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Developing a Regional Power Market in South Asia: Options for Market Design

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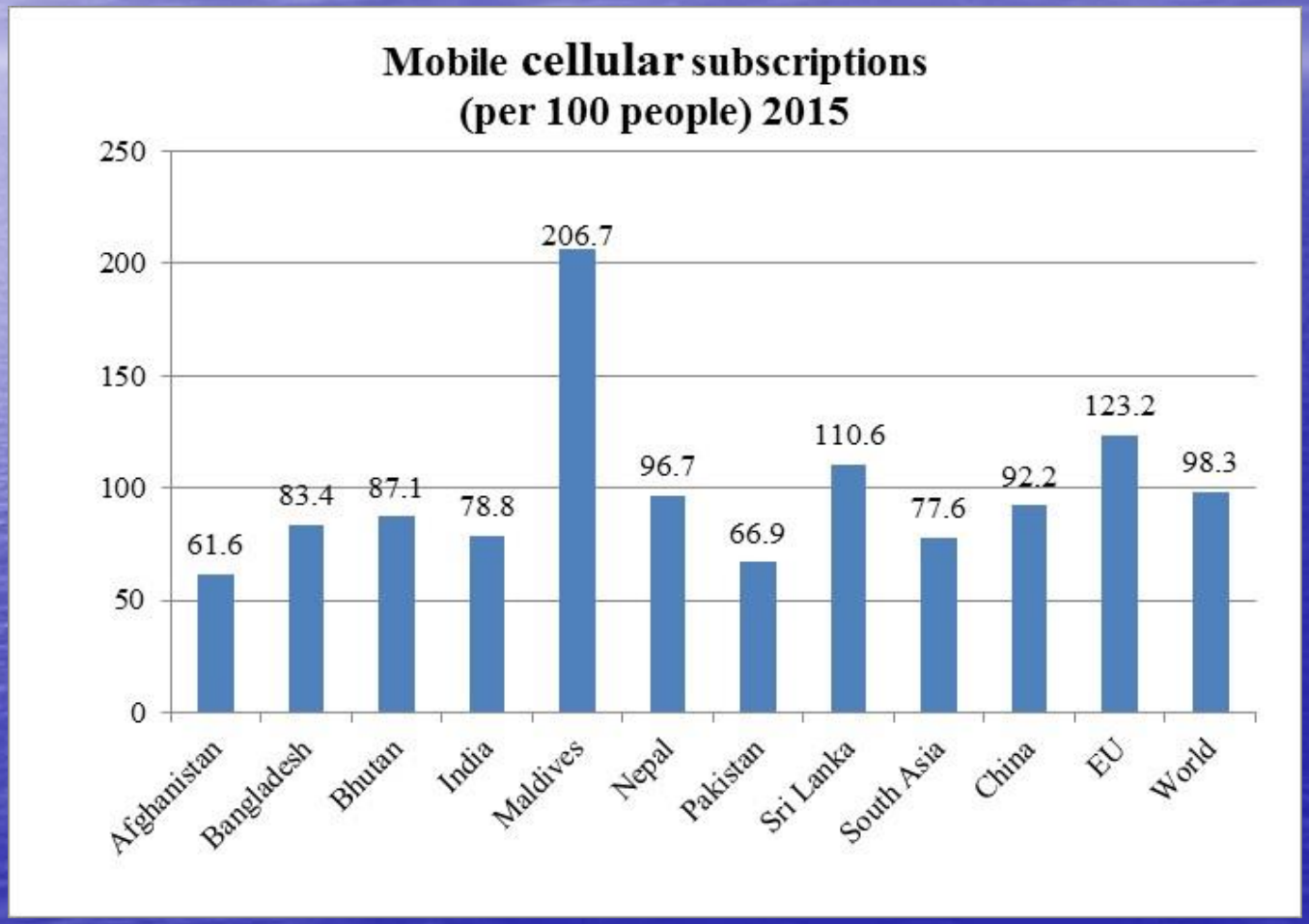
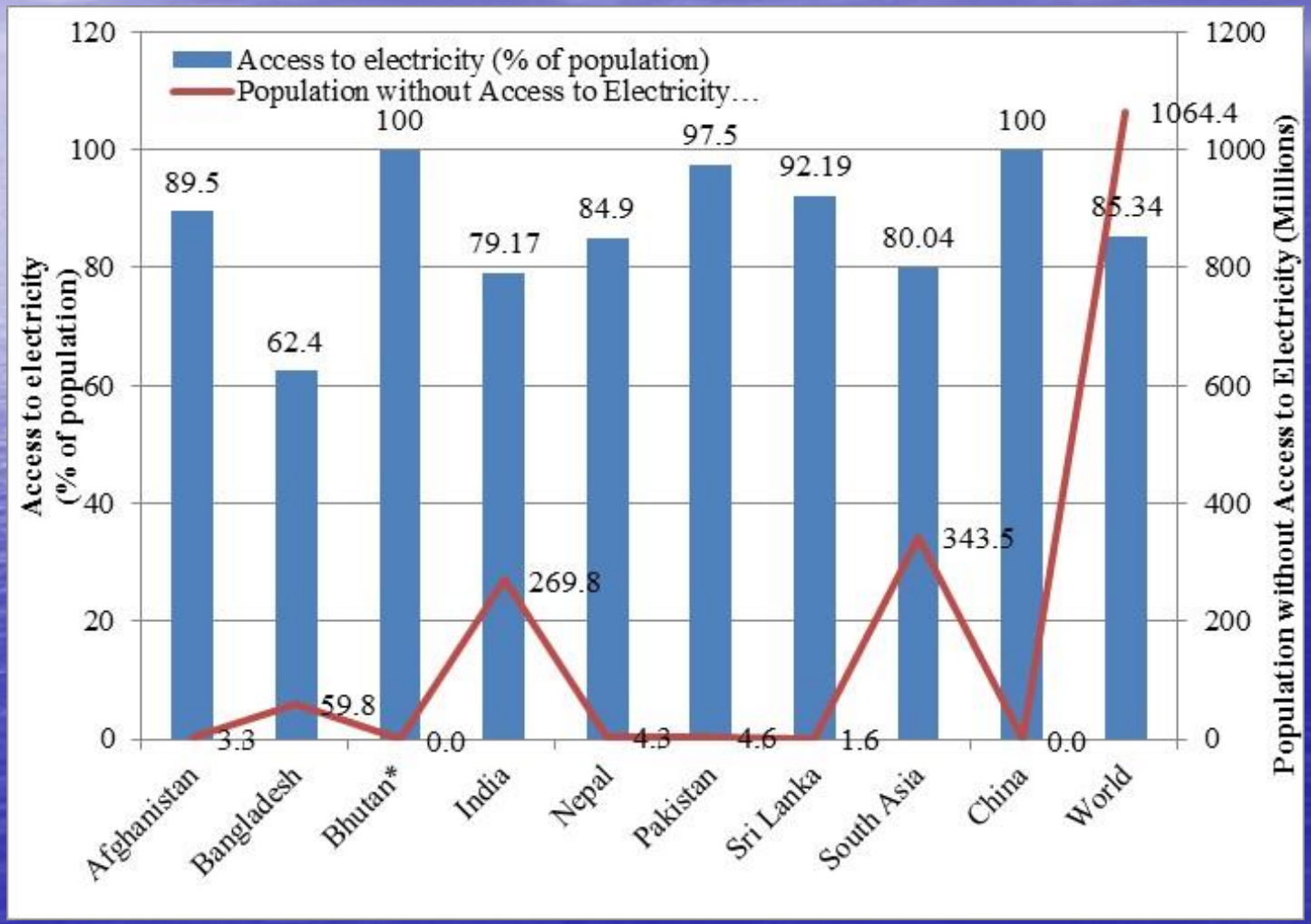
Telecom Access in South Asia



