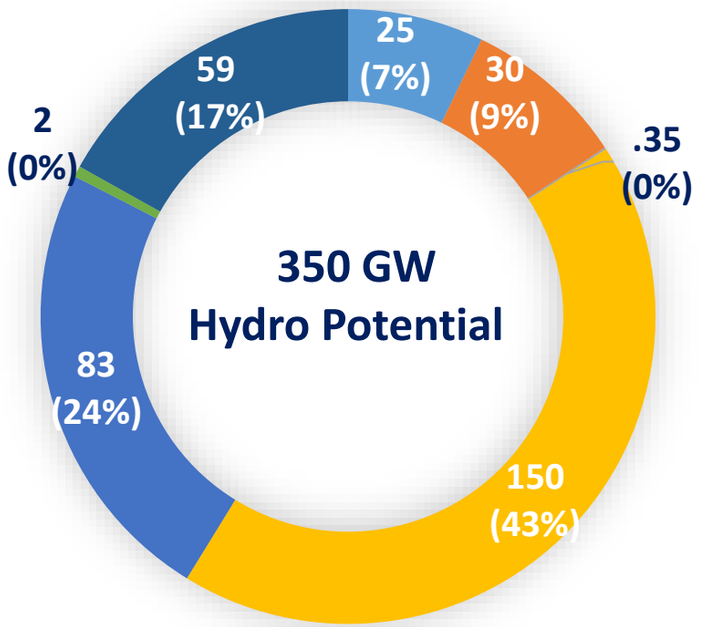
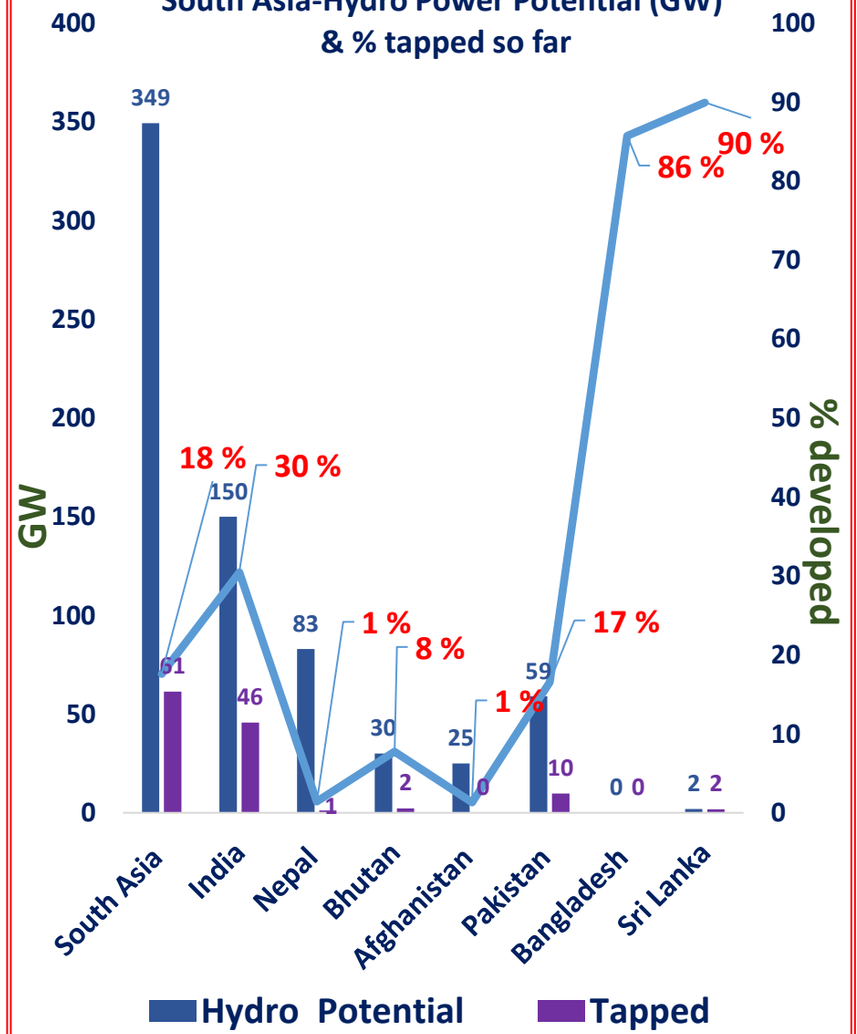
South Asia-Large Renewable Energy Potential

South Asia Hydro Power Potential in GW (%)

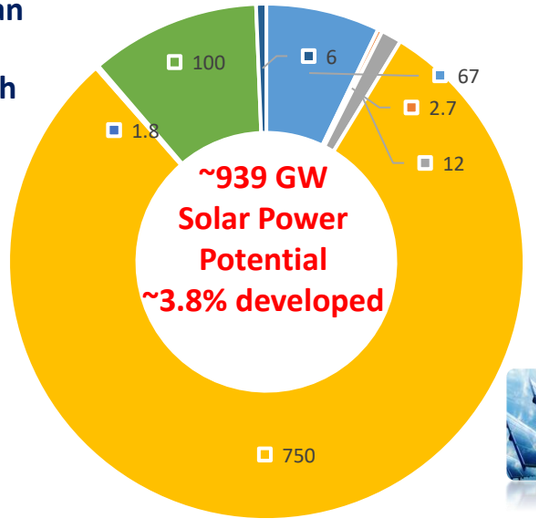


South Asia-Hydro Power Potential (GW) & % tapped so far

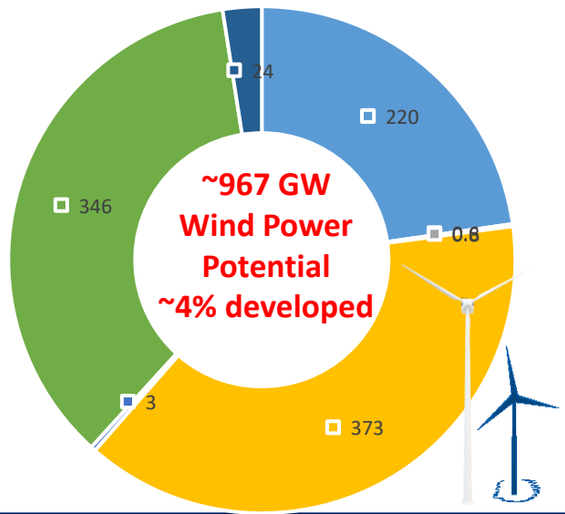


Large Solar & Wind Potential

- Afghanistan
- Bangladesh
- Bhutan
- India
- Nepal
- Pakistan
- Sri Lanka



South Asia - Solar Power Potential



South Asia - Wind Power Potential

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

Data Source: Complied by Author from Various Sources-SARI/EI Data Source, CEA-India, DHPS-Bhutan, Ministry of Energy, NEA-Nepal, CEB, Ministry Energy-Sri Lanka , NTDC, NEPRA-Pakistan , DABS-Afghanistan

