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South Asia Regional Energy Partnership (SAREP)

Presentation

on

"Regional Clean Energy Transition in South Asia: Current Scenario & Future Regional Outlook"

Roundtable Dialogue: Enhancing Electricity Regulatory Ecosystem for Accelerating Clean Energy Transition and Achieving Net Zero Ambitions in the South Asia Region"
11.00-13.00 Hrs., 18th September 2023

SAFIR-SAREP Regional Regulatory Dialogue (SRRD)

"Enhancing Electricity Regulatory Ecosystem for Accelerating Clean Energy Transition and Achieving Net Zero Ambitions in the South Asia Region" 18th September 2023, 10.00-13.00 Hrs, Desire Hall, Hotel Le Meridien, New Delhi, India

Presented by
Rajiv Ratna Panda, Power Market Specialist, SAREP

Contents

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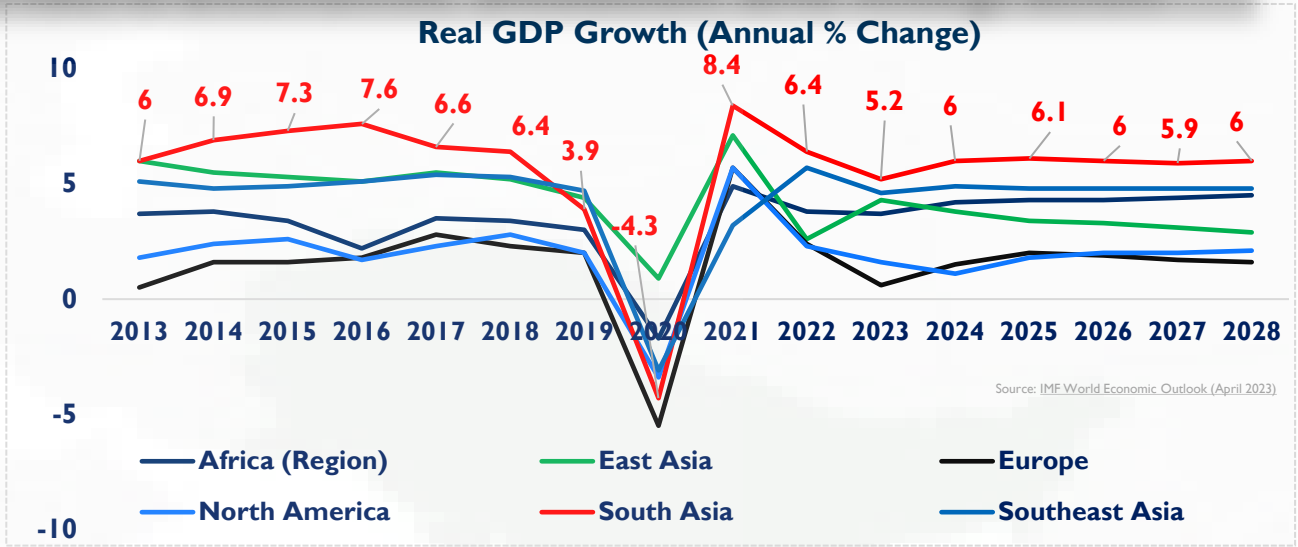
01

Macro-Economic Situation, Integration

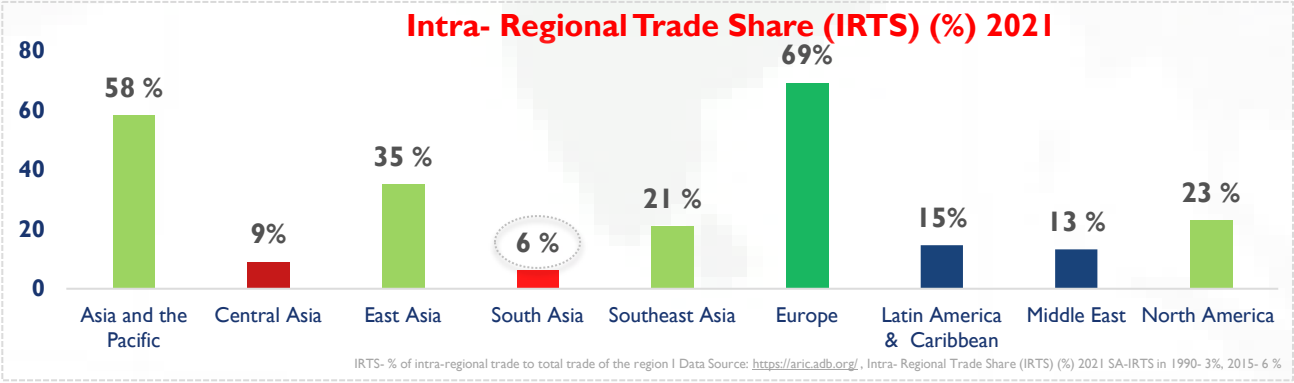
01 South Asia (SA): Macro-Economic Situation and Integration

- Decade of High Growth
- Resilient economy
- High growth prospects despite economic headwinds
- Fastest growing region



