South Asia Regional Initiative for Energy Integration (SARI/EI)

South Asian Power Sector :
Investment Prospects, Challenges and Issues

South Asia: Shaping the New Paradigm for Growth
SAARC Chamber of Commerce

3rd June 2016,Kalutara, Sri Lanka

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Outline of Presentation

- Overview of SARI/EI: Key Achievements and Publications
- Overview of South Asian Power Sector
- Resource Potential Across South Asian Region
- Key Drivers for Investment in CBET and Regional exploitation of Resources
- Country Wise: Capacity Addition Planned & Investment Required
- Issues related to investment and financing of Power projects, CBET infrastructures .

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Overview SARI/EI Program: South Asia Regional Initiative for Energy Integration (SARI/EI)

- **SARI/E is a long standing program of USAID started in the year 2000.**

- **Program has consistently strived to address energy security in South Asia by focusing**
  1) Cross Border Energy Trade
  2) Energy Market Formation and
  3) Regional Clean Energy Development.

- **SARI/EI–Phase IV (2012-2017): Key Outcomes.**
  Three Key Development Outcomes:
  1. *Coordinate policy, legal and regulatory issues.*
  2. *Advance transmission interconnections.*
  3. *Establish South Asia Regional Electricity Markets.*

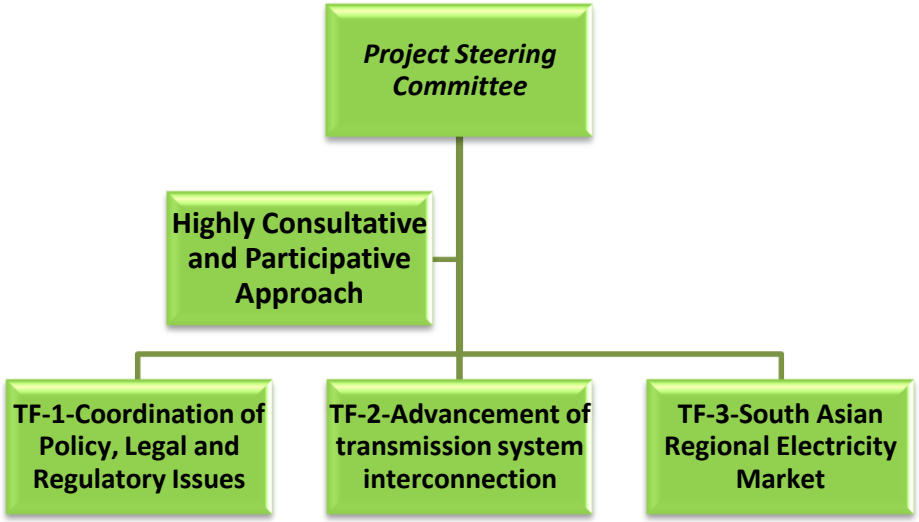
- **First Three Year of the Program is Completed.**

- **Demand Driven 'Bottom Up' Approach**

- **IRADe, a regional organization, is implementing partner**

SARI/EI Framework

- **Project Steering Committee (PSC)** is the apex body of the program and provides overall strategic directions.
- PSC members consist of **Senior level officials from the country governments, SAARC, ADB, Independent Energy Experts/Diplomats.**
- Task Forces are **represented by Government Nominated members of level of Directors/Chief Engineers/Members etc. from Utilities, Regulators, planners, Power Exchanges of SA countries.**



- **TF1: Coordination of Policy, Legal and Regulatory issues**

- **TF-2: Advancement of transmission system interconnection**

- **TF 3: South Asian Regional Electricity Market**

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Demand Driven Studies /Exercises to Achieve the Deliverables of Task Forces as Defined in the Terms of Reference of Task Forces

TF-1 :

- **Study -1: Study on R**eview of policies, regulations and laws, preparation regulations etc. ***(Report has been finalized, Proposed Changes, amendments in electricity laws, regulations and policies Regional Regulatory Guidelines) -Completed***
- **Study-2:** Study on Investment policies/guidelines for SA countries ***(On going)***

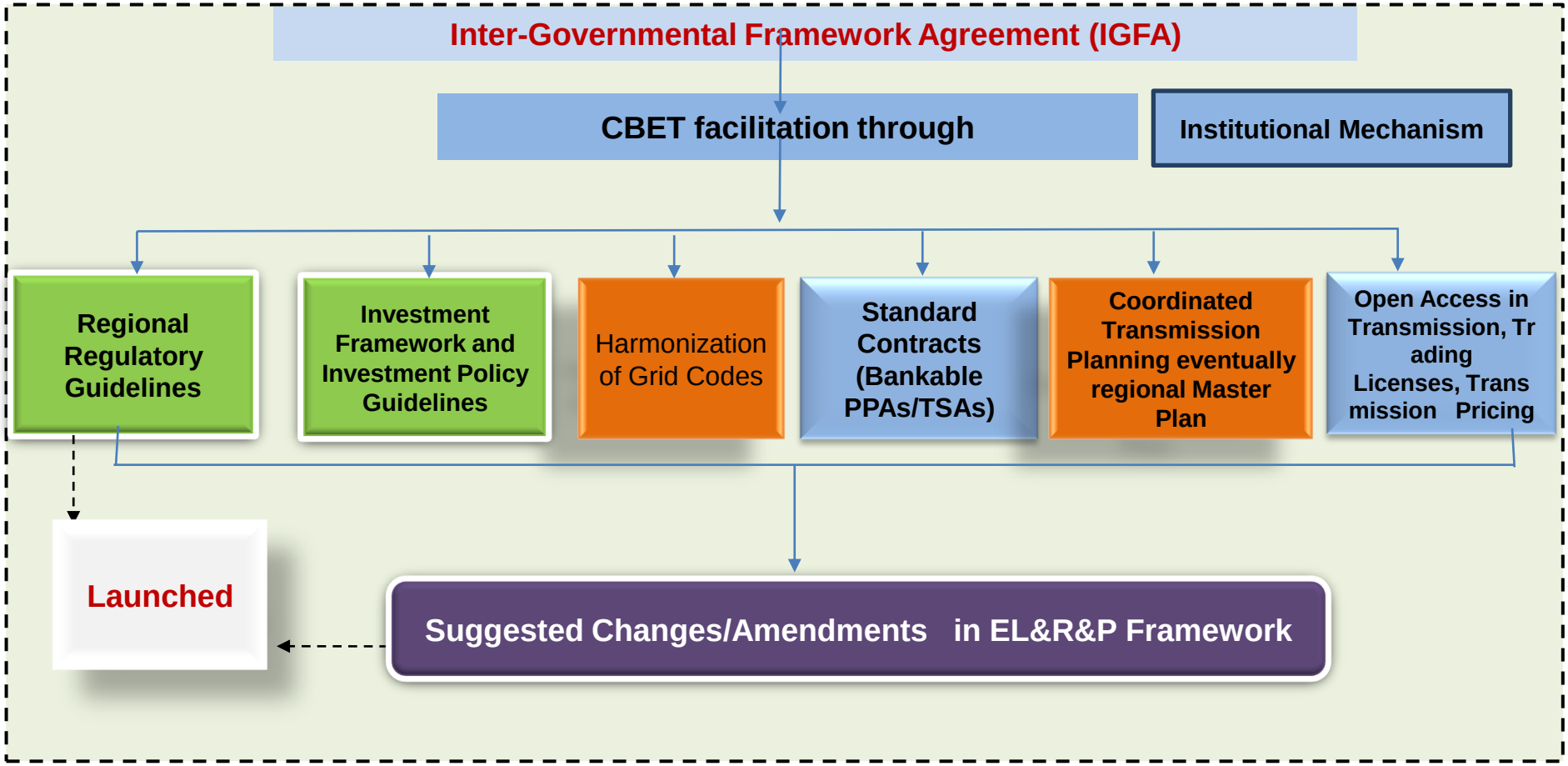
TF-2 :