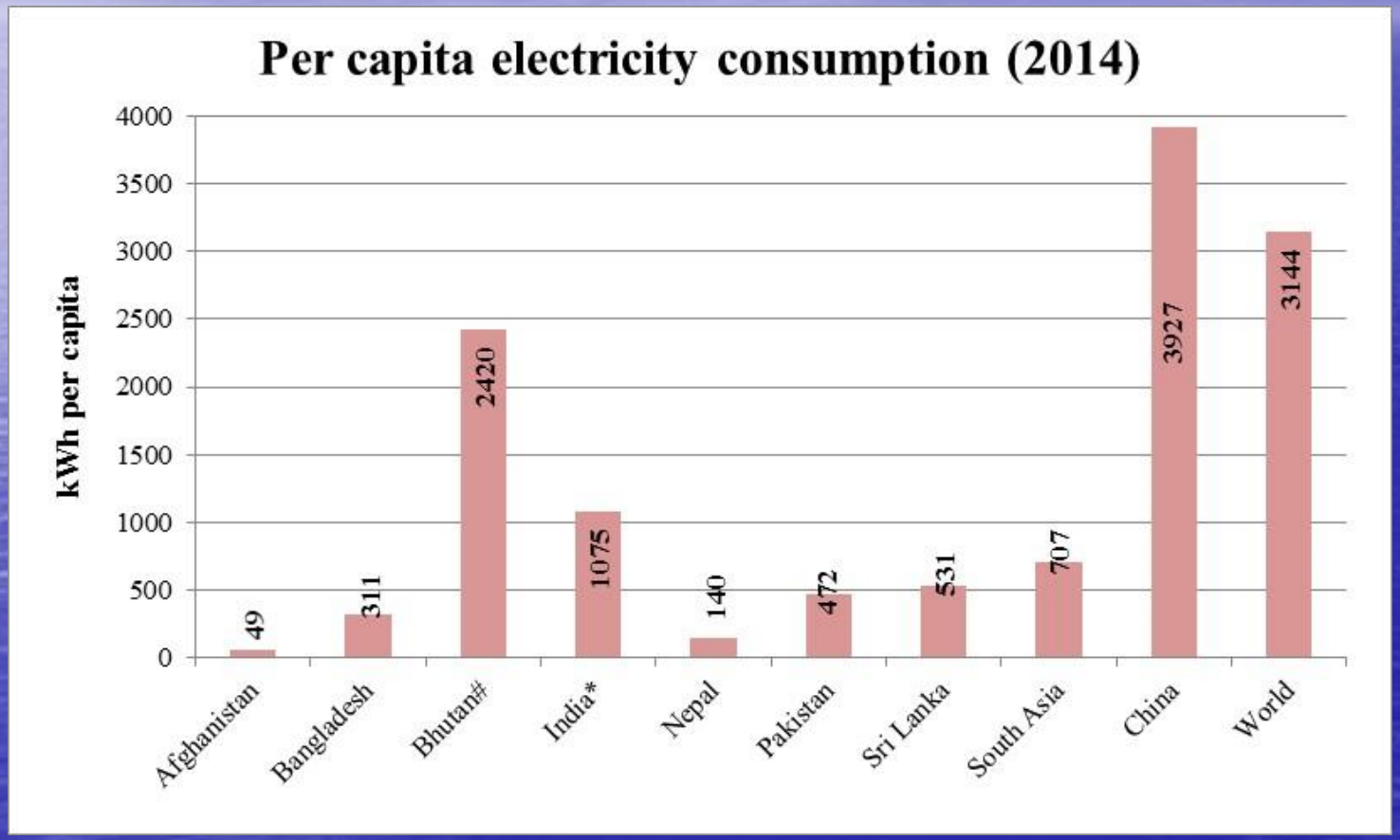
So: World Development Indicators (2017)