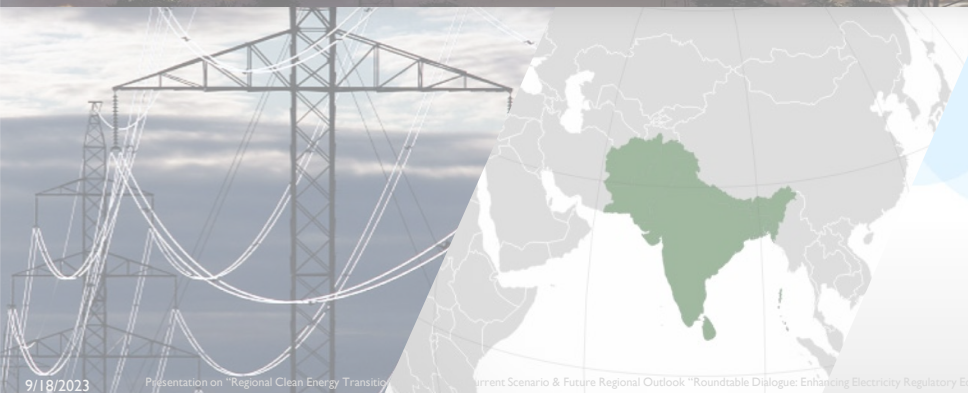
Intra-Regional Trade

- Continue to be the Least Integrated Region
- Only 6% IRTS

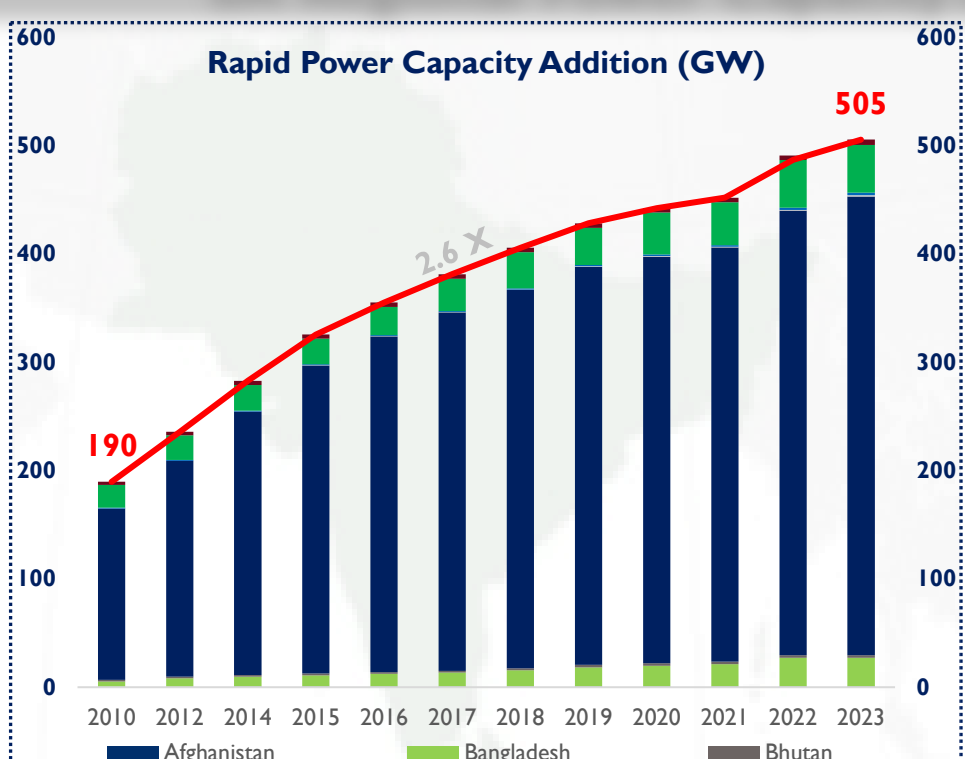


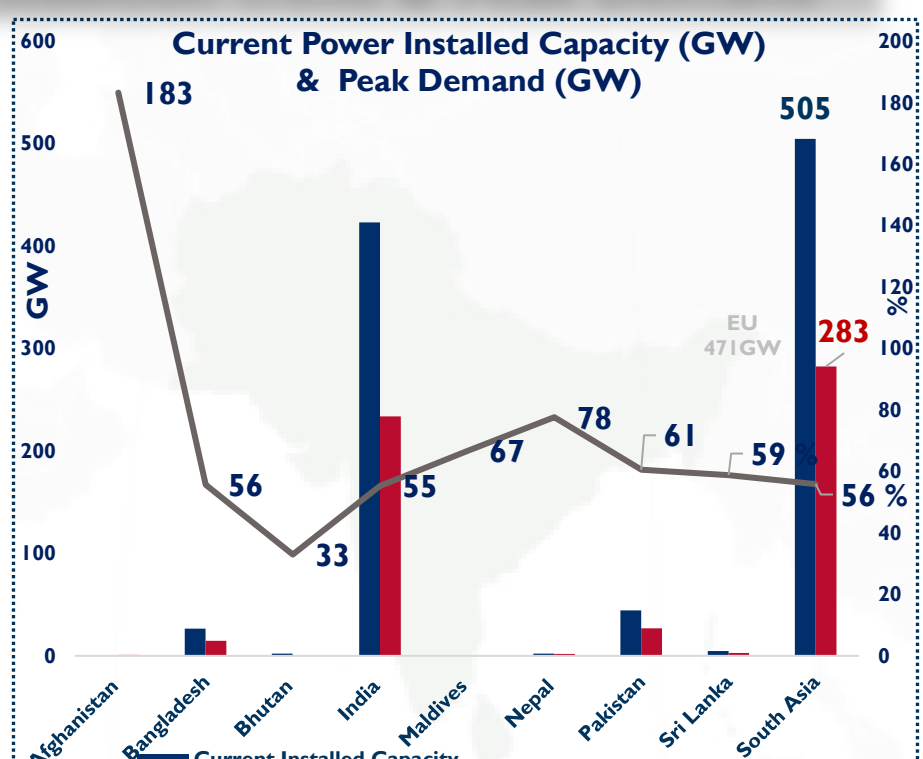
02

Regional Clean Energy Transition in South Asia:
Current Scenario



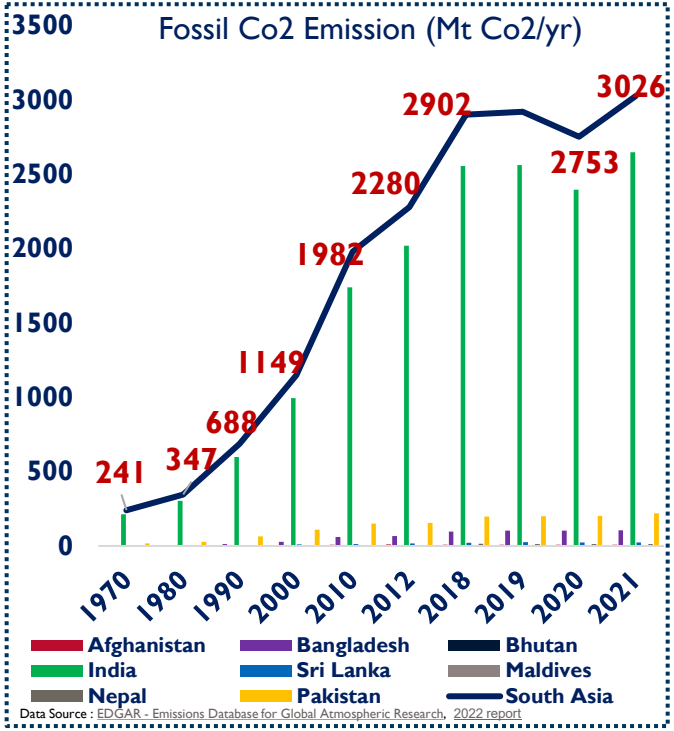
02.1 SA Regional Power Capacity Addition Trend & Peak Demand



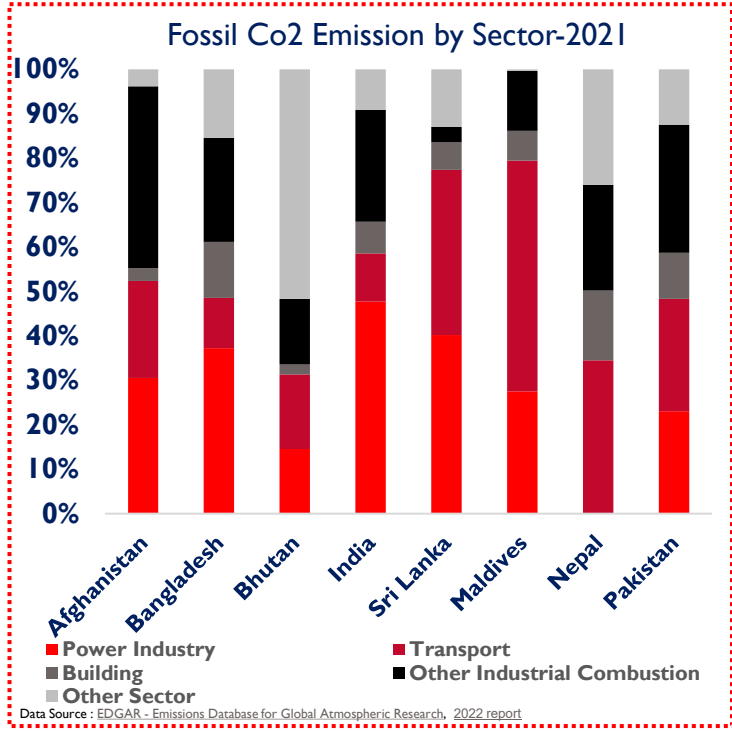


Significant Capacity Addition | 84% India | 283 GW of Peak Demand | Still Low Electricity Consumption (~1105 KWh/Capita) | World ~3105 KWh

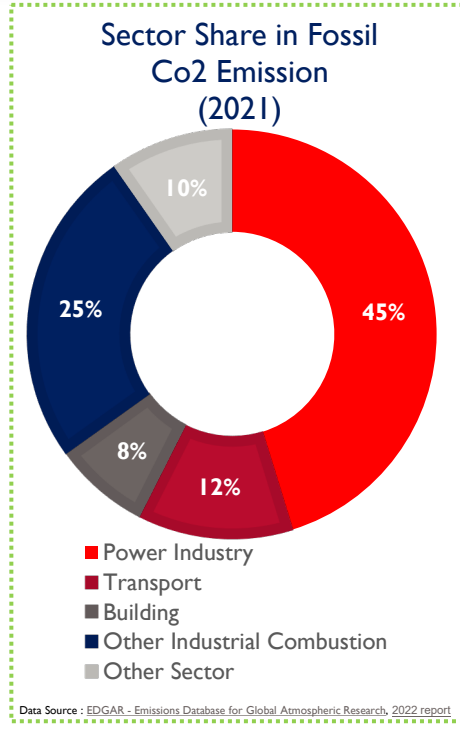
02.2 Regional Fossil Co2 Emission & SA Regional Power Sector Contribution