- **Study 1:** Study to find out the Trading Potential of South Asian Countries ***(Draft Final Report -Ongoing)***
- **Study 2:** Harmonization of Grid Codes ***(Draft final Report-Ongoing)***

TF-3 :

- **Study 1:** "Assessment and recommendation of commercial terms & conditions for Cross Border Electricity Trade (CBET) and suggesting the model Of Power Exchange in South Asian region" ***(Draft Final Report– Ongoing)***
- **Study 2:** Implementation of Pilot Market & Market rules ***(RFP Issued)***

Overall Framework for development of CBET in South Asia



SARI/EI: Key Achievements

1. "Regional Regulatory Guideline" and "Suggested Changes/Amendments in Electricity Laws, Regulations and Policies of South Asian Countries for Promoting Cross Border Electricity Trade in the South Asian Region"- Launched.

2. SARI/EI Participation in 2nd SAARC energy Regulators meeting :
    1. SARI/EI and ADB to provide technical advice to SAARC Council of Experts of Energy Regulators.
    2. SARI/EI to assist SAARC Energy Centre in preparation of Compendium of Regulations.

3. SARI/EI PSC strengthened by the PSC nomination from SAARC secretariat, Nominations from Pakistan in TFs.

4. Engaging and partnering with SAARC Energy Centre, Islambad.

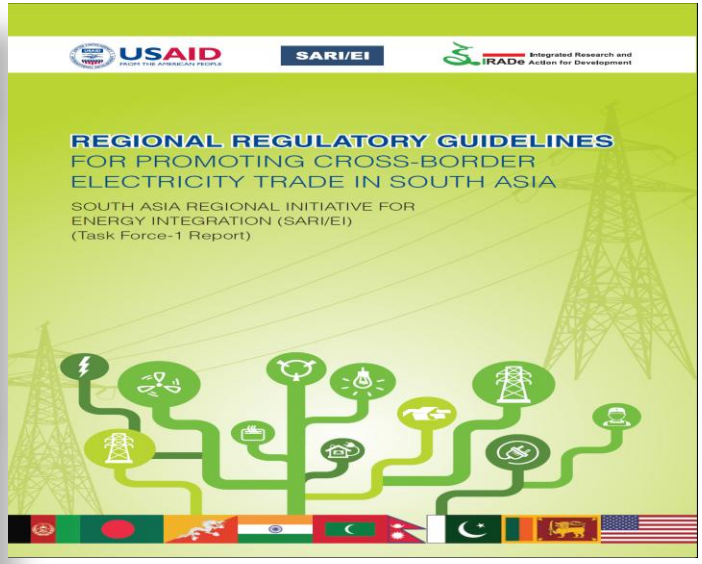
5. Some Key Events:
    - ✓ SAFIR-SARI/EI Joint Workshop on Sustainable Development SA power sector & CBET: Policy, regulatory issues and challenges
    - ✓ Power Cell, MPEMR, GoB,-SARI/EI Joint workshop on "Power Market Development in India: Key Lessons Learnt."
    - ✓ SA Investors workshop: Challenges and Opportunities.

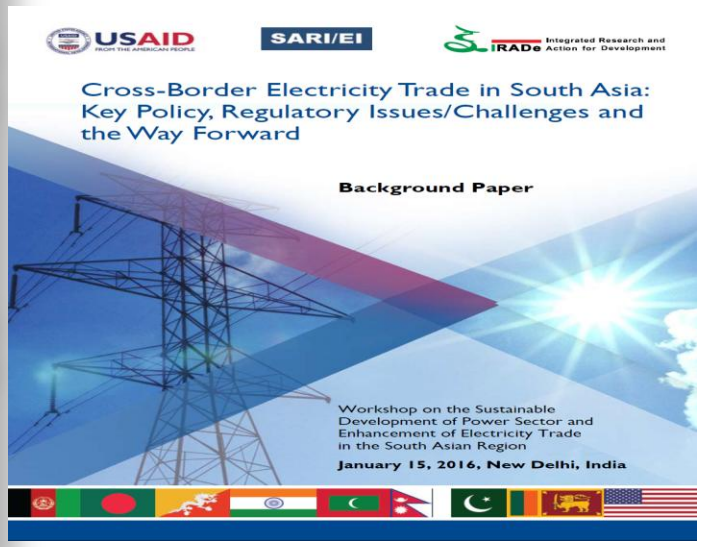
6. Program Outreach : Launched SARI/EI News Mailer and Annual Updates.

Launch of SARI/EI TF-1 report on Suggested Changes/Amendments in Electricity Laws, Regulations and Policies of South Asian Countries for Promoting Cross-Border Electricity Trade in the South Asian Region by Mr. Nasrul Hamid,MP, Hon'ble State Minister, MPEMR, Govt. of Bangladesh

Major Publications

1) Back ground paper on “Prospects for Regional Cooperation on Cross-Border Electricity Trade in South Asia”
2) Inaugural Conference Proceedings .
3) European Regional Power Market Study Tour Report.
4) Concept Paper on “Cross Border Electricity Trade in South Asia: Investment Challenges and Opportunities”
5) Investor Workshop Proceedings.
6) Background Paper on “Cross Border Electricity trade in South Asia: Key Policy, Regulatory Issues/Challenges and the way forward “
7) Regional Regulatory Guidelines.
8) Suggested Changes/ Amendments in Electricity laws, Regulation and Policies of SA countries for Promoting CBET.
9) Annual Updates





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Overview of South Asian Power Sector