Access to Electricity in South Asia



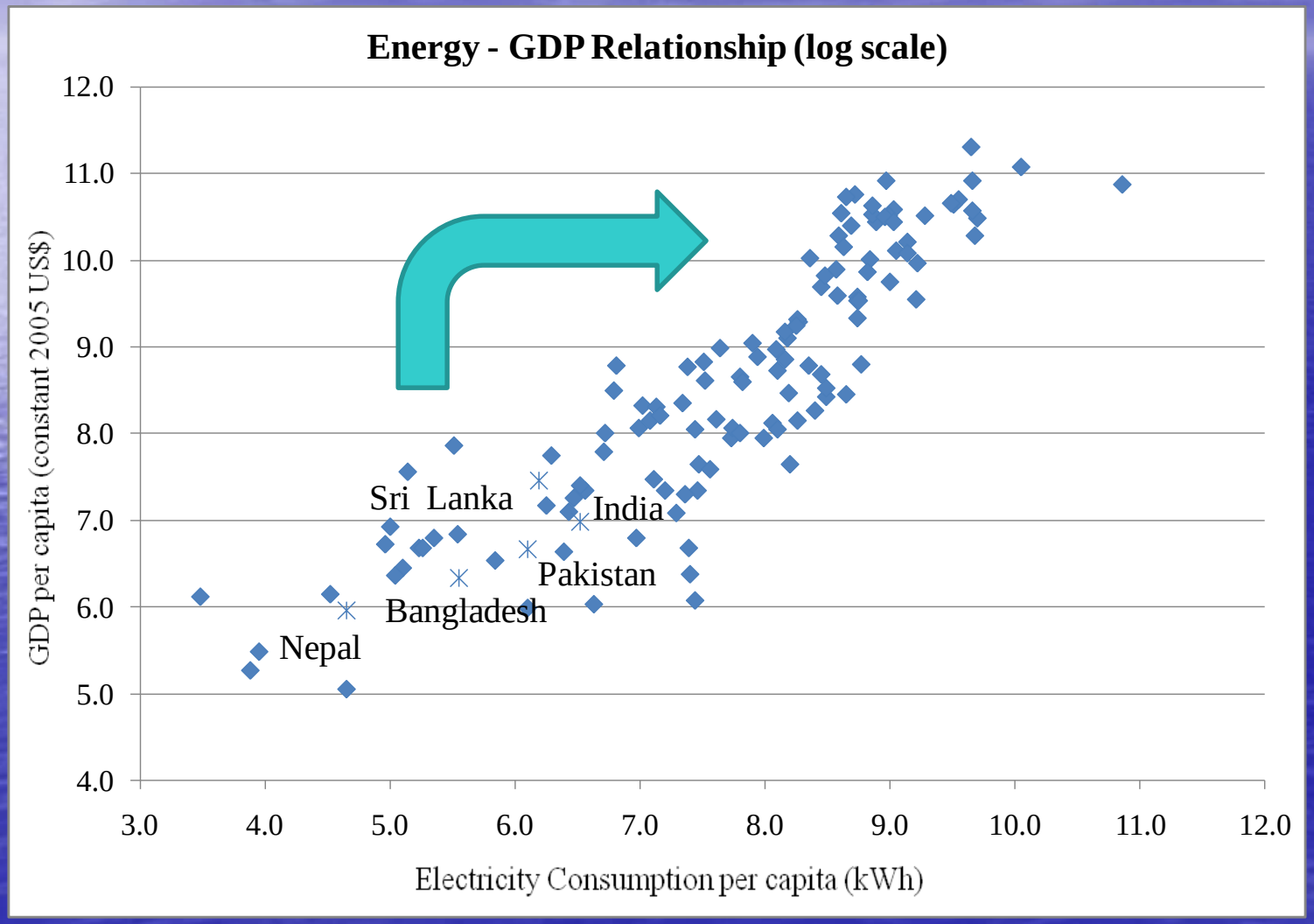
So: WDI (2017)

Per capita electricity consumption in South Asia



Notes: * - Feb, 2017; # - 2012
So: WDI (2017), RGoB (2012), CEA (2017)

Electricity Consumption and Economic Growth



Current and Forecasted Peak System Demand (MW) in SA

	Nepal	Bangladesh	India	Bhutan	Pakistan	Sri Lanka
	Existing Peak System Demand (MW)					
2012-13	1163.2	8349	144225*	276.24 @	31348	2451
	Projected Peak System Demand (MW)					
2021-22	2363	18838	283470	1500#	70163	4125
2027-28	3679	28487			121649	5369
2029-30		33708	541823&	2500	145304	5893
CAGR (%)	7.98	8.53	7.80	12.29	8.41	4.73

So: Compiled by the Author from CEA (2013a, b, 2012), NTDC (2013), CEB (2013), NEA (2013, BPDB (2013)

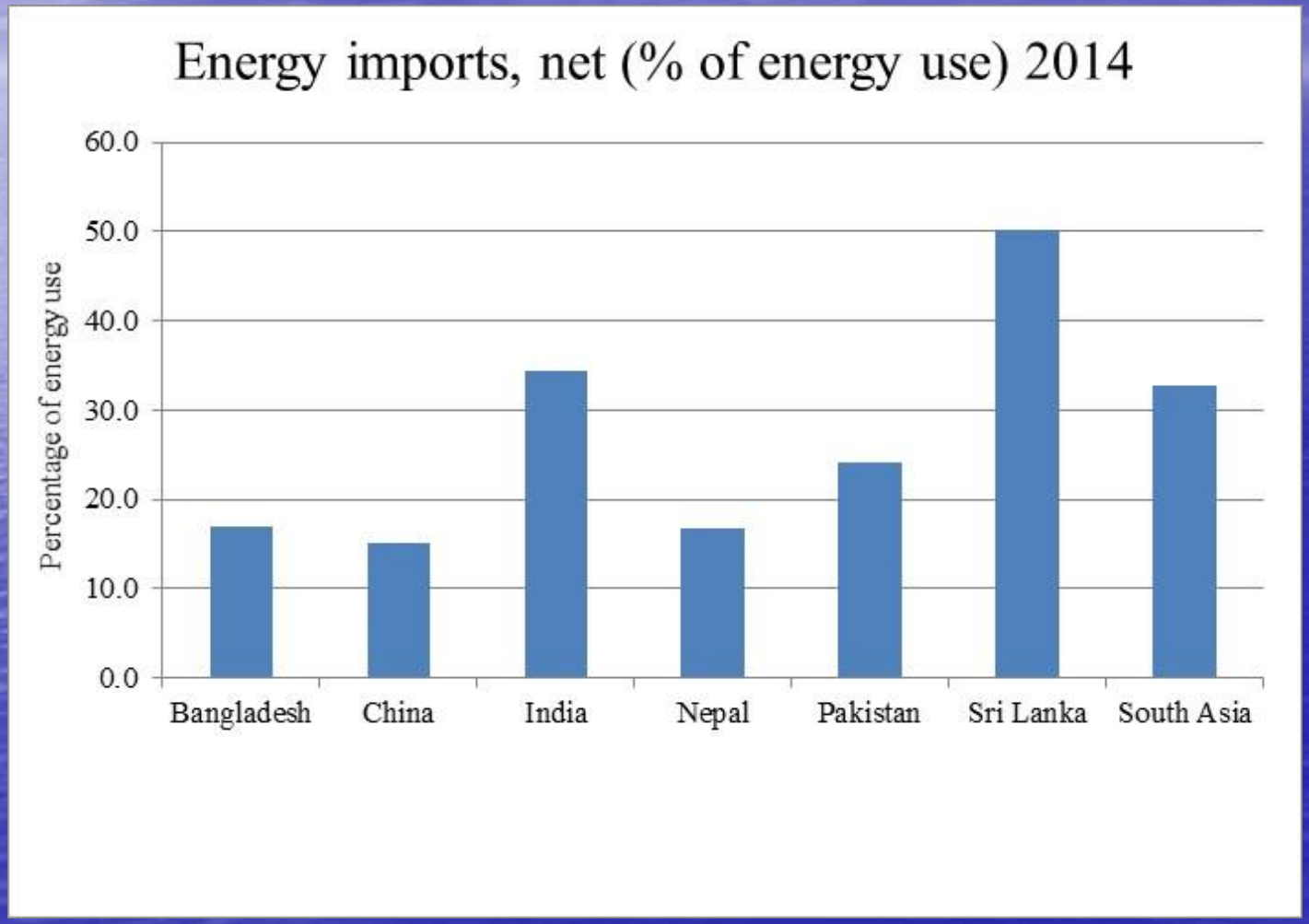
Notes: * - 2013-14; @ - 2011; # - 2019-20; & - 2029-30

Energy Resource Endowments in South Asia – An Indicator for Potential Trade?