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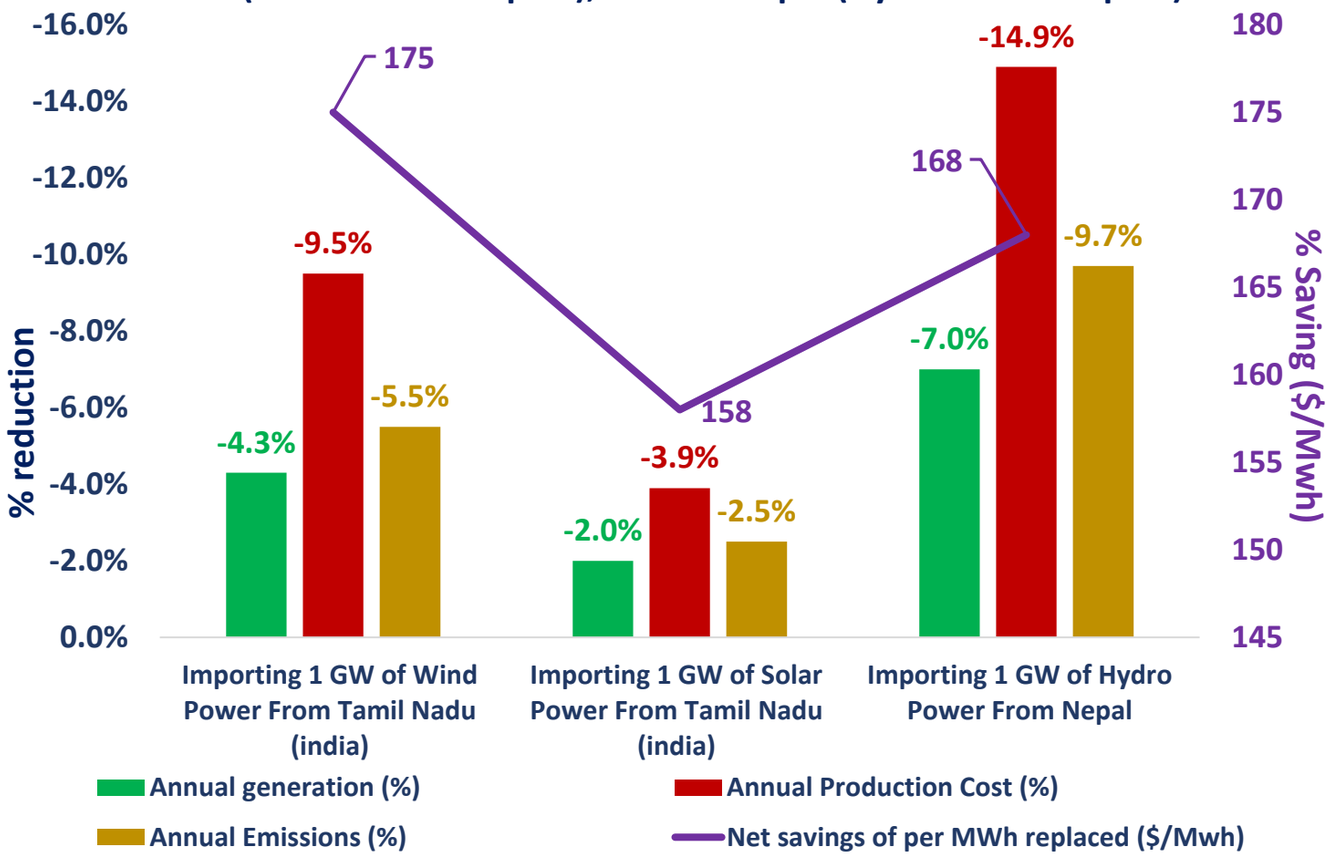
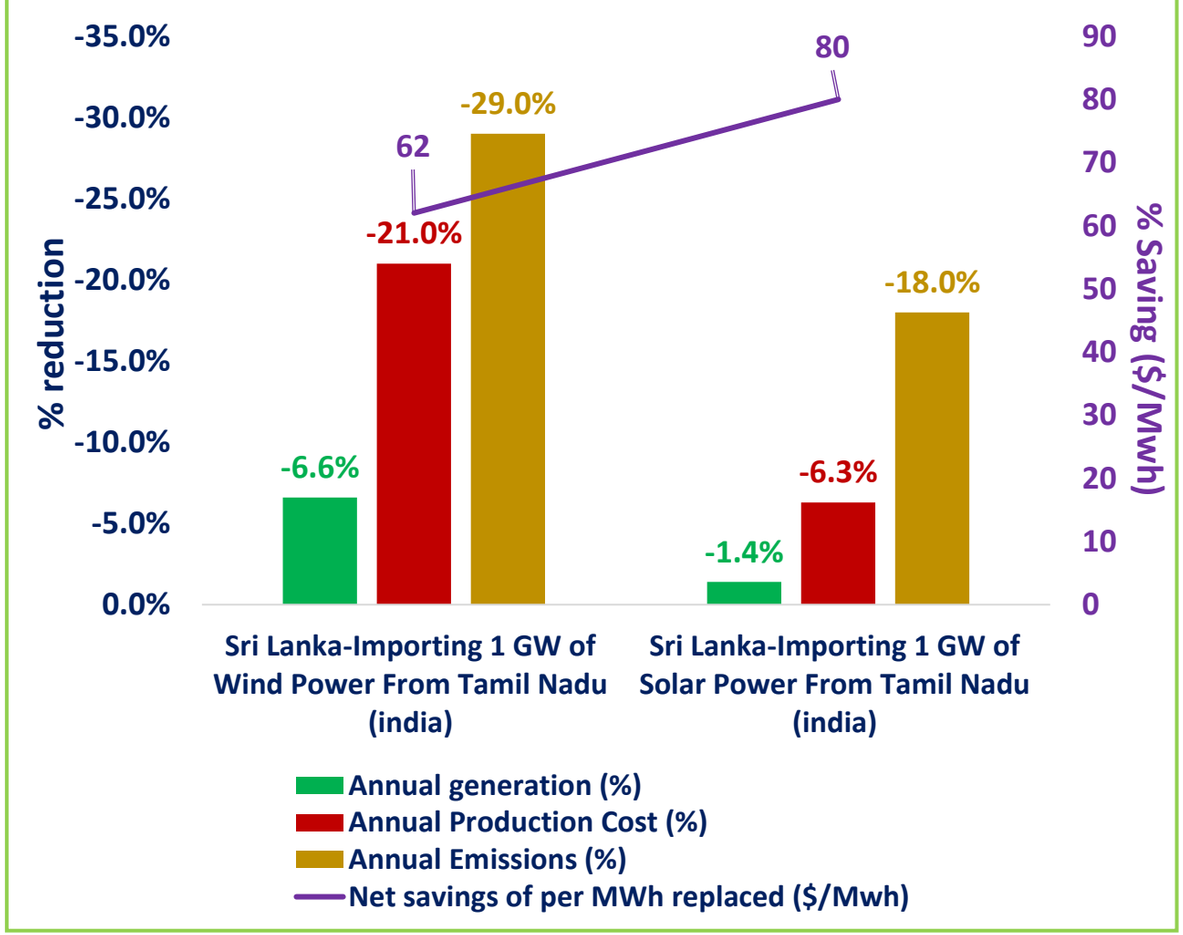
South Asia : Cross Border Electricity Trade From Renewable Energy Zones