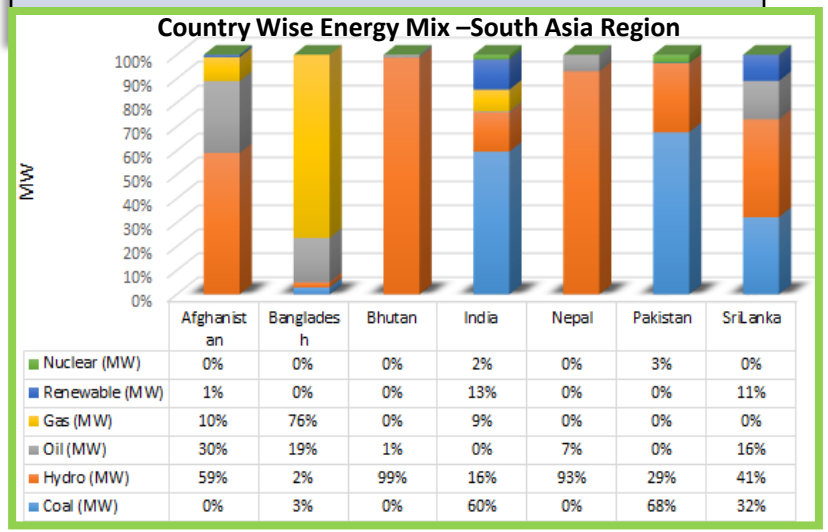
South Asian Power Sector. Total Installed capacity of around 3,47,593 MW

- ✓ **Afghanistan :** Small Power system(1341 MW), Electricity Imports high, Hydro Dominated.
- ✓ **Bhutan:** Small Power system (1614 mw) Hydro dominated, Surplus Hydro , Exporting to India
- ✓ **Bangladesh :** Gas Dominated, Resource Constraints , Imports Electricity from India and in future will remain as a Importing Country.
- ✓ **India:** Very Large Power System, Coal Dominated, reducing deficits, long terms electricity demand are huge and potential large market, Electricity importing and exporting nation.
- ✓ **Nepal :** very Small Power system (765 MW), Hydro based, very high deficits, Importing Electricity from India , Potential exporter and importer of electricity.
- ✓ **Sri Lanka:** hydro dominated but the fuel mix is changing, no trading at present, High peak demand.

Overall SA region is a power hungry region and per capita consumption is very low. Large part of population remains without access to electricity.

Country	Installed Capacity (MW)
Afghanistan	1341
Bhutan	1,614
Bangladesh	12,071
India	**302833**
Nepal	765
Sri Lanka	4050
Pakistan	24,829
Total	**347593**

Source : Compiled form various sources PGCB, DGPC,CEA,Annual Report NEA, Status of Industry Report NEPRA, Task Force 1 Report IRADe Report on CBET in

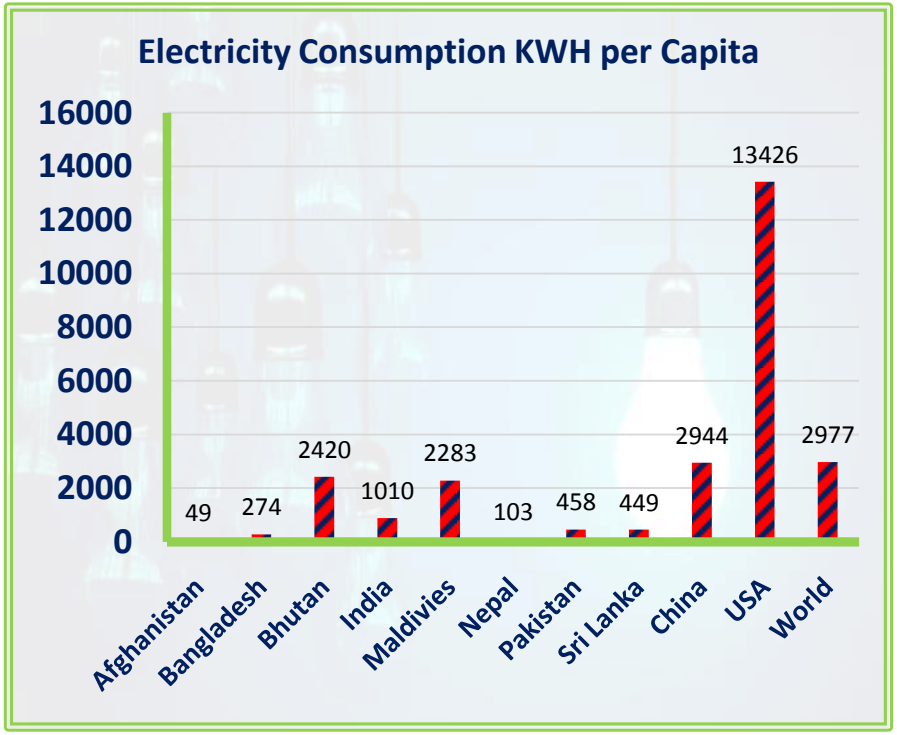


	Afghanistan	Bangladesh	Bhutan	India	Nepal	Pakistan	SriLanka
Nuclear (MW)	0%	0%	0%	2%	0%	3%	0%
Renewable (MW)	1%	0%	0%	13%	0%	0%	11%
Gas (MW)	10%	76%	0%	9%	0%	0%	0%
Oil (MW)	30%	19%	1%	0%	7%	0%	16%
Hydro (MW)	59%	2%	99%	16%	93%	29%	41%
Coal (MW)	0%	3%	0%	60%	0%	68%	32%

PER CAPITA ELECTRICITY CONSUMPTION

Country/ Region	Electricity Use kWh/capita/yr
SAARC	517
USA	12,914
EU	6,592
BRAZIL	2,206
MALAYASIA	3,614
CHINA	2,631
WORLD	2,803

Source:SAARC Energy Centre



- Low per capita electricity consumptions.
- Maldives and Bhutan have high per capita electricity consumption among SA countries.
- Developed countries are at much higher level of consumption.
- Need to increase the level of consumption for a decent standard of living.

Resource Potential: Hydro Potential :350 GW !

- ✓ Vast potential of hydro power:350 GW
- ✓ Bhutan, Nepal, Pakistan, India: 30,83, 59, 150 GW respectively.
- ✓ Nepal and Bhutan can build export oriented hydro power plants
- ✓ Significant Coal deposits in India and Pakistan.
- ✓ Coal deposits in Bangladesh yet to be exploited.
- ✓ In addition to the conventional energy resources, there is huge renewable energy resources like solar and wind.