Country	Coal (million tons)	Oil (million barrels)	Natural Gas (trillion cubic feet)	Biomass (million tons)	Hydropower* (Gigawatts)
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

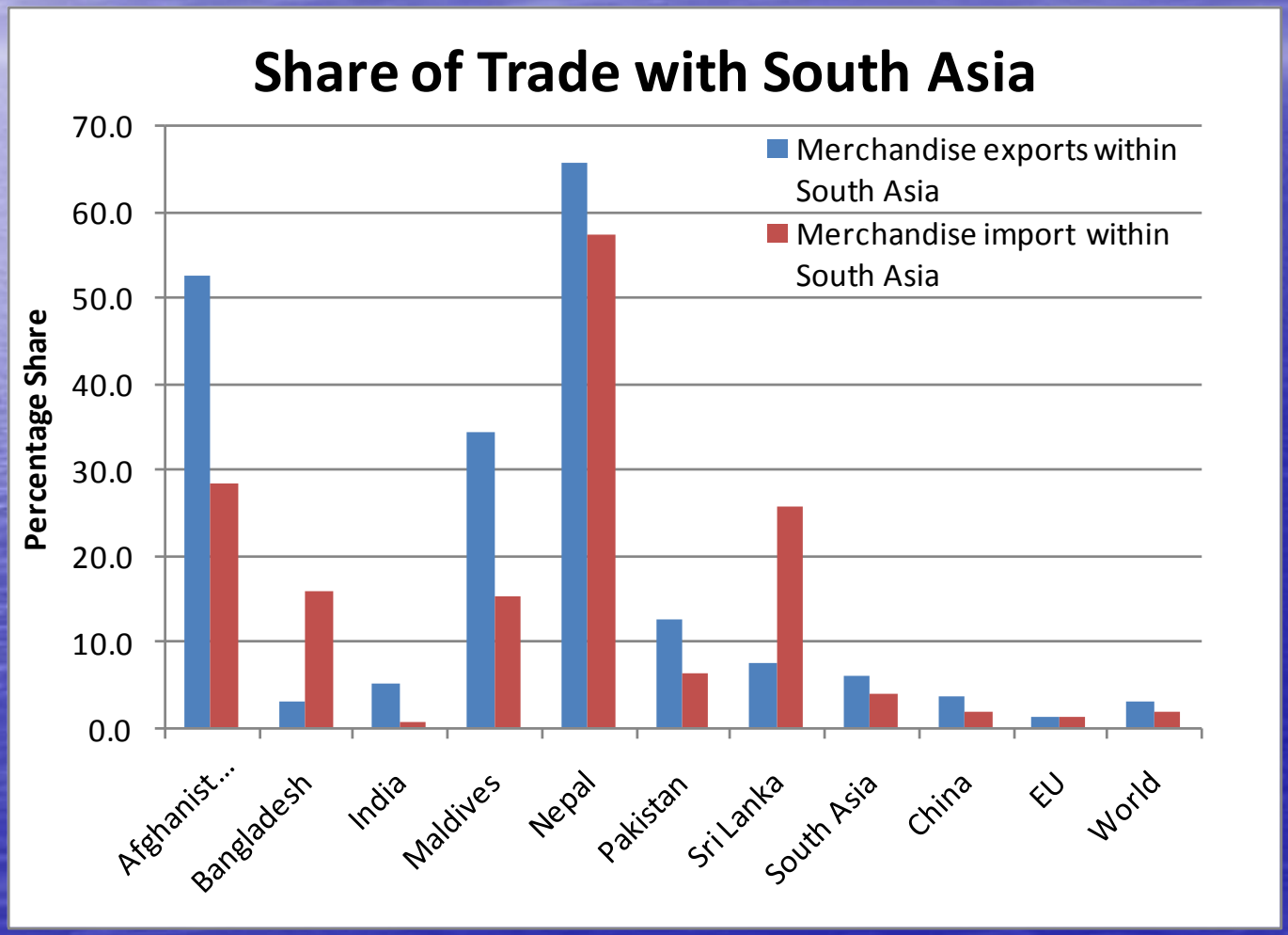
Source: ADB (2012), SAARC Secretariat (2010), CWC (2005), WAPDA (2011)

Concerns for Energy Security



So: WDI (2017)

Economic Integation in South Asia – Share of Merchandise Trade



Common Energy Sector Goals for South Asia

- Improve Quality of Life (Human Development Index)
- Sustainable Energy Access to All (2012 – UN's "International Year of Sustainable Energy for All")
- Improve energy security
- Optimal utilisation of region's energy resources
- Greater economic and energy cooperation
- Share best practices in the energy sector