Bangladesh Importing from Renewable Energy Zones (Tamil Nadu State (Solar & wind export), India & Nepal (Hydro Power Export)



Source: NREL Report on "Cross-Border Electricity Trading and Renewable Energy Zones" https://www.nrel.gov/docs/fy20osti/76919.pdf https://www.nrel.gov/docs/fy20osti/77029.pdf

Sri Lanka Importing from Renewable Energy Zones (Tamil Nadu State (Solar and wind export), India)



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

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

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

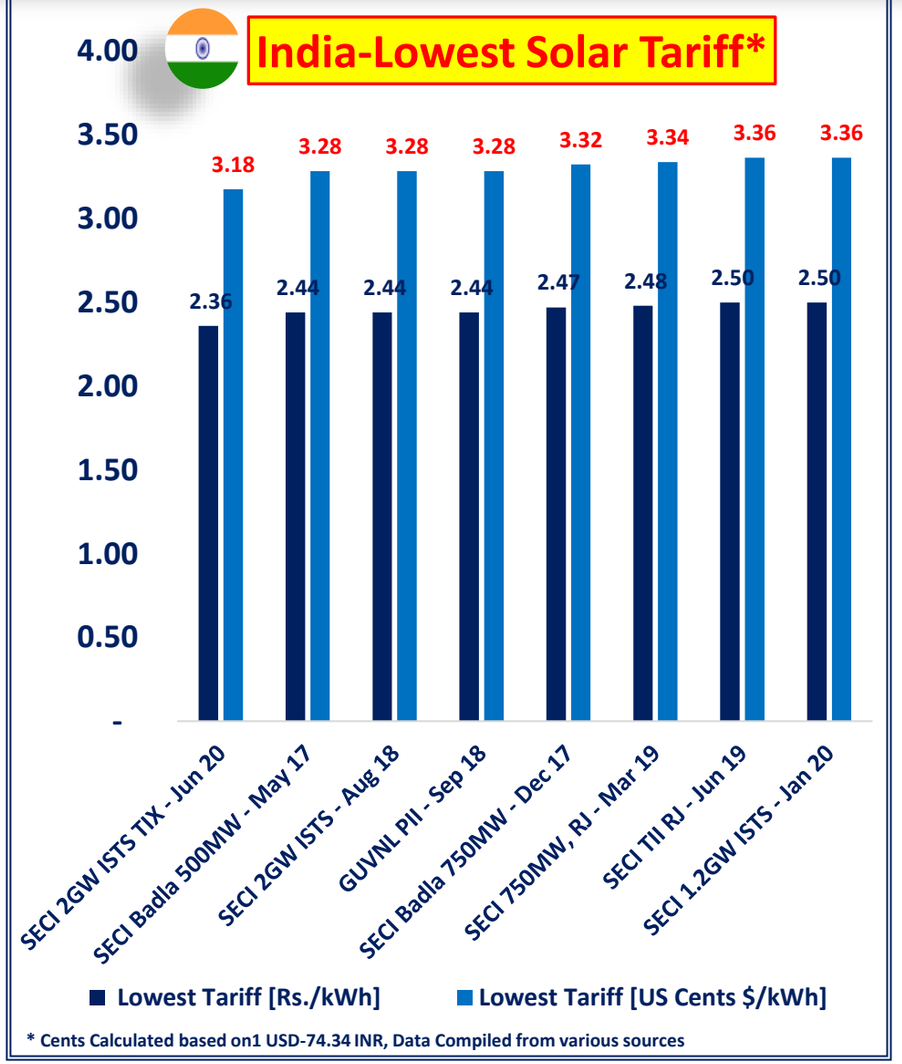
Ministry of New and Renewable Energy
Government of India

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



Phase III (Global interconnection)

Phase II MESASEA grid interconnected with African power pools

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

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

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CBET Outlook -3

Commercial form of CBET

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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

Commercial CBET

2020

1226 MW

2010

0 MW

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

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

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CBET Outlook -4

Regional Power Market Development & Market Integration

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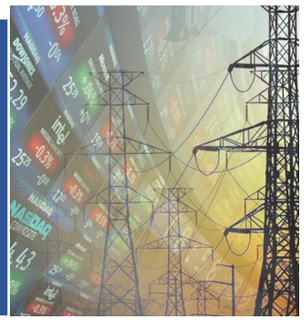
Regional Power Market & Power Exchange (PX)-Transitioning to Market form of CBET in SA