Country	Coal (million tons)	Oil (million barrels)	Natural Gas (trillion cubic feet)	Biomass (million tons)	Hydro (GW)
Afghanistan	440	NA	15	18–27	25
Bhutan	2	0	0	26.6	30
Bangladesh	884	12	8	0.08	0.33
India	90,085	5,700	39	139	150
Maldives	0	0	0	0.06	0
Nepal	NA	0	0	27.04	83
Pakistan	17,550	324	33	NA	59
Sri Lanka	NA	150	0	12	2
Total	108,961	5,906	95	223	349.33

Source: SAARC Secretariat (2010) for Bangladesh, Bhutan, India, Nepal, Sri Lanka; CWC (2005) for Indian States and WAPDA (2011) for Pakistan

Renewables	Bangladesh	India	Nepal	Bhutan	Pakistan	Sri Lanka
Solar Power (Kwh/sq. m per day)	3.8 - 6.5	4 - 7	3.6 - 6.2	2.5 - 5	5.3	NA
Wind (MW)	Very limited potential	151,918	3,000	4,825	24,000	25,000 MW

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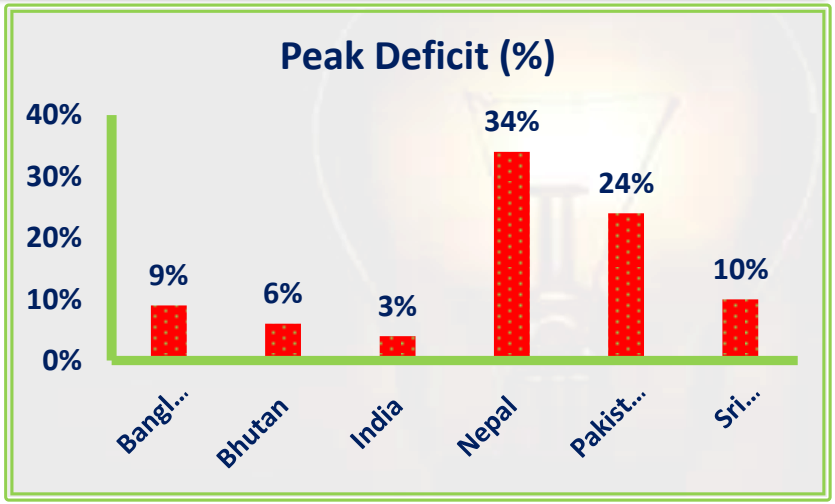
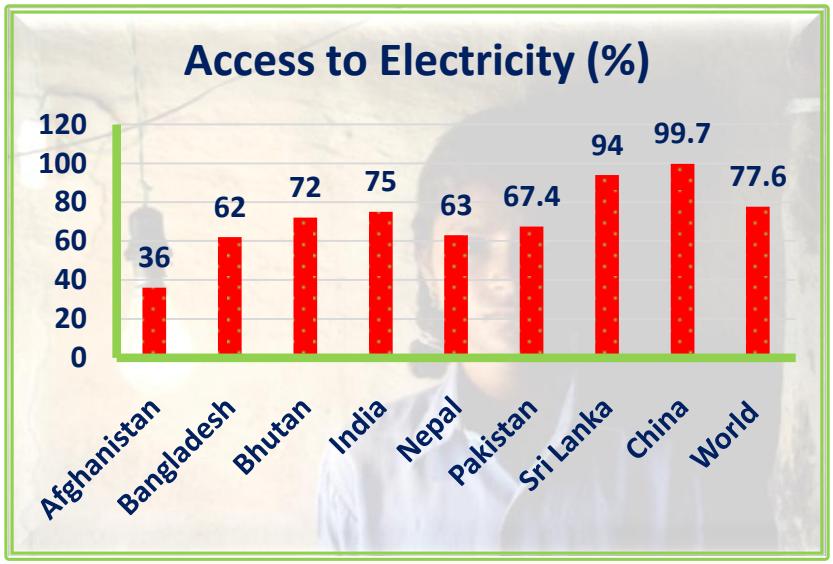
Key Drivers for Investment in South Asian Power Sector,CBET and Regional Exploitation of Energy Resources

- ✓ Energy and Peak Shortages.
- ✓ Low per Capita electricity consumptions
- ✓ Poor access to electricity.
- ✓ Resource Crunch (In Bangladesh)
- ✓ Optimal utilization of energy resources.
- ✓ Economic benefits.





Country wise Capacity Addition(Generation and Transmission)Planned & Investment Requirements

India: Capacity Addition(Generation and Transmission)Planned & Investment Requirements

India: Capacity Addition Planned & Investment Required

- Twelfth Plan period (2012-2017) the target has been fixed at **88,537 MW.**
- **There is separate renewable energy capacity addition of around 30,000 MW** (5,000 MW wind, 10,000 MW solar, 2,100 small hydro)(target recently revised)
- **Total Capacity addition planned =1,18,536 MW (USD 92 Billion)**
- ✓ USD 30 billion required in power transmission .(***~29% is anticipated from private sector)***
- **1,200 MW import of hydro power from Bhutan is also considered.**
- **Total investment required is around** Rs 13,72,580 crore (US$ 228.76 billion)

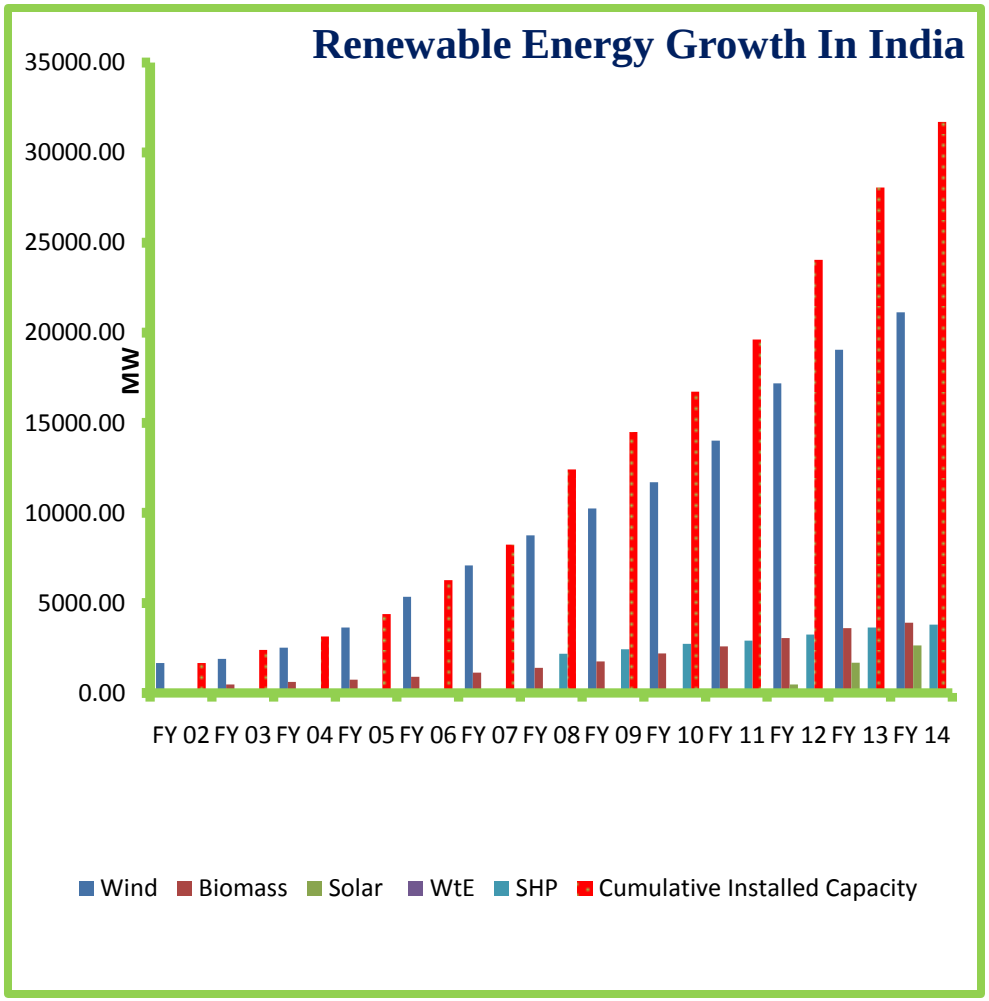
Distribution of funds during the 12th Plan (in Rs crore)