Status of Reform in the Electricity Sector

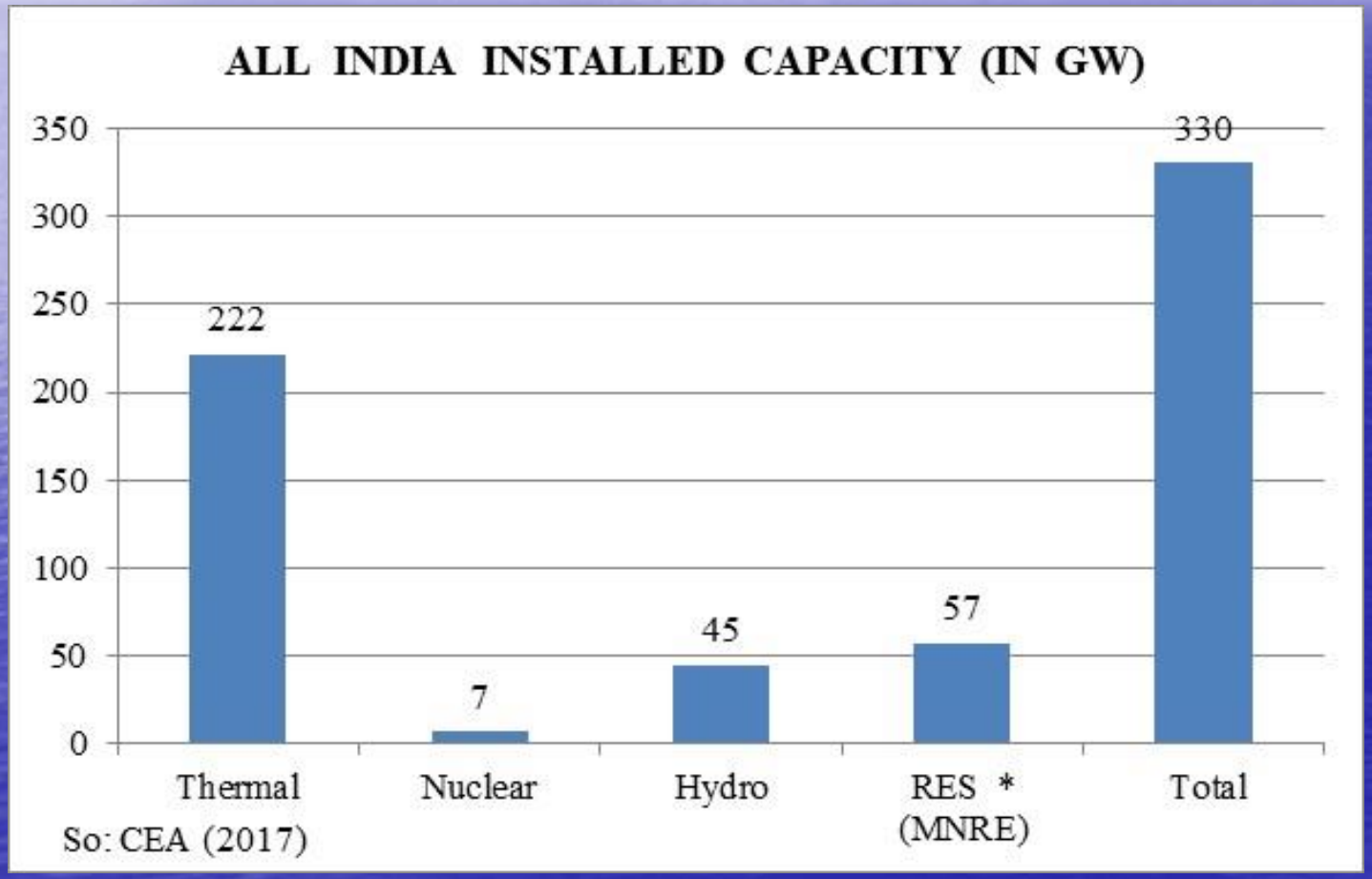
Electricity Sector in SA – A Status

	Installed capacity (MW)	Peak demand met (MW)	Peak demand (MW)	IPPs/Private Sector share in installed capacity (%)	Electrification access rate (%)*	T & D (%)	Per capita electricity consumption (kWh)
Bangladesh	8537	6434	8349	16.35	60	14.36	213
India #	243028	126793 $	131943 $	34.0	75	23.65	917
Nepal	720	569.6**	1094.6	33.33	76	25.03	106
Pakistan	23412	13445	18467	35.56	69	17	450
Sri Lanka	3312	2112***	2146	33.15	85	14	490

Sources: Bangladesh (BPDB, 2014); Nepal (NEA, 2013); Sri Lanka (CBSL, 2013), India (CEA, 2014); Pakistan (Kessides, 2013), * IEA (2011), ** excludes electricity imports capacity from India, *** based on 1.2 GW hydro plant not running during drought seasons, # As on March 2014, $ For March 2014

So: Singh et al. (2015) - WB PRWP

Installed Electricity Generation Capacity in India (GW) (April 2017)



Status of Electricity Sector Reform

Country	*Nominal generation market structure*	*Initiation of private ownership and/or participation:*			*Introduction of legally independent regulator*	*Transmission Arrangement*
		Genera-tion	Trans-mission	Distri-bution		
Afghanistan	Vertically integrated monopoly					Vertically integrated
Bangladesh	Multiple sellers, single buyer	1992			2003	Unbundled transmission owner
Bhutan	Multiple sellers, single buyer	2009 @			2002*, 2010**	Vertically integrated
India	Competition with organized trading and power exchanges	1991	2000	1999 (Orissa); 2002 (Delhi)	1996 (Orissa); 1998 (national)	Independent system operator
Nepal	Multiple sellers, single buyer	1992	PPP mode (Year?)		1994/2011 (ETFC Independence?)	Vertically integrated
Pakistan	Multiple sellers, single buyer	1994		1998 (KESC)	1995	Unbundled transmission c
Sri Lanka	Multiple sellers, single buyer	1996			2002	Ve int