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)



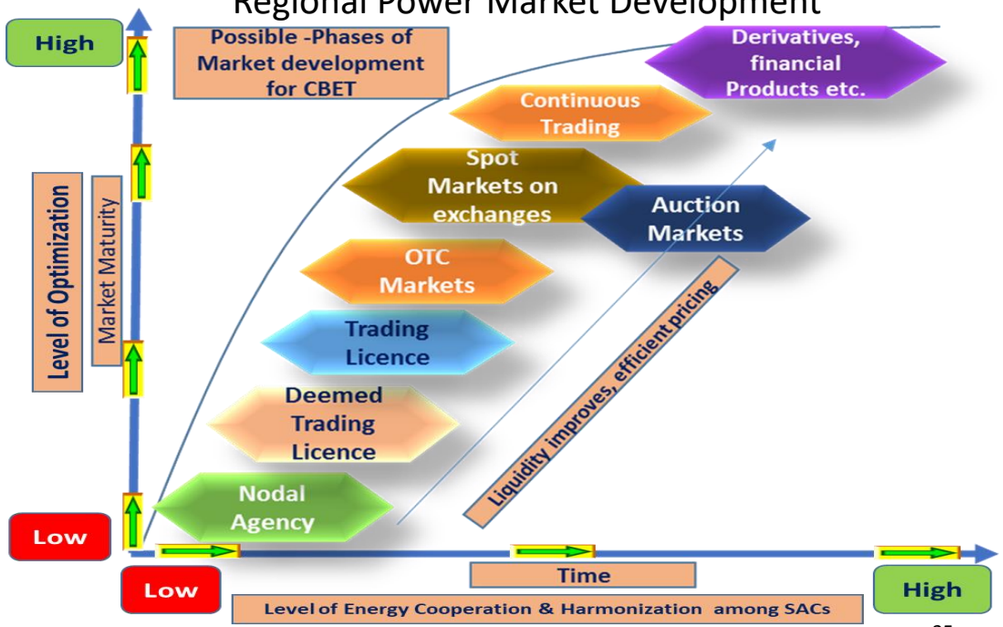
SARI/EI-Study-SARPEX- Pilot Market Exercise- DAM in PX Platform. Bangladesh, Nepal, Bhutan in PXs, the quantum of MCV increased in the range of 5-7% (2015-16).

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

Seasonal complementarity– Monthly Electricity Load Profiles across South Asia [2]

	January	February	March	April	May	June	July	August	September	October	November	December
Bangladesh												
India-North East												
Bhutan												
India-East												
Nepal												
India-North												
India-West												
Pakistan												
India-South												
				Low	Medium	High						

Regional Power Market Development



SACs-South Asian Countries

[2] Source: World Bank Study

SARPEX-South Asia Regional Power Exchange -addition of BBN 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.

[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

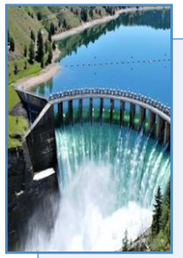
7.9 Gw[2] by 2041

Sri Lanka

50% Generation[4] from RE by 2030

Pakistan

16 Gw[3] by 2040



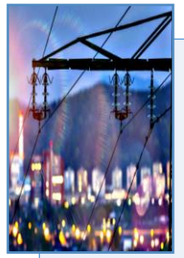
Hydro Power through CBET for optimised grid balancing

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

[1] http://cea.nic.in/reports/others/planning/irp/Optimal_generation_mix_report.pdf [3] https://nepra.org.pk/Admission%20Notices/2019/09-September/IGCEP%20Plan%20(2018-40).pdf [2]https://powerdivision.portal.gov.bd/sites/default/files/files/powerdivision.portal.gov.bd/page/4f81bf4d_1180_4c53_b27c_8fa0eb11e2c1/Revisiting%20PSMP2016%20%28full%20report%29_signed.pdf [3] https://nepra.org.pk/Admission%20Notices/2019/09-September/IGCEP%20Plan%20(2018-40).pdf [4] For Sri Lanka 50% renewable energy (including major hydro) by year 2030, https://www.pucsl.gov.lk/wp-content/uploads/2020/06/PUC-LI-AP19-01-May-28-PUC-reply-to-revised-LCLTGEPrev1-3.pdf [5] Successful 9PM, 9 minutes event Highlights the Outstanding Cooperation in Electricity Grid Management in South Asia https://posoco.in/download/report-on-pan-india-lights-off-event-9-pm-9-minutes-on-5th-april-2020/?wpdmdl=28819

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Enablers for accelerating CBET & Development of Regional Power Market

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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

Key Policy & Regulatory Enablers in SA

SAARC Framework Agreement for Energy Cooperation (Electricity) [1]
(Nov,2014)

MoU on BIMSTEC Grid Interconnection[2]
(August 2018)

Guidelines for Import/Export (Cross Border) of Electricity[3]
(Dec, 2018)

GOVERNMENT OF INDIA
MINISTRY OF POWER

CERC (Cross Border Trade of Electricity) Regulations[4]
(March,2019)

Draft Electricity (amendment) Bill, 2020 defines "CBTE"[5]
(April, 2020)

GOVERNMENT OF INDIA
MINISTRY OF POWER

One Sun One World One Grid' (OSOWOG)- A grand Vision[6]
(May,2020)