Expenditure Area	Centre	State	Private	Total
Thermal	48,650	55,734	1,73,117	2,77,500
Hydro	35,183	8,042	6,952	50,159
Nuclear	26,200	-	-	26,600
Biomass	-	-	-	10,500
Small Hydro Projects	-	-	-	8,000
Solar	-	-	-	49,400
Wind	-	-	-	67,200
Captive Projects	-	-	65,000	65,000
Total Generation Investment	5,54,359 (in Rs crore)			
Modernisation of Plants	19,847	12,040	-	31,887
Transmission	1,00,000	55,000	25,000	1,80,000
Distribution	48,191	2,38,082	19,963	3,06,235
Energy Efficiency	7,482	-	-	7,482
Human Resources	4,108	-	-	4,108
R&D	4,168	-	-	4,168
Advance for 13th Plan	1,65,372	15,417	91,793	2,72,582
Total Investment	₹ 13,72,580 crore (US$ 228.76 billion)			

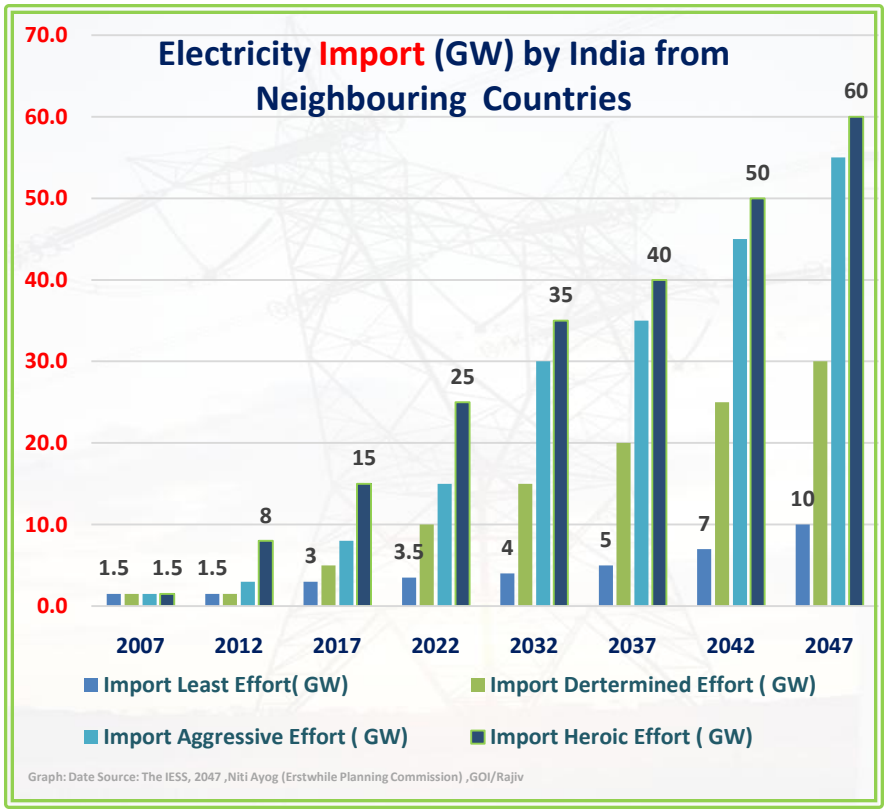
Source: Planning Commission – Report of the Working Committee on power

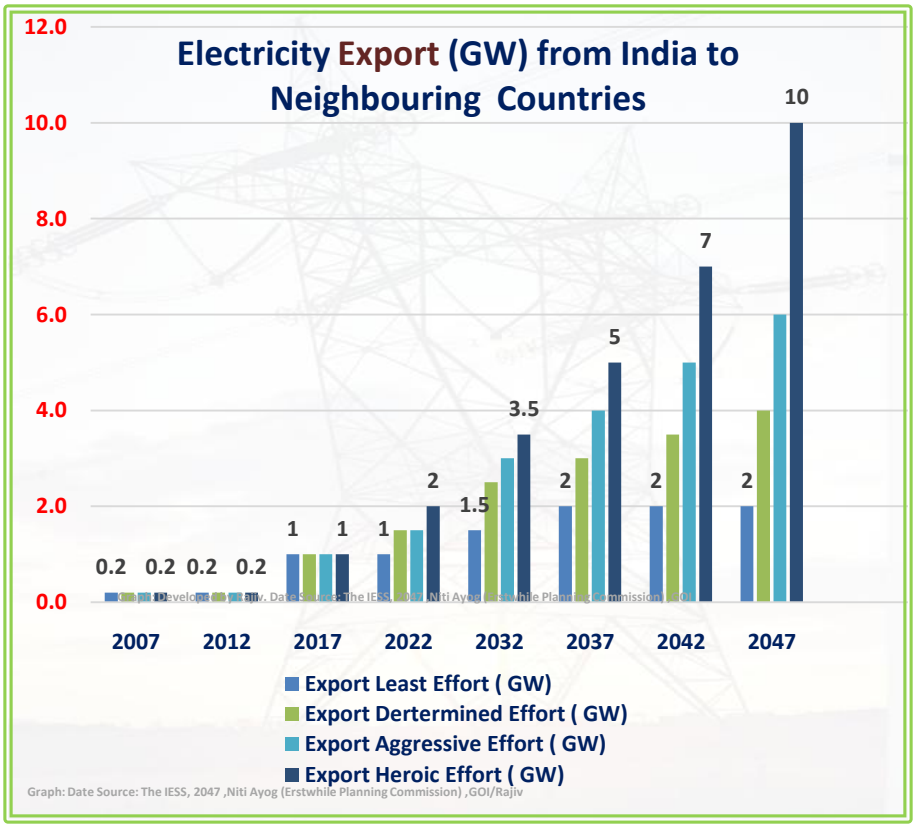
India: Significant Emphasis on Renewable Energy

- India has witnessed significant Growth in RE.
- Current RE installed capacity is 42 GW.
- India recently revised its RE targets with a increase in five fold to 175 GW by 2022.
  (100 GW solar, 60 GW wind, 10 GW biomass, 5 GW small hydro)
- Significant Investment Required in Renewable energy.