So: Singh et al. (2015). WB-PRWP

Status and Opportunities for Electricity Trade

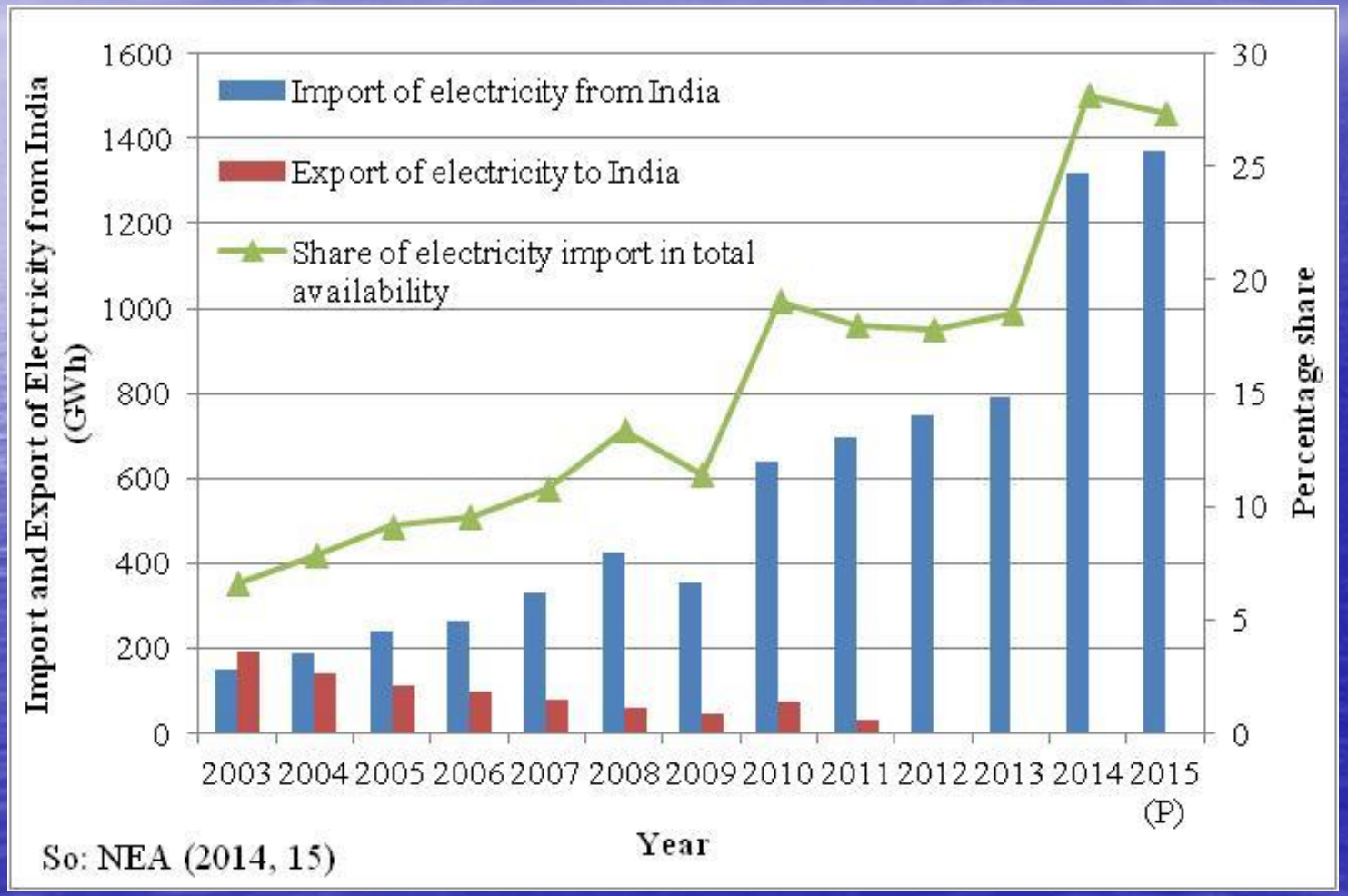
Status of Electricity Trade in SA

Participants	*Capacity*
India – Nepal	Nepal imported 793 GWh electricity in 2013 from India over multiple interconnections. (Singh, 2014)
India-Bhutan	Electricity import from Bhutan to India was 5556 GWh in 2013-14 (4627 GWh in 2012-13) from Hydro power stations at Tala, Chukha and Kurichu with a total export led capacity of 1416 MW. (ERLDC, 2014) As per an umbrella agreement between the two countries, India assures a minimum of 5000 MW electricity import by 2020.
Pakistan-Iran	Pakistan imported 419 GWh electricity in 2014 from Iran, up from 375 GWh in the previous year (NTDC, 2014). A MOU, signed in 2014, could enable Pakistan to import up to 3000 MW and electricity costing Pakistan PKRS 3 million per month. CASA-1000 expected to enhance trade with Central Asia

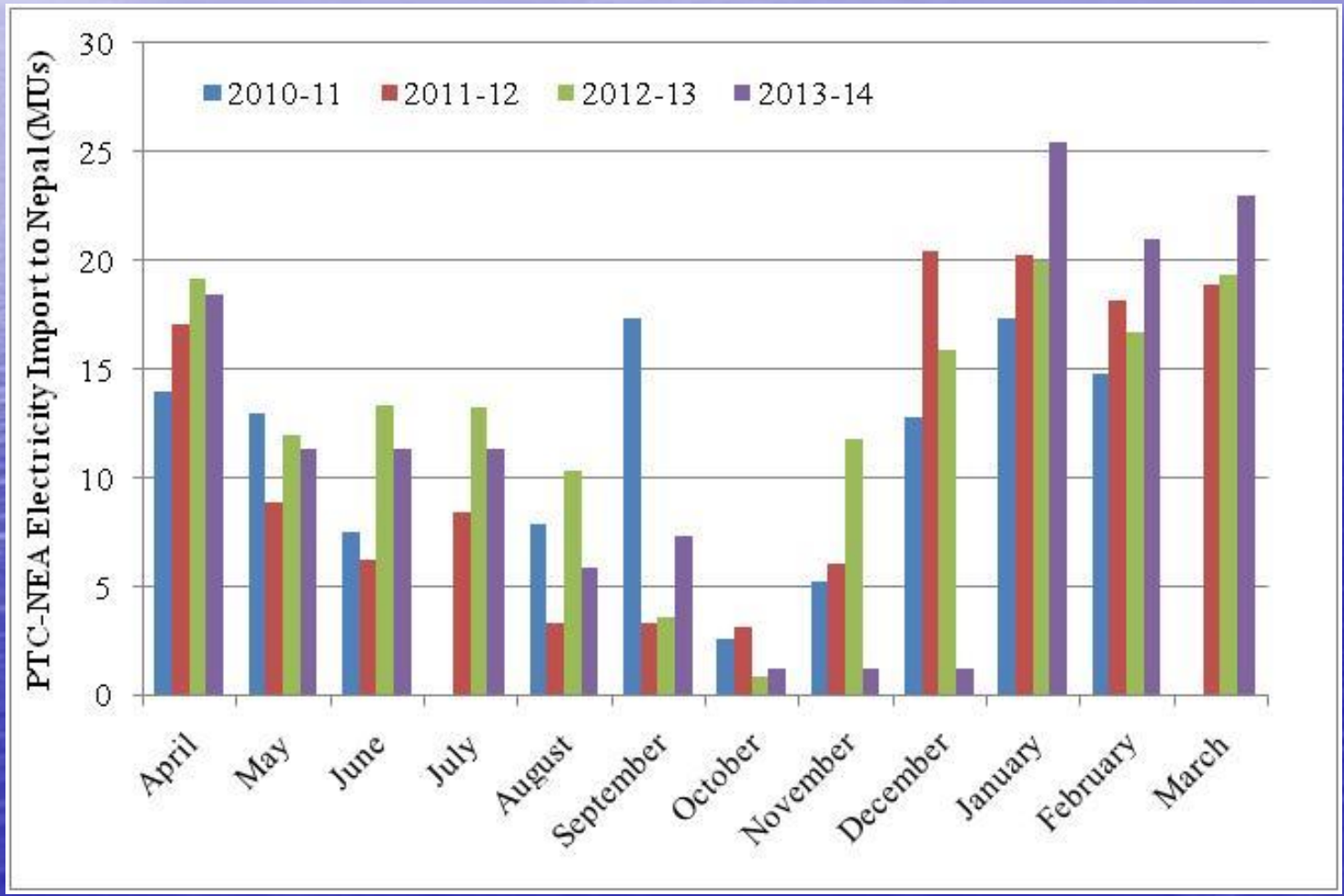
Status of Electricity Trade in SA (Contd.)