Data Source : EDGAR - Emissions Database for Global Atmospheric Research, 2022 report



Data Source : EDGAR - Emissions Database for Global Atmospheric Research, 2022 report

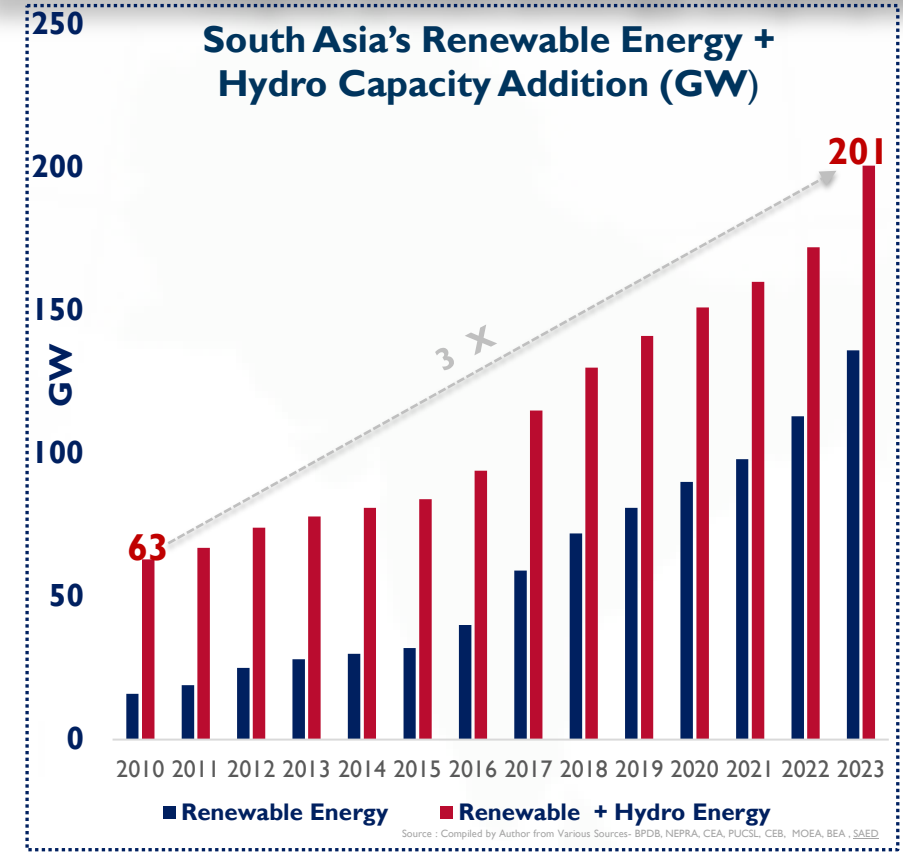


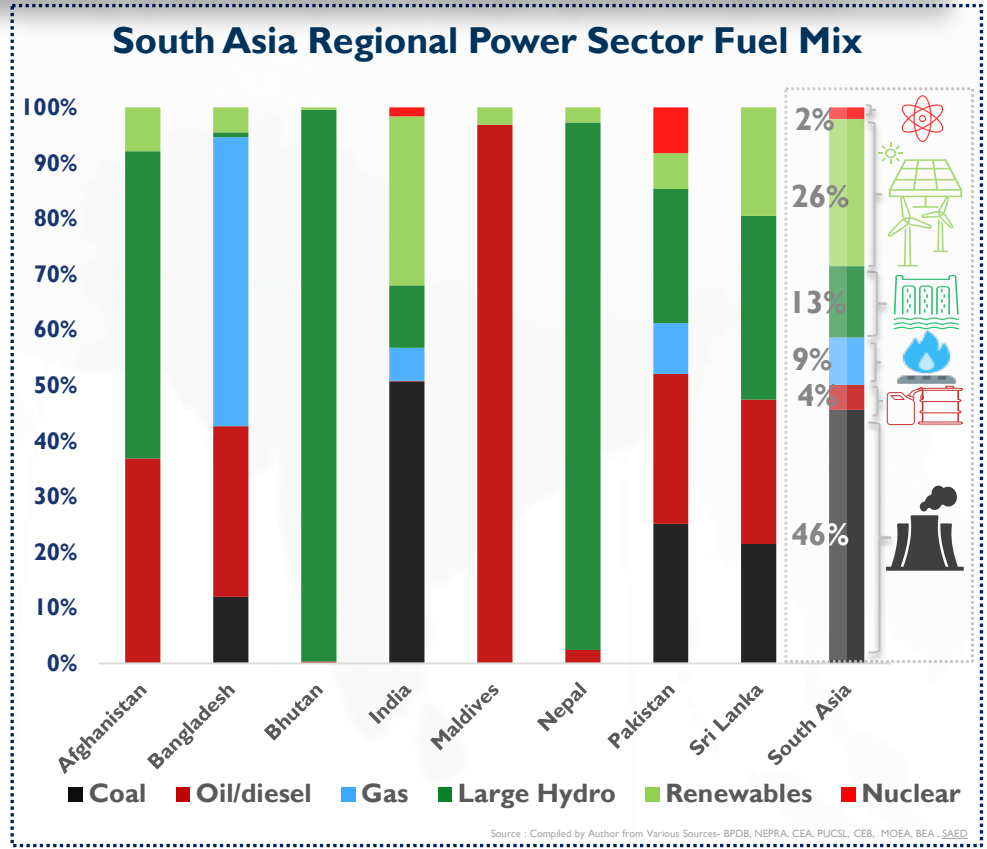
Data Source : EDGAR - Emissions Database for Global Atmospheric Research, 2022 report

Transformational Action in Power followed by Transport Sector will be Crucial in South Asia

Greening Power Sector and Electrifying Transport

02.3 Rapid Clean Energy Deployment, Continued Fossil Dominance





Tripled Renewable Energy (RE) Electricity Capacity Addition I ~201 GW RE I 59 % Fossil Capacity I 39 % RE Capacity I Fossil Domination

02.4 Cross Border Electricity Trade (CBET) in South Asia : Current Scenario

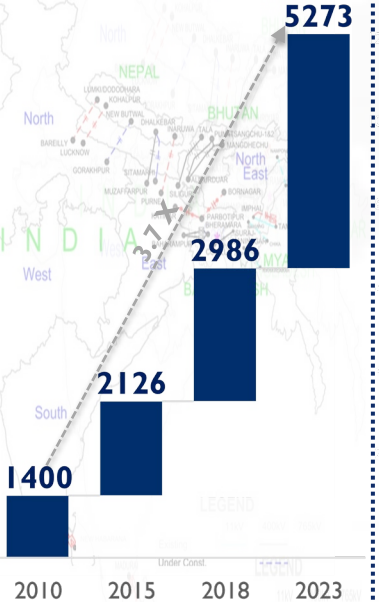
Bhutan-India ~2100 MW

India- Bangladesh ~2568 MW

Nepal-India ~ 600 MW

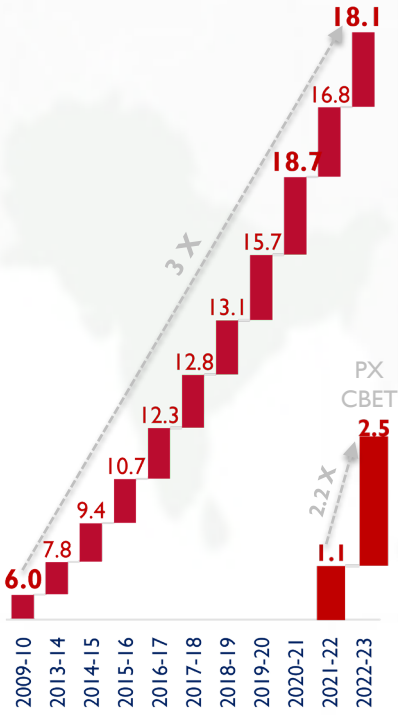
Myanmar -India ~3-5 MW

South Asia CBET* (~ 5273 MW)