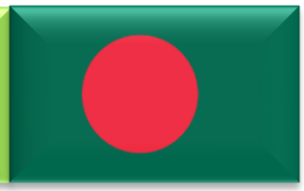


India: Electricity Imports & Export India Energy Security Scenarios, 2047 (Niti Ayog)



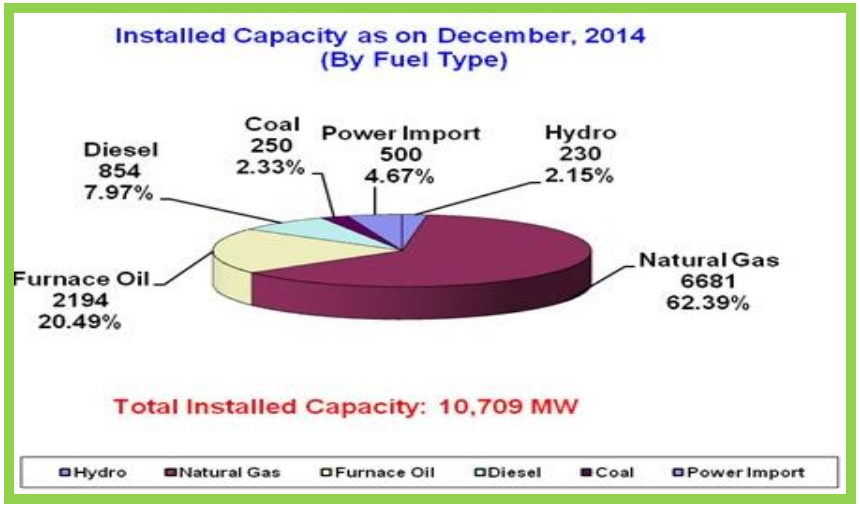


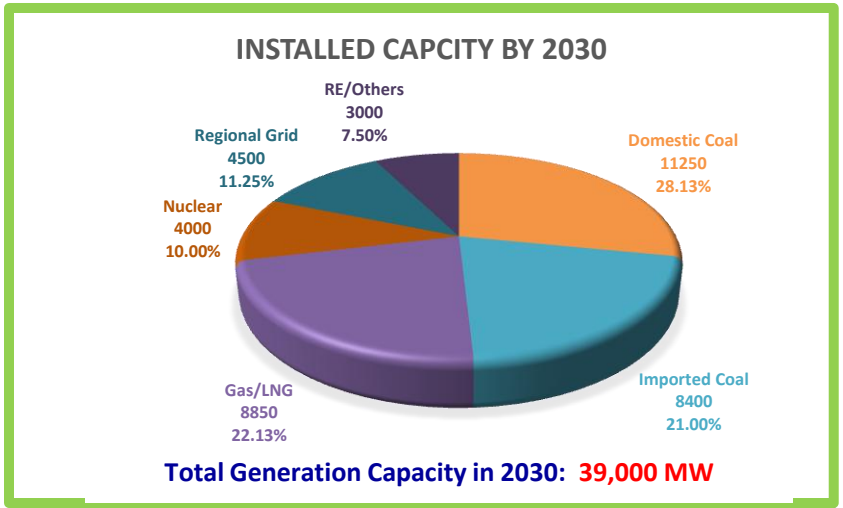
Bangladesh : Capacity Addition(Generation and Transmission) Planned & Investment Requirements



Bangladesh :Capacity Addition(Generation and Transmission)Planned & Investment Requirements

- ✓ Total installed capacity 12,071 MW.
- ✓ As per the PSMP 2010: To attain 8% GDP, the installed capacity planned is 39,000MW by the year 2030.
- ✓ Bangladesh plans to diversify from gas-based generation to coal based by 2030.
- ✓ It also plan to import 4500 MW from regional Grid .
- ✓ The aggregated investments for generation, transmission and related facilities are worked out to Taka 4.8 trillion (US$ 69.5 billion over a period of 2010-2030).
- ✓ The annual average of the investment amounts to Tk 241 billion (US$ 3.5 billion).
- ✓ Envisages more Private sector participations.





* Source :PSMP

Bhutan: Capacity Addition(Generation and Transmission)Planned & Investment Requirements

Bhutan: Capacity Addition Planned

- ✓ Installed Capacity 1614 MW and small domestic load.
- ✓ Hydro Projects of 11,044 MW are under various stages of implementation.
- ✓ Minimum of 5000 MW of export to India by the year 2020.
- ✓ Projects are being Developed in various modes 1) Intergovernmental framework mode 2) Joint Venture 3) PPP

Sl. No.	Name of HEP	Installed Cap. (MW)	Year of Commissioning	Implementation Mode/Remarks
1.	Punatsangchhu-I	1200	2016/17	IG/Under construction
2.	Punatsangchhu-II	1020	2017	-do-
3.	Mangdechhu	720	2017	-do-
4.	Sankosh	2560	2023	IG/DPR under review
5.	Kuri-Gongri	2640	2025	IG/DPR to begin soon
6.	Wangchhu	570	2022	JV/DPR under review
7.	Bunakha	180	2020	JV/DPR cleared
8.	Kholongchhu	600	2021	-do-
9.	Chamkharchhu-I	770	2024	JV/DPR under review
10.	Amochhu	540	2022	IG/DPR cleared
11.	Nikachhu	118	2019	PPP/DPR cleared
12	Dagachhu	126	2014	PPP/ commissioned
	Total	**11,044 MW**		

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Bhutan: Some of the Key project and Investment requirements

- ✓ A total investment of US$ 12.62 Billion is required for Developing Generation and Transmission Projects.
- ✓ This cost may go up considering the cost escalation nature of hydro projects due to various uncertainties.

Project Name	Implementation Mode/Remark	Capacity	Investment Requirements (INR Cr.)	Associated transmission cost (INR Cr.)
Punatsangchhu-I HEP	IG*/Under construction	1200	Punatsangchhu-I HEP Is at Final Stage of Implementation and Dagachhu has been Commissioned	
Dagachhu HEP	PPP-commissioned	126		
Punatsangchhu-II HEP	IG/Under construction	1020	8160	434.1
Mangdechhu HEP	IG/Under construction	720	5760	905.5
Amochhu Reservoir HEP	IG/DPR cleared	540	4320	105.1
Chamkharchhu-I HEP	JV/DPR under review	770	6160	586.95
Kholongchhu HEP	JV/DPR cleared	600	4800	811.45
Wangchhu HEP	JV/DPR under review	570	4560	53.8
Sunkosh Main HEP	IG/DPR under review	2500	20000	
Sunkosh Barrage HEP	IG/DPR under review	85	680	296.95
Bunakha Reservoir HEP	JV/DPR cleared	180	1440	104
Nikachhu HEP	PPP/DPR cleared	210	1680	147
Kuri-Gongri HEP	IG/DPR to begin soon	1800	14440	809.9
Bindu Khola HEP	NA	13	104	4.75
		10334	72104	4259.5
Total Investment Required			**76363.5(12.62 US $ billion)**	