Afghanistan-Central Asia	Import of 2,246.2 GWh electricity from Iran, Uzbekistan, Turkmenistan, and Tajikistan in 2011. CASA-1000 expected to enhance this trade.
Pakistan-India	Pakistan has submitted a draft MoU to India on importing electricity using a 1200 MW interconnection. There are also possibilities of CASA-1000 to be extended up to India.
India-Sri Lanka	Feasibility studies for a 400-kV India-Sri Lanka have been conducted to support import of up to 1000 MW electricity from India.
India-Bangladesh	In 2013, power systems of India and Bangladesh were interconnected through a HVDC line that can support electricity export of up to 500 MW (expandable to 1000 MW in future) from India to Bangladesh based negotiated price and market based price.

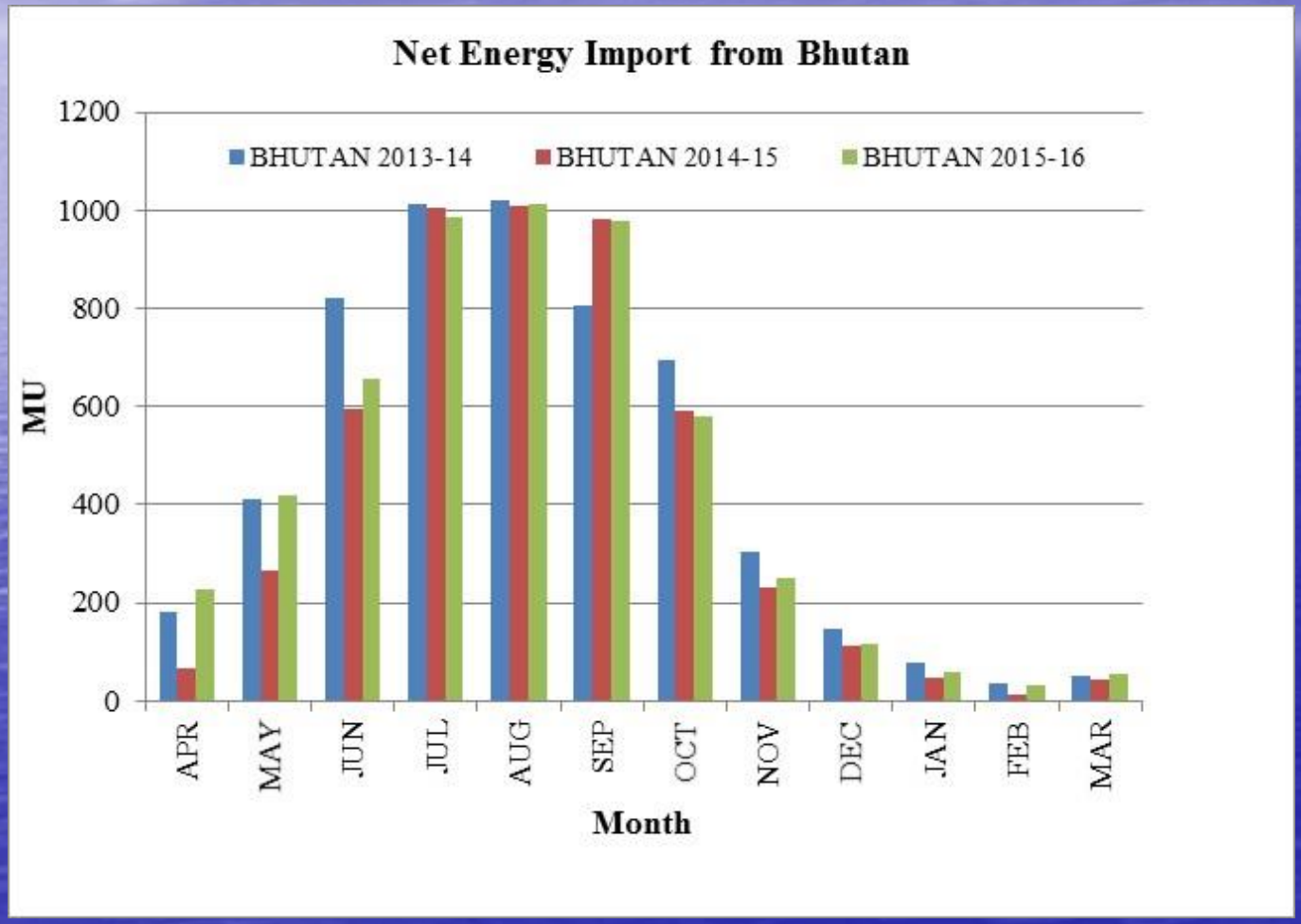
Growing Import Dependency in Nepal



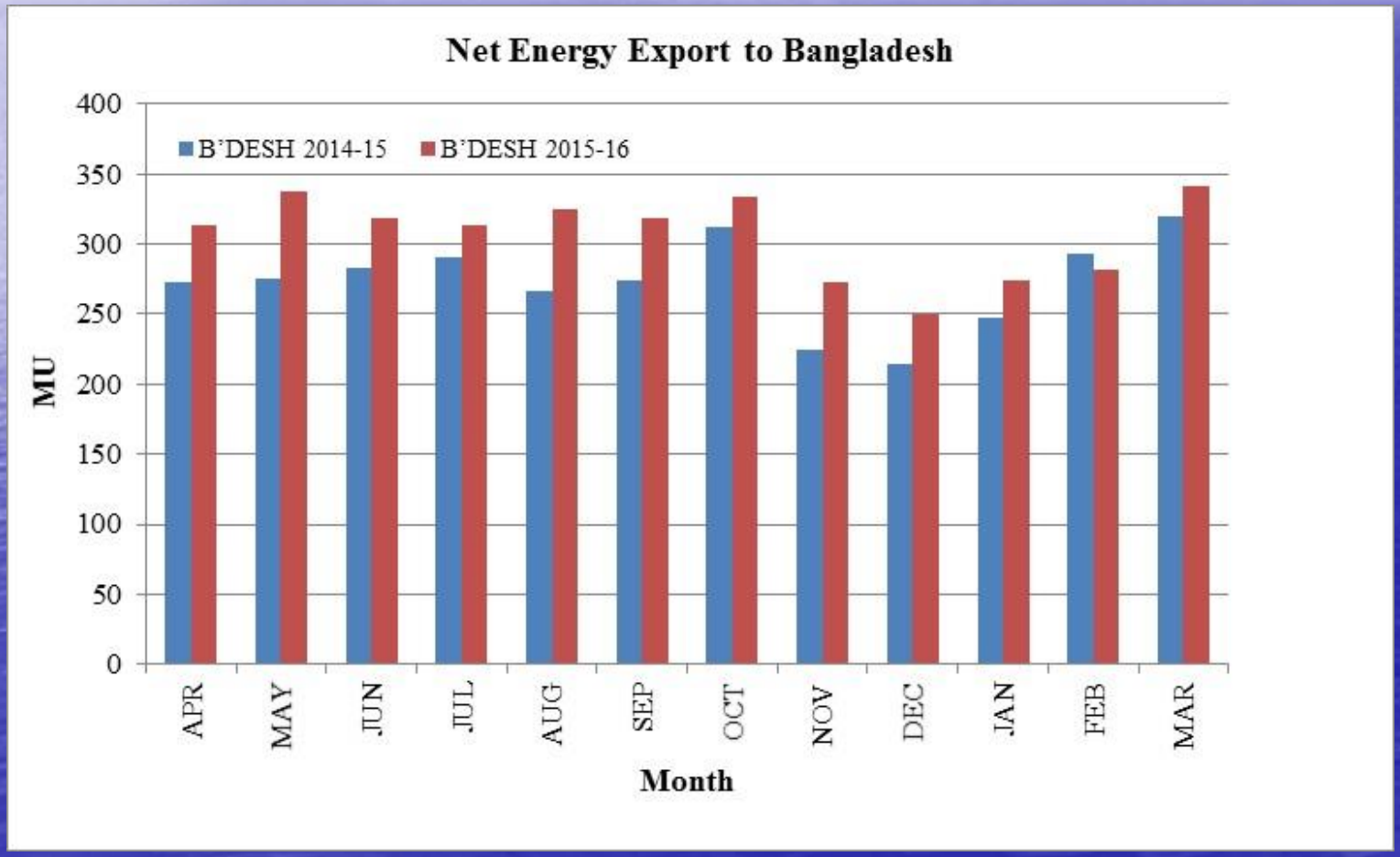
Winter dependency of electricity import of Nepal



Seasonality of Export of Electricity from Bhutan



India's Electricity Export to Bangladesh



Regional Power Sector Cooperation – International Experience

Regional Electricity Arrangements

- European Network of Transmission System Operators for Electricity (ENTSO-E)
- Gulf Coast Countries (GCC)
- Greater Mekong Sub-region (GMS)
- Nile Basin Initiative (NBI)
- Southern African Power Pool (SAPP)
- South East Europe (SEE)
- Central American Electrical Interconnection System (SIEPAC)

International Experience

Regional Entity	Formal Creation	Participating Members
ENTSO-E	2011	41 Transmission System Operators (TSOs) from 34 countries
GCC	2001	(6) United Arab Emirates, Bahrain, Saudi Arabia, Oman, Qatar, and Kuwait
GMS	1995	(7) Cambodia, PRC (Yunnan and Guangxi Zhuang), Lao PDR, Myanmar, Thailand, and Viet Nam.
NBI	1999	(9) Egypt, Sudan, Ethiopia, Uganda, Kenya, Rwanda, Burundi, DR Congo and Tanzania. Eritrea (Observer)
SAPP	1995	(9) Botswana, Democratic Republic of the Congo, Lesotho, Mozambique, Namibia, South Africa, Swaziland, Zambia, and Zimbabwe; (3 non-operating members)