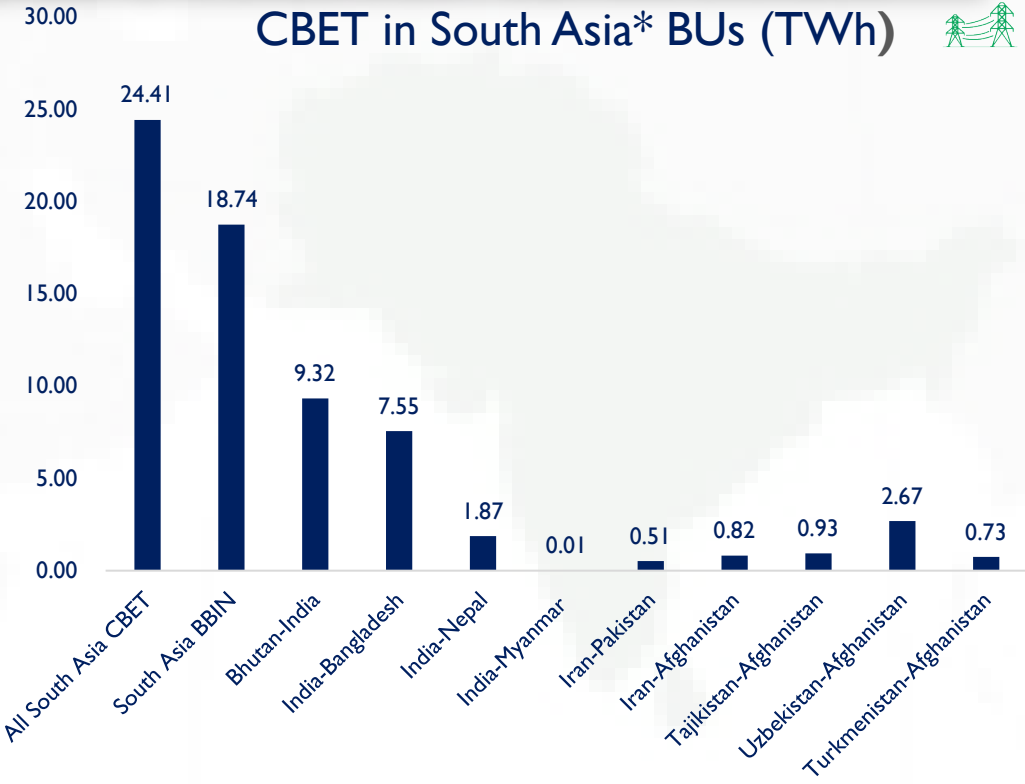
* BBINM, ~ Maximum Peak Trade Data Source-CERC, POSOCO, NEA, MEA, NSB, Grid India Daily Report, Includes Godda -> Bangladesh day Peak –Ex-1408 MW on 12-Sep-2023 & Other Sources

South Asia (BBINM) CBET BUs (TWH)



Data Source-CERC, GRID India, MEA, NE, NSB etc. BUs-Billion Units

CBET in South Asia* BUs (TWh)



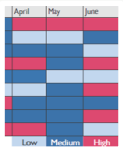
* BBIN & Trade with Neighbouring Region's Countries i.e., Afghanistan's CBET with Central Asian Countries and Iran, Pakistan's CBET with Iran, India's CBET with Myanmar
Data Source- Compile by Author from various Sources -CERC, POSOCO, NEPRA, Afghanistan Statistics , CBET-Cross Border Electricity Trade I BUs-Billion Units

CBET Tripled I Potential Remains Large I EU (ENTSOe)-427 TWh I Prospects for Inter–Regional Integration I CBET through PX- 4.3 BUs*

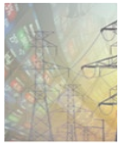
*Till July,2023

02.4 Relying on Market Based Instruments (MBIs), Regional Energy Market Development

Trend is to Rely on Competition & Market Instruments under Policy & Regulatory Oversight



Tapping Demand Diversity- Daily, Weekly ,Monthly, Seasonal

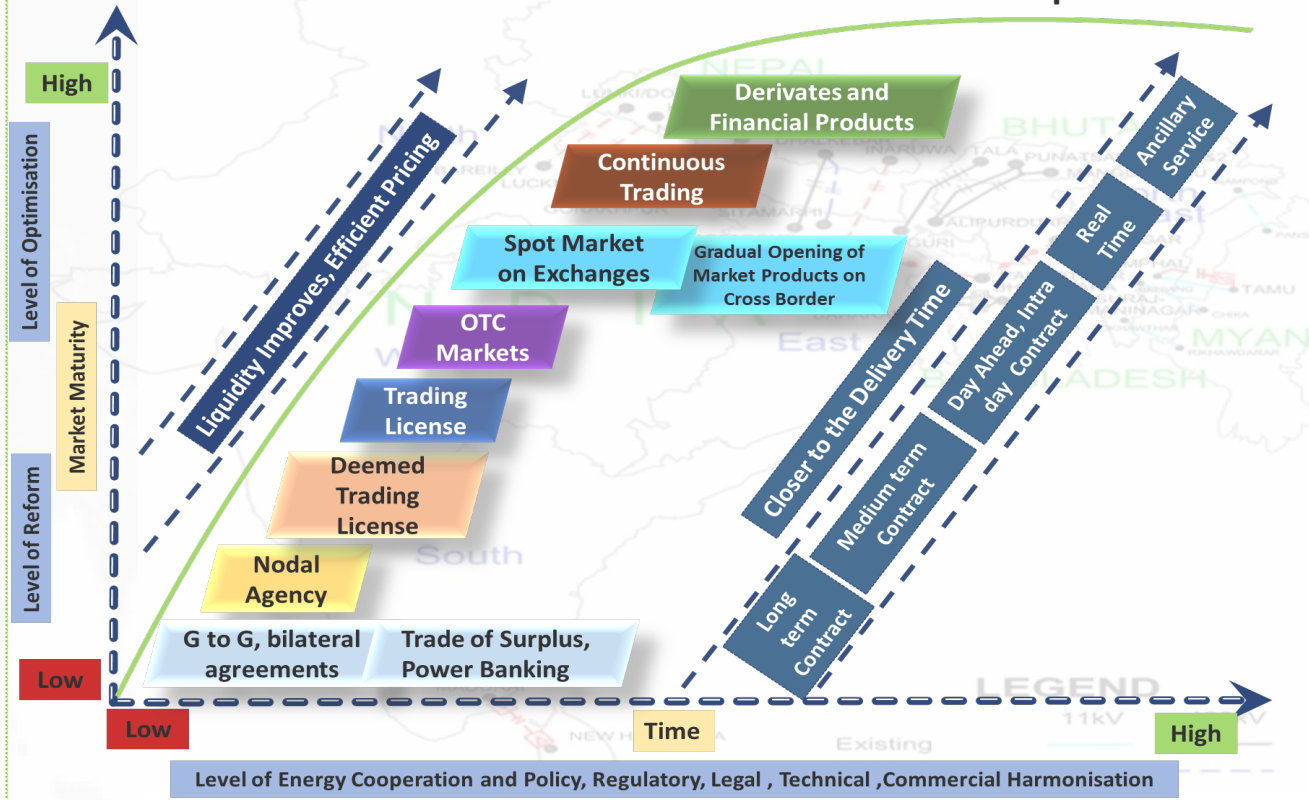


Power Exchange- Competitive price discovery, Auction Platforms

Portfolio of Product, Electricity (DAM, RT) , Green (G-DAM, G-TAM) , REC, ESCRTs

Emergence of Carbon Market, Resurgence of Carbon Credits

Possible Phase of Power Market and Product Development



Source: Compiled by Author from various Sources. Rajiv Ratna Panda/SARI/EI/

Increase in Commercial/Market CBET since 2010 I Integrated Regional Power Market will facilitate optimal allocation of cost & and benefit of clean energy transition.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03
Clean Energy Transition in South Asia :
Future Regional Outlook
FUTURE OUTLOOK