Nepal: Capacity Addition(Generation and Transmission)Planned & Investment Requirements

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Nepal: Capacity Addition Planned

- ✓ Installed Capacity : 765 MW
- ✓ Nepal is expected to have peak load of 5622 MW by 2030.
- ✓ Nepal is expected to add 4541 MW of additional capacity by 2025 (3057 MW RoR and 1484 Storage)
- ✓ There are many projects are being pursed currently which are Cross Border Power in nature

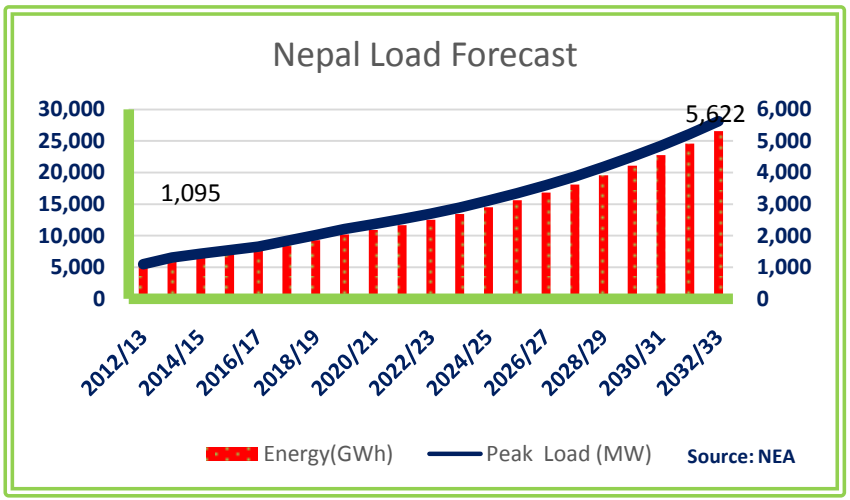
PDA Concluded:

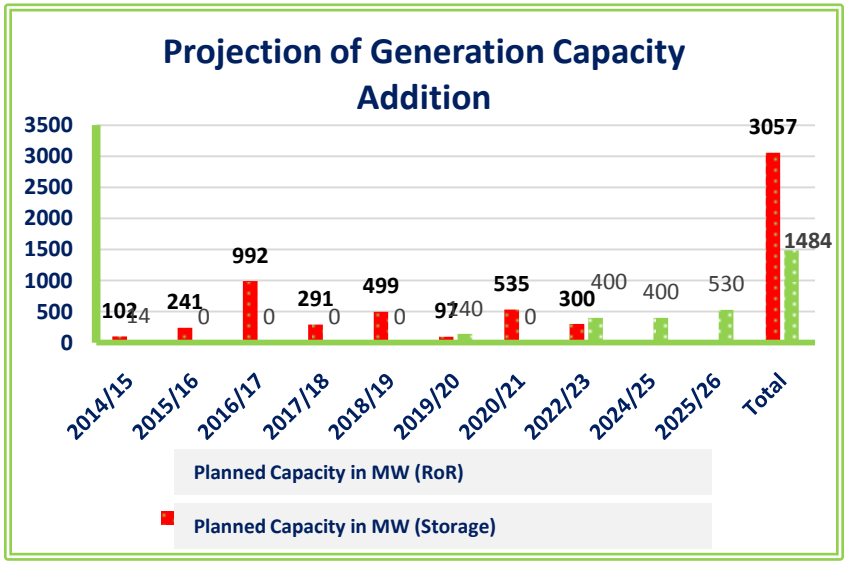
1. 900 MW Upper Karnali with GMR India
2. 900 MW Arun -3 with SJVNL

PDA in the pipelines:

1. 600 MW Upper Marsyangdi - GMR
2. 750 MW West Seti – CWE (Three Gorges)
3. 880 MW Tamakosi III (SN Power)

✓ For development of 10,000 Mw hydro power around US$ 7.21 billion and US $ 1.78 billion for Transmission will be required. (total around US $ 9 Billion)





Nepal: Some of the Key Hydro Projects and Investment Requirement

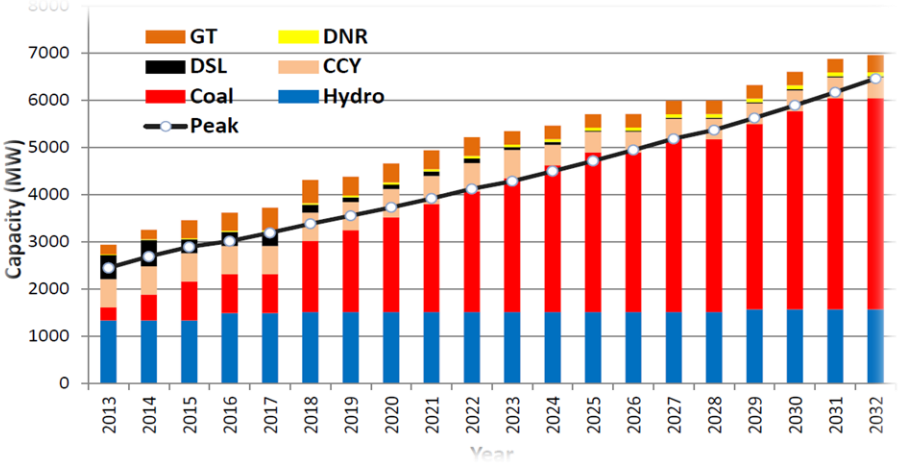
Name of the Project	Capacity in MW	*Estimated Project Cost
Arun-3	900	$ 944.5 million
Upper Karnali Project	300	$450 million
Sapat Koshi	3300	$ 4950 million
Karnali	10,800	$ 16200 million
Naumure	225	$ 337.5 million
Pancheshwar	5600	$ 8400 million

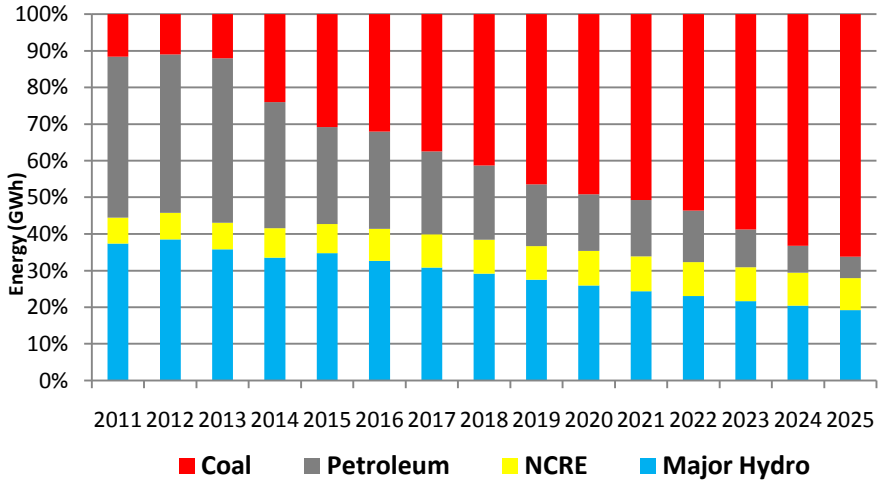
* USD 1.5 Million per MW

Sri Lanka: Capacity Addition(Generation and Transmission)Planned & Investment Requirements

Sri Lanka: Capacity Addition Planned and Investment Requirement

- ✓ Installed Capacity: 4,050 MW.
- ✓ By 2032, installed capacity planned 6985 MW.
- ✓ 4600MW is planned from coal based generation.
- ✓ 714 MW from Nonconventional renewable energy.
- ✓ Thermal share to go up from 49% to 68% by 2032.
- ✓ 500 MW HVDC Indo-Sri Lanka
- ✓ As per the Long Term Generation and Transmission expansion Plan, total investment of US$ 14.05 billion approx. is required by 2032.