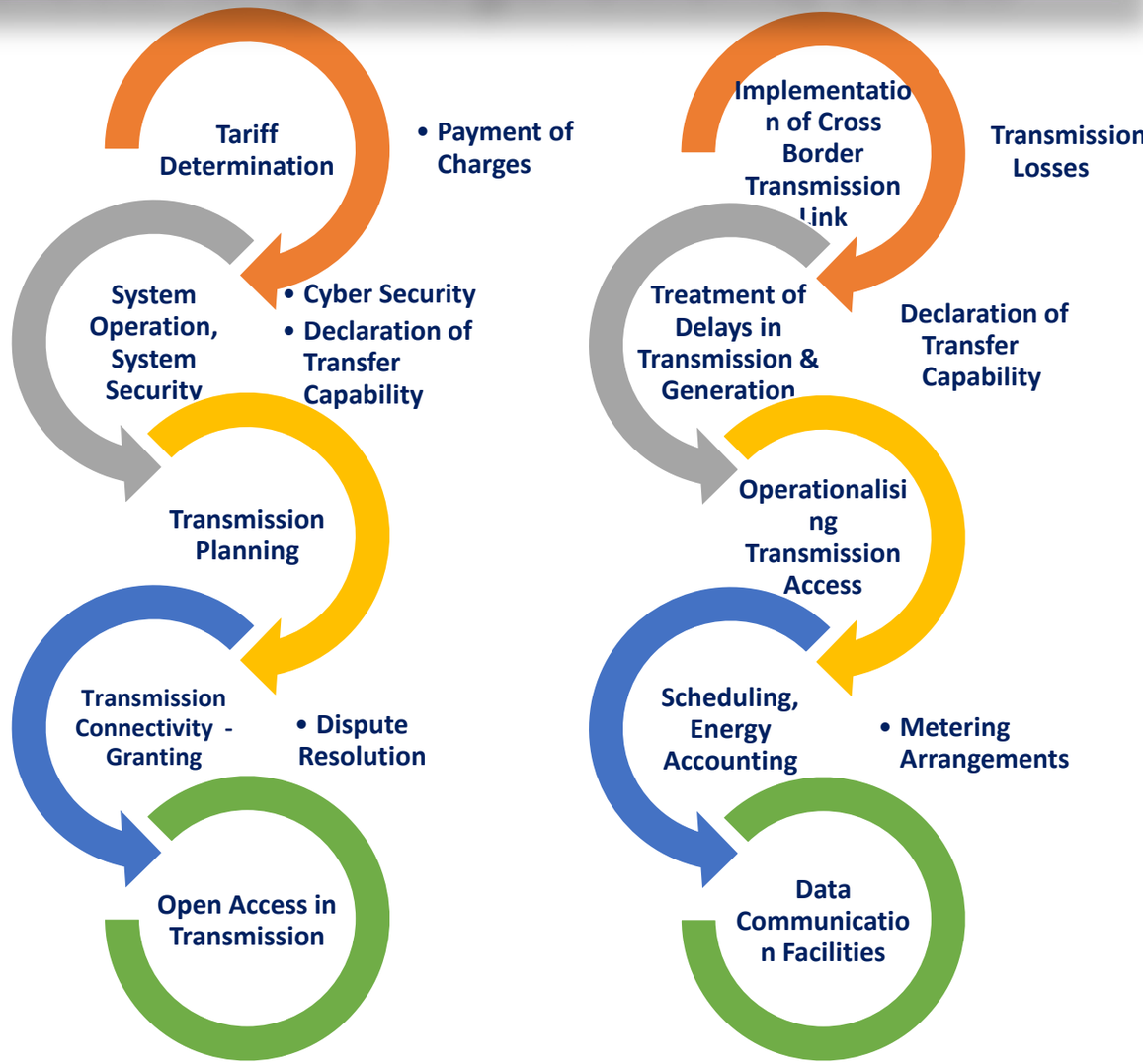
Ministry of New and Renewable Energy
Government of India

(Idea Announced in October 2018)

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] Enables trilateral power trade, CBTE through PXs [4] Comprehensive regulation- address connectivity ,open access , planning, system operation, Metering, Energy Accounting & Settlement etc. [5] "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 " [6] 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. , On May 2020 , MNRE issues RFP on 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

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***



Designated Authority : facilitating the process of approval and laying down the procedure for import and export of electricity

A comprehensive and detailed regulation, covers all possible regulatory aspects of CBET

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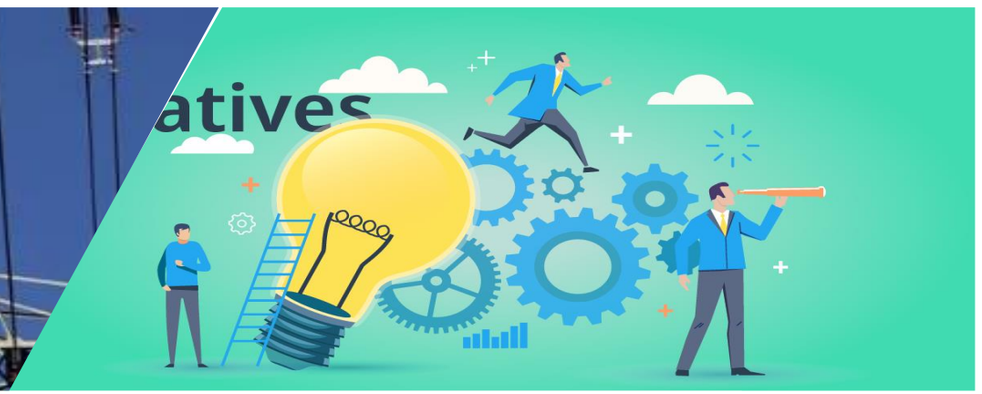
SARI/EI Initiatives



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Deepening Energy Cooperation & Accelerating CBET: SARI/EI Initiatives

Harmonisation of legal, Policy framework, Common Regulatory Roadmap(CRP)

Coordinated Regional Generation & Transmission Master Plan (CRGTMP)

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

Common Operating Standards, Common Minimum Grid Code (CMGC)

Power Exchange Platform for CBET (SARPEX)

Framework-Regional Ancillary Service Market (FRASM)

Potential for Natural Gas Trade Potential (NSTP)

South Asia Energy Knowledge Resource Database (SAEKRD)

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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

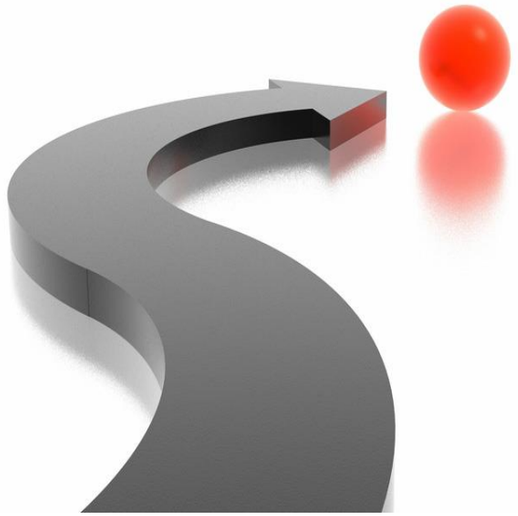
South Asian Forum of Transmission Utilities (SAFTU)