03.1 Climate, Clean Energy & Net Zero Goals of SA Countries

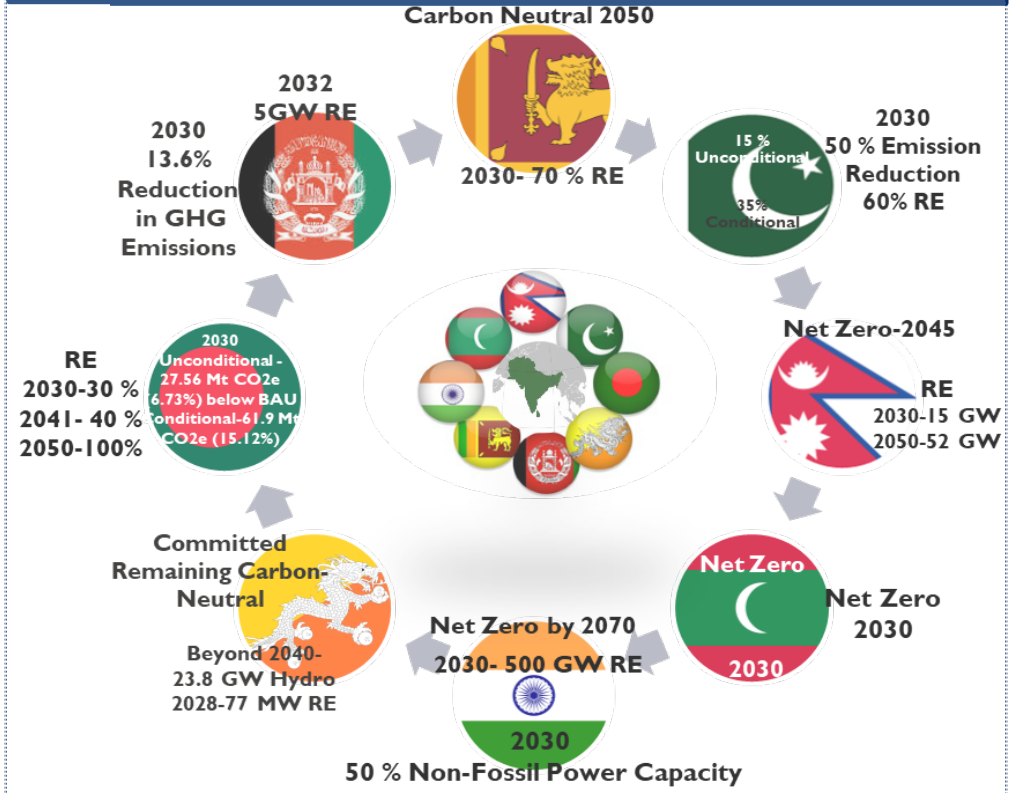
Net Zero & RE Goals/Ambitions

- **World's 1st Carbon Neutral** Country-**Bhutan**
- **Net Zero**
  - **2030**-Maldives
  - **2045**-Nepal
  - **2050**-Sri Lanka (Carbon Neutral)
  - **2070**-India
- **Renewable Energy by 2030**
  - **500 GW**-India
  - **35 GW**-Pakistan
  - **16 GW**-Bangladesh
  - **15 GW**-Nepal
  - **9.3 GW**-Bhutan
  - **8.7 GW**-Sri Lanka

584 GW RE by **2030**

Note: RE- Renewable+ Hydro/Clean Energy/Non-Fossil /Hydro as the case in a Country Context, BD-16 GW-MCPP-M Scenario (Page-82), India, Pakistan-IEGEP Plan 2018-40 Page 78 of 147, MCPP (Page 82), Sri Lanka-CEB LGTEP 2023-2042, Nepal –WAM Scenario- Page-27 of Nepal's LTS for Net-zero, Bhutan- NTGM-2018 (Page 17, Graph -2)

Climate-Induced Energy Sector Transformation



Source : Compiled by Author from Various Sources, RE-Renewable/Clean Energy, Afghanistan - UNFCC , AREP , Bangladesh – UNFCC , MCPP (Page 84 & 81), Bhutan- UNFCC , NTGM-2018 , 88 MW (Page-15- UNFCC) , India - UNFCC , 500 GW RE/Non-Fossil Capacity by 2030 ; Maldives- UNFCC , Nepal- UNFCC , Pakistan- UNFCC , Sri-Lanka (UNFCC) Presentation on Envisioning Trans-Regional Energy Connectivity between the SA – SEA Grids

03.2 Transformational Action Across Energy Value Chain in South Asia : Future Outlook

Electrifying and Greening the Way of Life

Rapid De-carbonising Power Sector

Cleaner and Efficient Public Transport

Renewable Energy

Electric Vehicle & Charging Infrastructure

Modernising power grid , smart grid, smart utility

Green Hydrogen Economy and Energy Storage

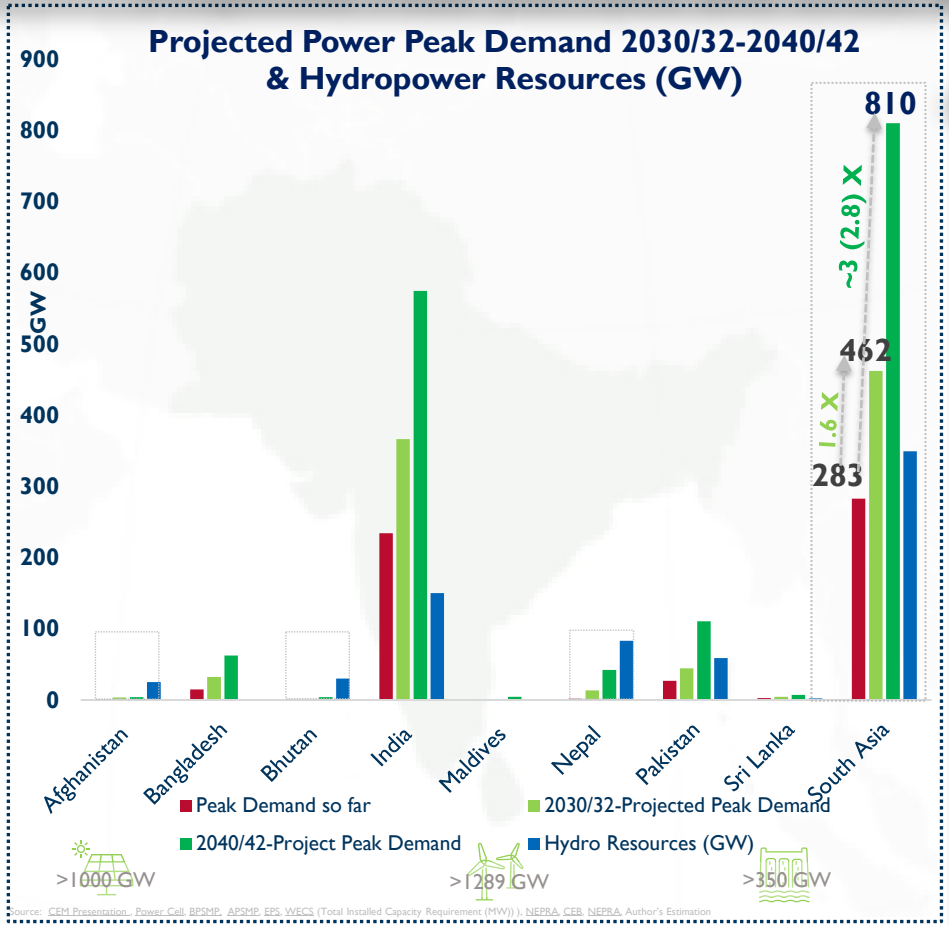
Cross Border Hydro Power Projects & Cross Border Power Transmission