*Source: Base Case :Generation expansion plan 2012

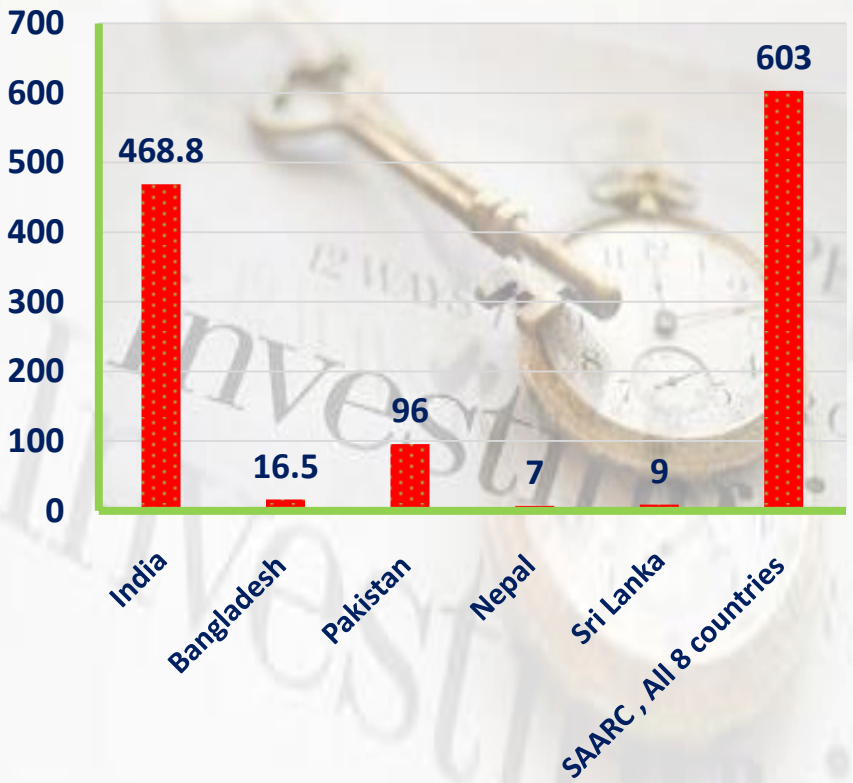
Sri Lanka: The New "Energy Sector Development Plan"(March, 2015)

- ✓ To make Sri Lanka an energy self-sufficient nation by 2030.
- ✓ Increase the share of renewable energy in primary energy supplies from 3 % in 2013 to 34% by 2030 .
- ✓ Increase the electricity generation capacity of the system from 4,050 MW to 6,400 MW by 2025
- ✓ Generate a minimum 1,000 MW of electricity using indigenous gas resources discovered in Mannar basin by 2020
- ✓ Reduce the carbon footprint of the energy sector by 5% by 2025

Petroleum Sector Upstream and Downstream Development	USD 3,600.00 million
Electricity Generation	USD 1,800.00 million
Electricity Transmission	USD 1,725.00 million
Electricity Distribution	USD 220.00 million

Investment Requirement in Electricity in South Asia 2020

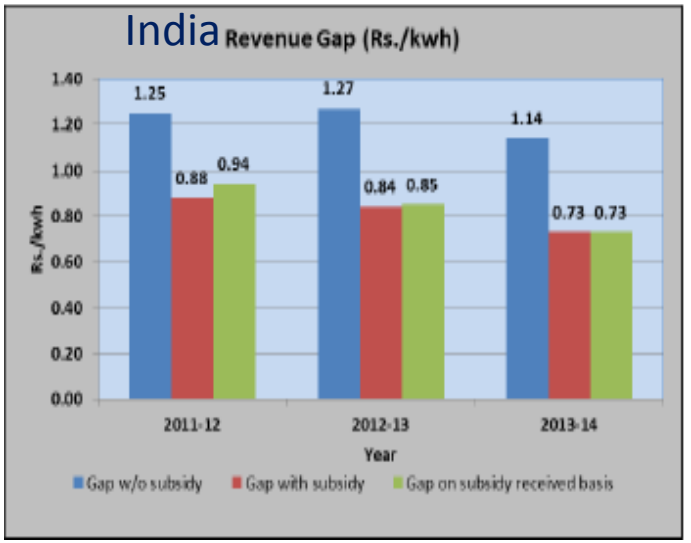
- ✓ South Asia is one of the fastest growing regions in the world.
- ✓ As per world bank estimates, SA countries needs to invest in the range of **USD 1.7 trillion to USD 2.5 trillion(2011-2020)** to bring its power grids, roads, water supplies up to the stranded needed to serve the population.
- ✓ Total investment of **USD 603 billion** is required for SAARC countries for Electricity Infrastructure development.
- ✓ Bangladesh, India, Nepal , Pakistan and Sri Lanka are expected to invest around **US$ 16.5 Billion, US$ 468.8 Billion, US$ 7billion, US$ 96 Billion and US $ 9** Billion respectively by 2020.



Issues related to Investment and Financing of Power Projects, CBET infrastructures

Issues related to Investment and Financing of Power Projects, CBET infrastructures

- Policy & Regulatory Risk
- Lenders concerns:
  - Risk Profile & Project Viability
  - Developers/Promoters Creditability
- Protection of Investment
- Source of funding.
- Viability of the Power Sector



Way Forward:

- ✓ SA GDP Growth 6%, One of fastest growing region in the world.
- ✓ Low per capita :Need to increase for economic growth , quality of life and sustainability and stability of the region.
- ✓ **Investor friendly policies are important for sustainable exploitation of the energy resources and protection of investments.**
- ✓ Regional Regulatory Framework for CBET.
- ✓ Regional Transmission Master Plan.
- ✓ Need for single window clearances.
- ✓ Smooth and easy business operating environments.
- ✓ Potential to contribute significantly to mitigate climate change and Co2 emission in the region through development of Hydro power.
- ✓ Need to run power sector on commercial basis by making transparent subsidy provisions.
- ✓ Need for Public, Private and PPP mode of investments.

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Thank You