South Asian Forum of System Operators (SAFSO)

South Asian Forum for Electricity Market (SAFEM)

South Asian Forum for Energy Investment (SAFEI)

Conclusion and Way forward



Conclusion and Way forward

- Focusing on Complementary Regulatory framework development for CBET in each SA countries.
- Need to strengthen the process of Policy & Regulatory Harmonisation.
- Implementation of various inter-governmental agreements (bilateral, trilateral, multilateral).
- Regional System Planning- Generation and Transmission Master Plan.
- De-Risking CBET infrastructure Projects; enhancing bankability of projects; Investment mobilisation.
- Focusing on power market development including ancillary service market.
- Institutionalizing the Process of CBET-SAFER, SAFTU, SAFSO,SAFEM, SAFEI.
- Deepening CBET leads to Clean Energy Transition and Sustainability , Climate Change Mitigation.
- Strengthening Institutional Capacity.

Thank You

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https://www.irade.org/

Regional Legal, Regulatory, Institutional Framework for CBET in BIMSTEC

A	**Enabling Legal framework**	Desirable to have ***specific Legal*** provisions for cross border energy/electricity trade. ***Trading*** as a ***distinct*** Activity , ***desire*** to have Power/energy Market Development. ***License requirements*** *and the underlying rules/limitations*
B	**Regulatory Framework**	**Licensing for CBET: (***Important Regulatory Tool for Trading)* **Open Access (OA) to transmission system:** *(Competitive Market),* **Grid Connectivity** ***Setting of fair rules and procedures*** *for non-discriminatory open access, Defining* ***application process, eligibility criteria, priority order*** *and nodal agency for OA (*Cumbersome regulatory processes which causes decision making to be time consuming for governments and investors)
C	**Regulatory Framework**	**Transmission Pricing:** *(cost reflective & efficient)* ***Country's requirement and acceptability,*** *Setting up* ***principles and mechanism for determination of economically efficient transmission pricing regime*** *and gradually concept of location specific pricing* *Adoption of* ***tariff framework in respective country power system through enabling regulations***
D	**Regulatory Framework**	**Transmission Planning:** *(coordinated Regional Planning)* ***regional coordination mechanism of planners, National Transmission Plans*** *to* ***include details of CBET lines*** *(progress towards* ***developing a regional level master plan***
E	**Regulatory Framework**	**Imbalance Settlement:** *(transparent common procedure),* ***Scheduling, dispatch, energy accounting and settlement procedures:*** **Harmonization of grid codes:** *(safe and reliable regional integrated system operation),* **Dispute Resolution:** *(transparent and fair legal framework), Dedicated* **Cross Border Electricity Trade Regulations.**
F	**Structured Institutional Framework**	***Structured Institutional Mechanisms/Committees/Forums*** ***at the*** ***Level of Regulators, Transmission utilities/planning Authorities , System Operation.*** ***Committee/Mechanism*** ***to*** ***track & Monitor*** ***the progress of*** ***Implementation of MoU*** ***&*** ***advise needed interventions.***

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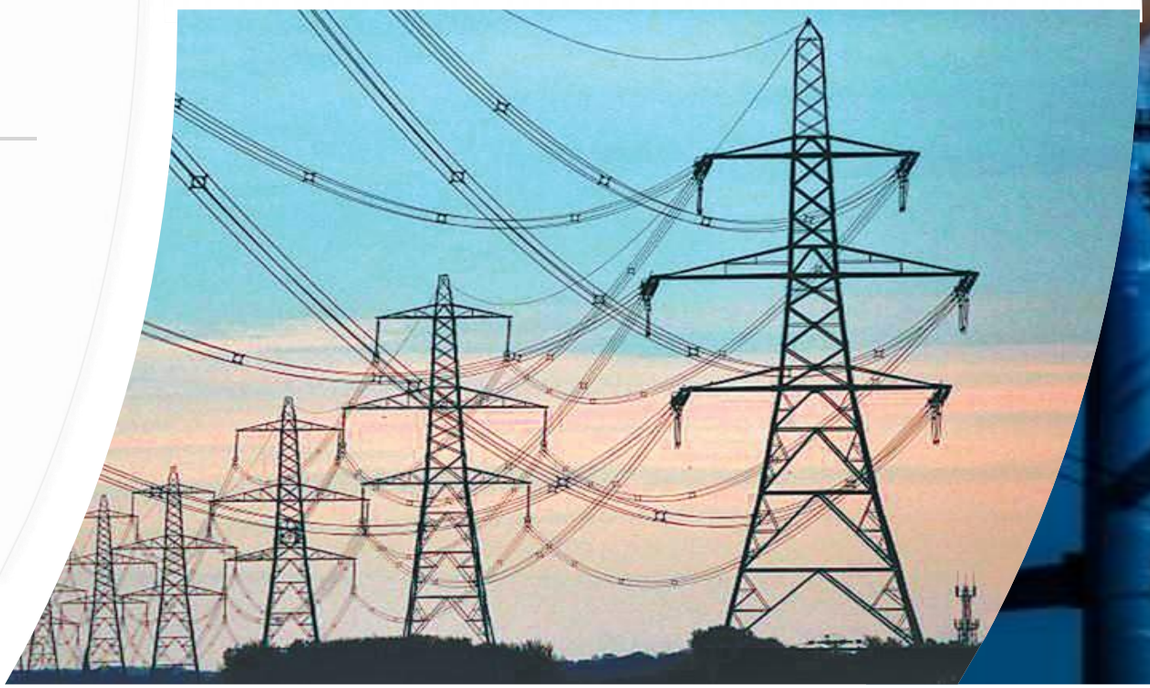
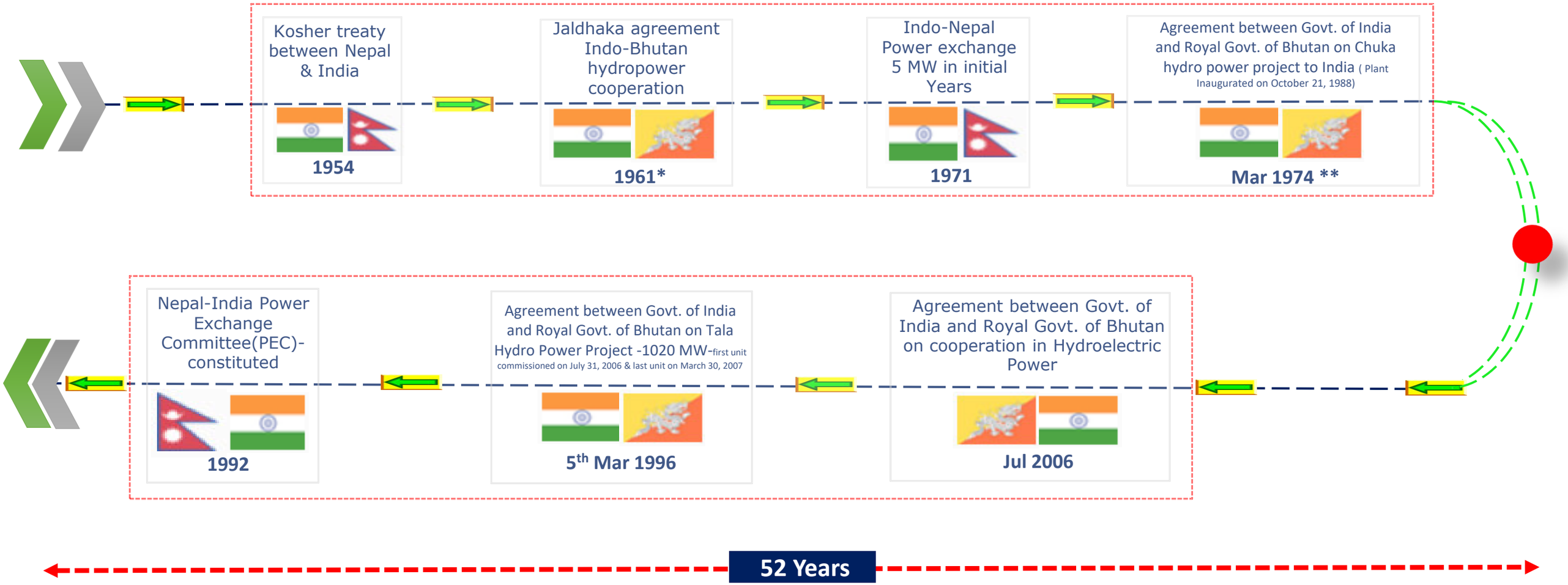
Evolution of Cross Border Electricity Trade (CBET) in South Asia