Natural Gas, LNG and Region Gas Grid

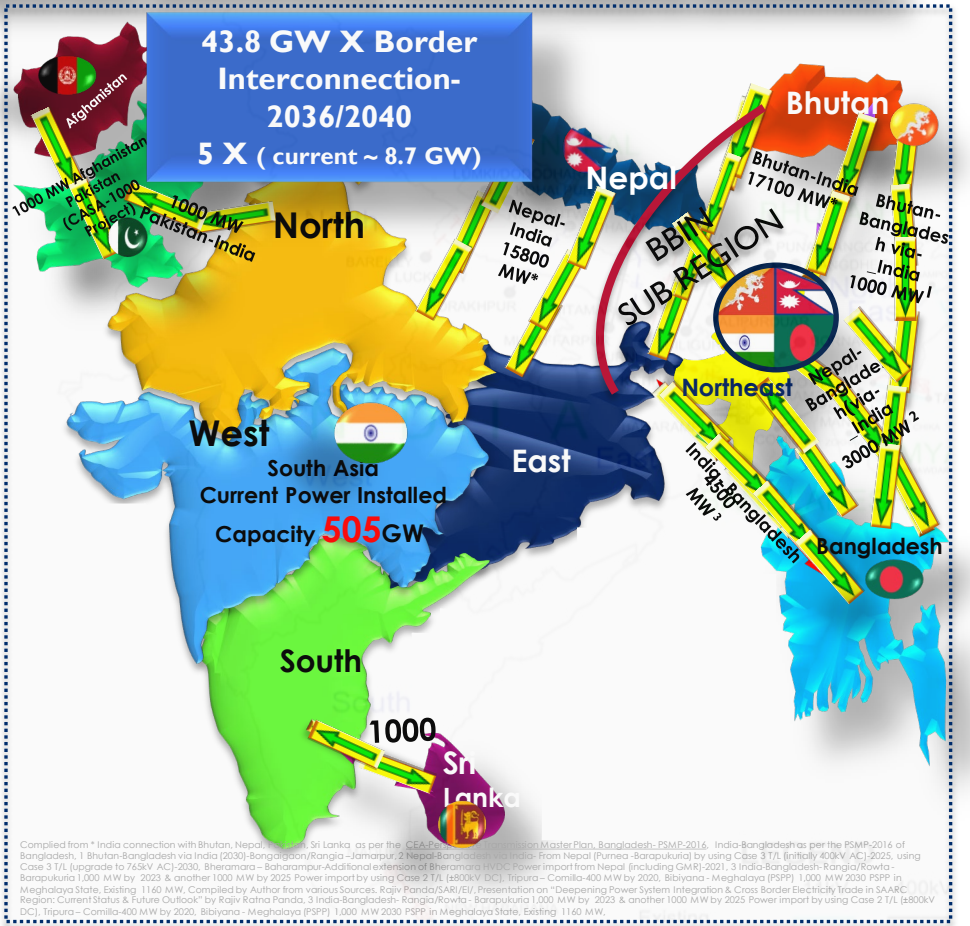
South Asia Power & Energy System is Undergoing Transformation : Electrifying and Greening the Way of Life

Source: Presentation on Creating Conducive Environment-Regional Investment Framework for Mobilizing Investment in Regional Energy Infrastructure projects in South Asia

03.3 Projected Peak Demand and Cross Border Electricity Trade Future Outlook



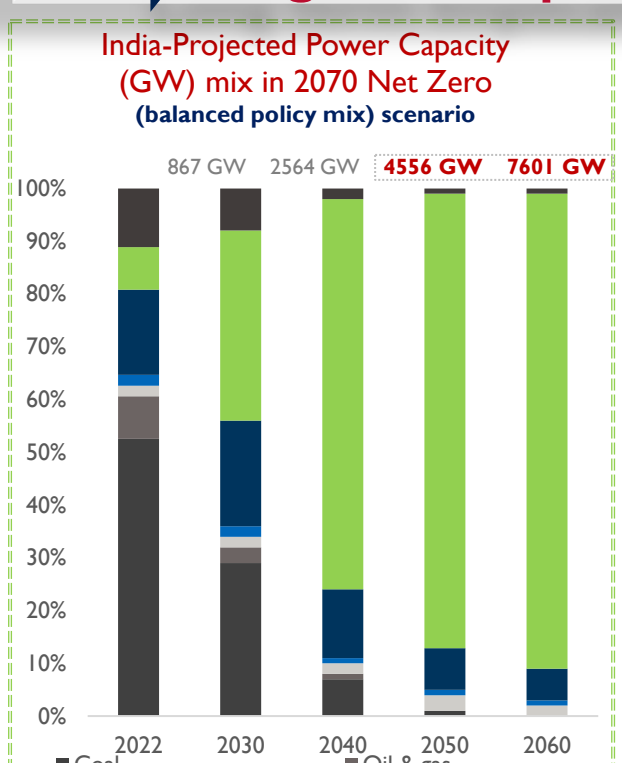
Source: CEM Presentation , Power Cell, BPSMP, APSMP, EPS, WECS (Total Installed Capacity Requirement (MW))), NEPRA, CEB, NEPRA, Author's Estimation

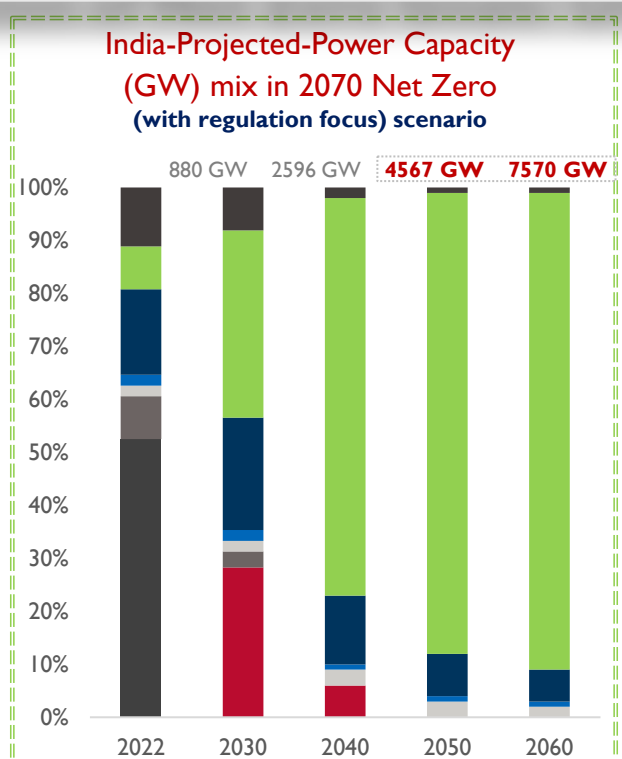


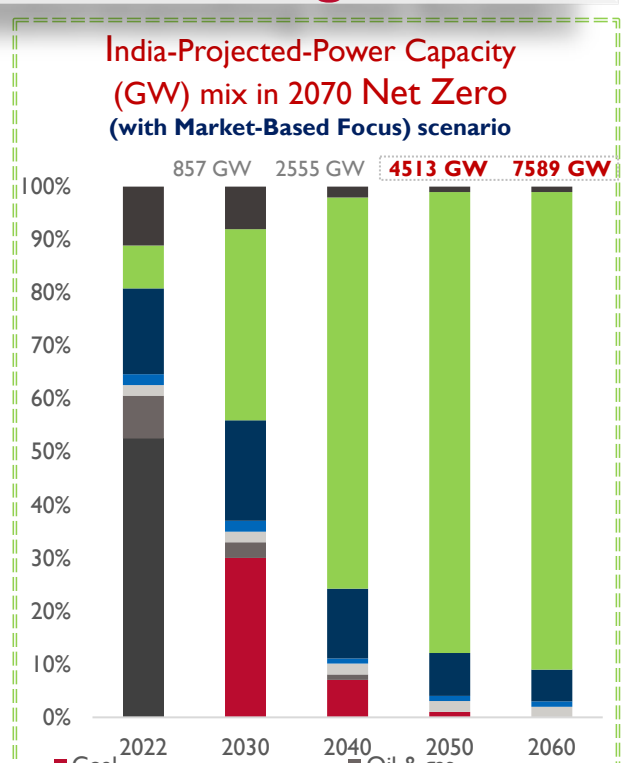
Complied from * India connection with Bhutan, Nepal, Bangladesh, Sri Lanka as per the CEA-Power System Transmission Master Plan, Bangladesh- PSMP-2016. India-Bangladesh as per the PSMP-2016 of Bangladesh, 1 Bhutan-Bangladesh via India (2030)-Bongaigaon/Rangia –Jamarpur, 2 Nepal-Bangladesh via India- 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 2 T/L (±800kV DC), Tripura – Comilla-400 MW by 2020, Bibiyana - Meghalaya (PSPP) 1,000 MW 2030 PSPP in Meghalaya State, Existing 1160 MW, Compiled by Author from various Sources. Rajiv Panda/SARI/EI/, Presentation on "Deepening Power System Integration & Cross Border Electricity Trade in SAARC Region: Current Status & Future Outlook" by Rajiv Ratna Panda, 3 India-Bangladesh- Rangia/Rowta - Barapukuria 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 2030 PSPP in Meghalaya State, Existing 1160 MW,

Recent Announcement are Encouraging- Prime Minister Shri Narendra Modi during the visit of Prime Minister of Nepal June 01, 2023, said, India to Import 10,000 MW of Power from Nepal in Next 10 Years

03.4 Long Term Implication of Net Zero Goals- Understanding the Scale



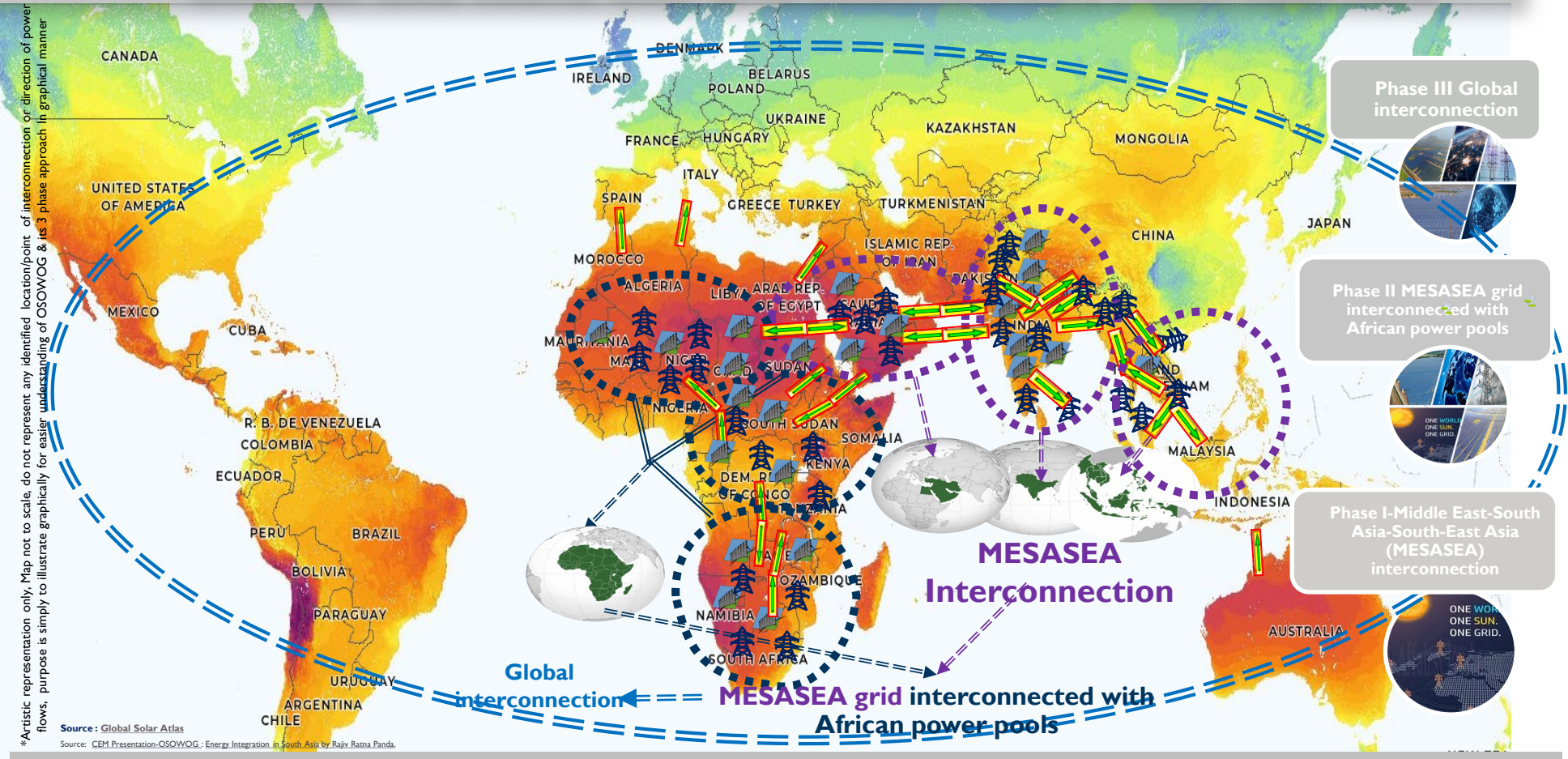




Getting India to Net Zero

India will need around $10.1Trillion in Cumulative Economy-wide Investment from now to meet its 2070 target I 7601 GW by 2060

03.4 One Sun One World One Grid (OSOWOG)-3 Phase Approach



*Artistic representation only, Map not to scale, do not represent any identified location/point of interconnection or direction of power flows, purpose is simply to illustrate graphically for easier understanding of OSOWOG & its 3 phase approach in graphical manner

Source : Global Solar Atlas

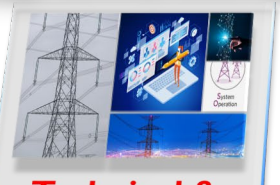
Source: CEM Presentation-OSOWOG : Energy Integration in South Asia by Rajiv Ratna Panda.

OSOWOG will provide further impetus to South Asia Grid Interconnection I Building Regional, Sub-Regional Consensus will be the key

03.5 Benefits of Integrated, Complementary Regional Energy Integration & Challenges

Economic & Financial

- Optimal System/Resource Development
- Export Revenues
- Economic Extension of grid
- Economic growth



Technical & Operational

- Larger grid, better grid
- Seasonal/Peak /Time zone differences
- Better Hydro -Thermal Mix
- Regional Balancing
- Trilateral Trade

Climate and Net Zero

- Achieving Climate/ Net Zero Goals
- Clean Energy Development
- RE based CBET
- Improved Energy & Climate Security

Regional Energy Market

- Competitive Energy Market
- Transparent Price Discovery
- Choice of Products
- Consumer Benefits & Social Welfare

Mobilizing of Investment

- New Investment Avenues
- Enhanced feasibility due to larger market
- Innovative Financing Mechanism

Challenges : Navigating Debates Around Energy Security-Interdependence | Resource Nationalism | Prioritisation of Regional-National Objectives | Competitive-Cooperative Spirit | Market access | Geopolitical Realities in a quantifiable manner to feed into planning processes

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G20 New Delhi Leaders' Declaration:

Extraordinary Consensus

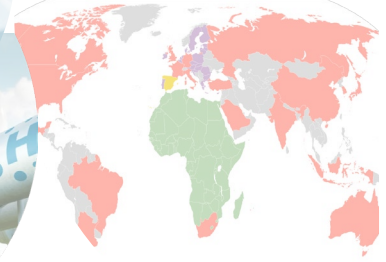
G20
भारत 2023 INDIA

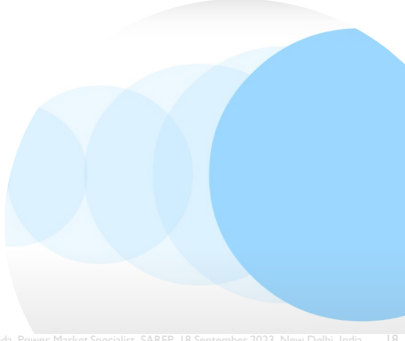
वसुधैव कुटुम्बकम्

ONE EARTH • ONE FAMILY • ONE FUTURE

G20 New Delhi Leaders' Declaration

New Delhi, India, 9-10 September 2023





G20 New Delhi Leaders' Declaration, 9-10 September 2023

G20:- 85% global GDP, 75% global trade, and two-thirds of world population

C. Green Development Pact for a Sustainable Future

implementation and support. We reiterate our commitment to achieve global net zero GHG emissions/carbon neutrality by or around mid-century, while taking into account the latest scientific developments and in line with different national circumstances, taking into account different approaches including the Circular Carbon Economy, socio-economic, technological, and market development, and promoting the most efficient solutions.