History of evolution of Energy Cooperation, CBET- Key Policy & Regulatory Development



* http://www.mfa.gov.bt/rbedelhi/?page_id=28

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

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 GOSL, GOI, CEB & PGCIL) — Jun 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

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

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

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

Ministry of Power Designates Nodal agency for CBTE — Dec 2016

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

CERC draft notification on CBET Regulations — Feb 2017

NEPRA (Import of Electric Power Regulations) — June 2017

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

MoU on BIMSTEC Grid Interconnection — Aug 2018

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' (OSOWOG)-A grand Vision — May,2020 (Idea Announced in October 2018)

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

10 Years

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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

BIDS

- 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)

BUSINESS MODEL

- Provided a flat tariff payment of Rs. 2.70/kWh (Off Peak power)
- peak power tariff through e-Reverse Auction

Result

- Reenko- awarded 900 MW peak power tariff - rate of Rs 6.12 (~$0.086)/ kWh,
- ReNew Power - 300 MW, peak tariff Rs 6.85 (~$0.096)/ kWh on 31.01.2020

* 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 I PEAK HOURS" shall mean the energy scheduling hours between (& including) 06:00 hrs up to 09:00 hrs, and between (& including) 18:01 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,

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-2030-president/articleshow/73804463.cms?from=mdr , https://www.livemint.com/politics/policy/india-confident-of-adding-450-gw-of-renewables-by-2030-raj-kumar-singh-11571137804129.html , While the timing is sometime unclear, recent government reports indicate 2030 as the target year for the 450 GW target. CEA's National Electricity Plan (NEP) 2018 had already projected a higher share of renewables (44%) compared to coal (38%) in 2027, CEA's draft report on Optimal Generation Capacity Mix for 2029-30, 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 *275 GW generating capacity and nearly 150 GW peak demand , Technical Committee for "Large Scale Integration of Renewable Energy, need for balancing, Deviation Settlement Mechanism (DSM) and associated issues"

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Five Year Vision Document for Power Sector- Power Markets

Goal 04	Implementation Roadmap
Goal	**Potential Interventions/ Actions**
Enhance cross border trade through market products	• Introduce standardized products in Day-Ahead Markets, Intra-day, Term-Ahead market for cross-border electricity trading – physical delivery • Introduce products in Balancing market for trading of balancing services from fast response plants such as Hydro • Introduction of financial products – futures & derivatives

Goal 03	Implementation Roadmap
Goal	**Potential Interventions/ Actions**
Deepen products in markets to enhance clean energy	Introduction of Real Time Market (RTM) for improved reliability and control and better absorption of RE
	Move from regulated to market based mechanism for Ancillary Services
	Inclusion and scale up of innovative models for Dencentralised Renewable Energy (DRE) based access

Source: https://www.eqmagpro.com/five-year-vision-document-for-power-sector/ http://indiaenergyforum.org/22nd-india-power-forum/images/Souvenir%20-%2022nd%20India%20Power%20Forum_6th%20DRAFT%20for%20website.pdf