Source: G20 New Delhi Leaders' Declaration

Implementing Clean, Sustainable, Just, Affordable & Inclusive Energy Transitions

xi. Recognize the role of grid interconnections, resilient energy infrastructure and regional/cross-border power systems integration, where applicable in enhancing energy security, fostering economic growth and facilitating universal energy access for all.

Source: G20 New Delhi Leaders' Declaration

05

Suggestions and Way Forward

05

Five Point Suggestion and Way Forward

1. **Coordinated and Complementary Regional Regulatory Frameworks:** Transition needs Transformational Action. Net Zero & Clean Energy Transition investments are long-term and irreversible in nature. Regulators can play a facilitating role by providing a level playing field for ensuring a smooth and balanced transition in a manner that is
   - ❖ **Resilient**
   - ❖ **Economical**
   - ❖ **Sustainable &**
   - ❖ **Inclusive (RESI)**
2. **Getting South Asia (BBIN) to Net Zero :** Conduct a comprehensive South Asia Regional Economy Wide Assessment (**SAREA**) on scope for optimization through Deepening Regional Energy Cooperation and Cross Border Electricity Trade for meeting Net Zero and climate Goals and it's quantitative and qualitative impact.
3. Create a "**High-Level Regulatory Working Group on Energy and Climate Prosperity (RWG-ECP)**" to evolve RESI-compatible **Long-Term Energy Regulatory Pathways & Roadmaps-2070** for clean energy transition, achieving Net Zero in South Asia (BBIN). (To be updated & and reviewed at regular intervals to remain consistent with technology progress/development)
4. Spur the development of **Innovative Regulatory & Market Instruments** (**IRMI**) for Regional Energy Market, Commission Biennial Knowledge Report on"**South Asia Clean Energy Transition & Net Zero Outlook** (SACETO)"
5. Commission and Institutionalise a South Asia Annual Regional Training Program on " **Regulatory Innovation for Accelerating Clean Energy Transition and Achieving Net Zero Goals** "

NEEDS A LONG-TERM APPROACH - NET ZERO REGULATORY ALLIANCE FOR KNOWLEDGE EXCHANGE

Thank You

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Disclaimer

The data, information and assumptions (hereinafter 'data-set') used in this document are in good faith and from the source to the best of SAREP (the program) knowledge. The program does not represent or warrant that any data-set used will be error-free or provide specific results. The results and the findings are delivered on "as-is" and "as-available" data-set. All data-set provided are subject to change without notice and vary the outcomes, recommendations, and results. The program disclaims any responsibility for the accuracy or correctness of the data-set. The burden of fitness of the data-set lies completely with the user. In using the data-set data source, timelines, the users and the readers of the report further agree to indemnify, defend, and hold harmless the program and the entities involved for all liability of any nature.

Getting India to Net Zero

POWER CAPACITY AND GENERATION MIX IN THE 2070 NET ZERO (BALANCED POLICY MIX) SCENARIO

		2022	2030	2040	2050	2060
Power capacity	GW	402	867	2,564	4,556	7,601
Coal	% of total	52	29	7	1	0
Oil & gas	% of total	8	3	1	0	0
Fossil fuels with CCS	% of total	0	0	0	0	0
Nuclear	% of total	2	2	2	3	2
Biomass (inc. with CCS)	% of total	2	2	1	1	1
Wind	% of total	16	20	13	8	6
Solar	% of total	8	36	74	87	90
Hydro	% of total	11	8	2	1	1
Power generation	TWh	1,850	2,811	5,901	9,967	15,886
Coal	% of total	76	50	11	1	0
Oil & gas	% of total	1	1	0	0	0
Fossil fuels with CCS	% of total	0	0	0	0	1
Nuclear	% of total	3	4	8	9	7
Biomass (inc. with CCS)	% of total	2	3	2	2	2
Wind	% of total	6	10	8	5	4
Solar	% of total	4	24	67	81	86
Hydro	% of total	6	9	3	2	1

Source: TABLE 0.14, Page No- , 66 , Getting India to Net Zero , A Report Of The High-level Policy Commission On Getting Asia To Net Zero, ASPI , A REPORT OF THE HIGH-LEVEL POLICY COMMISSION ON GETTING ASIA TO NET ZERO CONVENED BY THE ASIA SOCIETY POLICY INSTITUTE AS SECRETARIAT

Getting India to Net Zero

POWER CAPACITY AND GENERATION MIX IN THE 2070 NET ZERO (WITH REGULATION FOCUS) SCENARIO

		2022	2030	2040	2050	2060
Power capacity	GW	402	880	2,596	4,567	7,570
Coal	% of total	52	28	6	0	0
Oil & gas	% of total	8	3	0	0	0
Fossil fuels with CCS	% of total	0	0	0	0	0
Nuclear	% of total	2	2	3	3	2
Biomass (inc. with CCS)	% of total	2	2	1	1	1
Wind	% of total	16	21	13	8	6
Solar	% of total	8	35	75	87	90
Hydro	% of total	11	8	2	1	1
Power generation	TWh	1,850	2,814	5,946	9,992	15,860
Coal	% of total	76	49	9	0	0
Oil & gas	% of total	1	1	0	0	0
Fossil fuels with CCS	% of total	0	0	0	1	1
Nuclear	% of total	3	4	8	9	7
Biomass (inc. with CCS)	% of total	2	3	2	2	2
Wind	% of total	6	10	8	5	4
Solar	% of total	4	24	69	82	86
Hydro	% of total	6	9	3	2	1

Source: TABLE 0.15 Page No- . 67 , Getting India to Net Zero , A Report Of The High-level Policy Commission On Getting Asia To Net Zero, ASPI , A REPORT OF THE HIGH-LEVEL POLICY COMMISSION ON GETTING ASIA TO NET ZERO CONVENED BY THE ASIA SOCIETY POLICY INSTITUTE AS SECRETARIAT

Getting India to Net Zero

POWER CAPACITY AND GENERATION MIX IN THE 2070 NET ZERO (WITH MARKET-BASED FOCUS) SCENARIO

		2022	2030	2040	2050	2060
Power capacity	GW	402	857	2,555	4,513	7,589
Coal	% of total	52	30	7	1	0
Oil & gas	% of total	8	3	1	0	0
Fossil fuels with CCS	% of total	0	0	0	0	0
Nuclear	% of total	2	2	2	2	2
Biomass (inc. with CCS)	% of total	2	2	1	1	1
Wind	% of total	16	19	13	8	6
Solar	% of total	8	36	73	86	90
Hydro	% of total	11	8	2	1	1
Power generation	TWh	1,850	2,809	5,888	9,908	15,864
Coal	% of total	76	51	12	2	0
Oil & gas	% of total	1	1	0	0	0
Fossil fuels with CCS	% of total	0	0	0	0	1
Nuclear	% of total	3	3	7	8	7
Biomass (inc. with CCS)	% of total	2	3	2	2	2
Wind	% of total	6	9	8	5	4
Solar	% of total	4	23	67	81	86
Hydro	% of total	6	9	3	2	1

Source: TABLE 0.16 Page No- . 68 . Getting India to Net Zero . A Report Of The High-level Policy Commission On Getting Asia To Net Zero. ASPI . A REPORT OF THE HIGH-LEVEL POLICY COMMISSION ON GETTING ASIA TO NET ZERO CONVENED BY THE ASIA SOCIETY POLICY INSTITUTE AS SECRETARIAT