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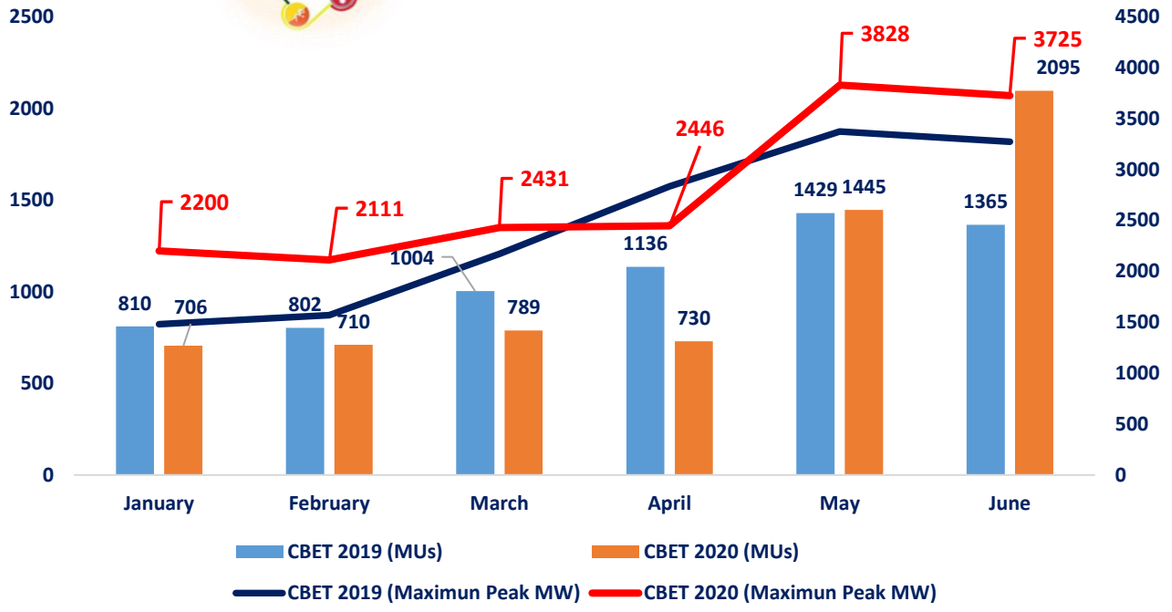
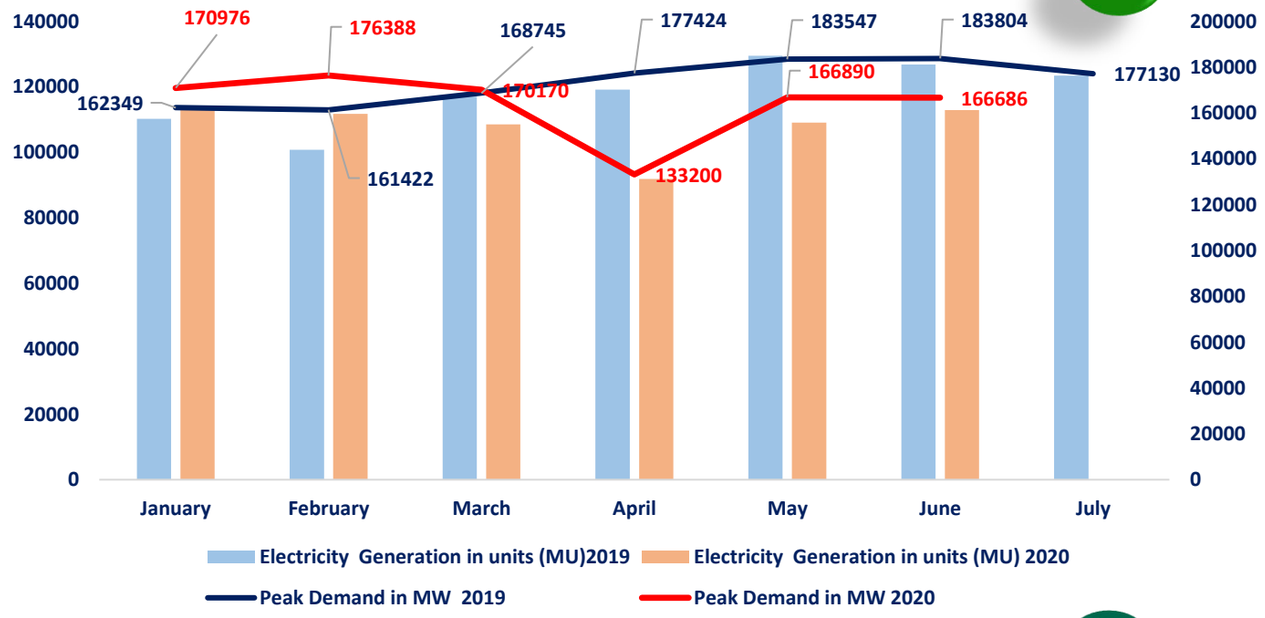
CBET and Power System Secenario-COVID-19 Times

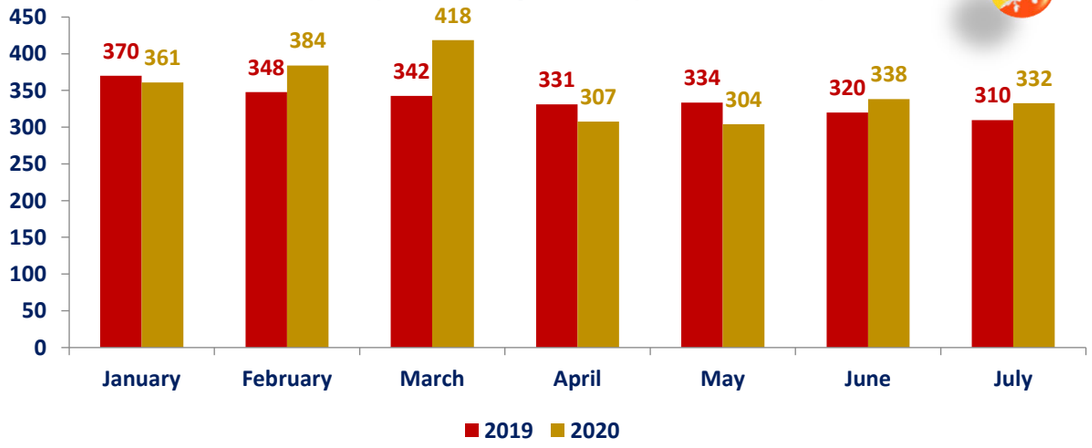
CBET In SOUTH ASIA (BBIN)



India Peak Demand (MW) & Generation (MU)



Peak Demand (MW) YoY Comparison (2019 & 2020) in Bhutan



Bangladesh Peak Demand (MW) & Generation (MU)