SEE	2005	(9) Albania, Bosnia & Herzegovina, Bulgaria, Croatia, Kosovo, Macedonia, Montenegro, Romania, and Serbia
SIEPAC	1999	(6) Guatemala, El Salvador, Honduras, Costa Rica, Nicaragua, Panama

International Experience (contd.)

Regional Entity	Motivation / Drivers	Trading Status
ENTSO-E	**Security of supply, seamless pan-European electricity market, secure integration of renewable resources…..**	428161 GWh (2012)
GCC	**Share reserve capacity,** thereby reducing generation investment needs in the region.	First in 2010 and intermittent
GMS	Efficient, environmentally sound growth of power sector; support to **regional projects and electricity trade**.	34139 GWh (2010)
NBI	**Coordinated investment in power sector** to meet region's social and economic development objectives in the region.	
SAPP	Development of a safe, efficient, reliable, and **stable interconnected electrical system and of a regional power trading mechanism.**	10409 MWh (2011-12)
SEE	Create **a regionally integrated electricity market**, forming part of the wider EU single market.	Dry run (2006 – 09)
SIEPAC	Create **an integrated regional electricity market** in Central America.	

Bilateral to Regional Approach

- SAPP was built upon historical bilateral interconnections in the 1950s and 1960s which witnessed development of interconnections projects between Democratic Republic of the Congo (DRC) and Zambia, and Zambia and Zimbabwe. Later, in 1975, between Mozambique and South Africa.
- GMS' historical foundations can be traced back to 1971 with export of power from the Nam Ngum hydropower plant (HPP) in Lao PDR to northeast Thailand.

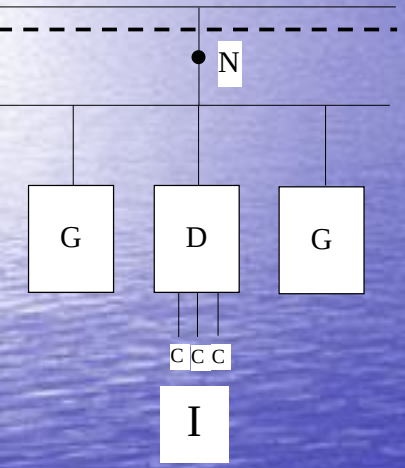
Options for Regional Power Market Development in South Asia

Choice of Being Cautious or Aggressive

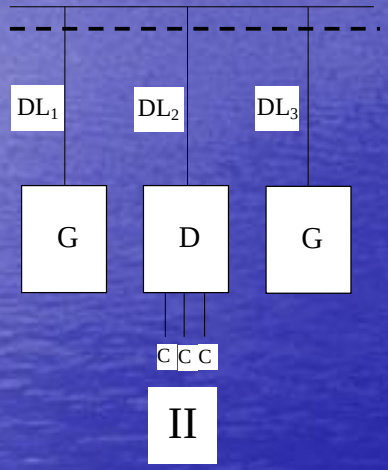
- Stage I - Nodal Agency Based Market Structure
- Stage II - Participation of Deemed Trading Licensees
- Stage III - Participation of Trading Licensees
- Stage IV - All eligible consumers

Choice of Being Cautious or Aggressive (Contd.)

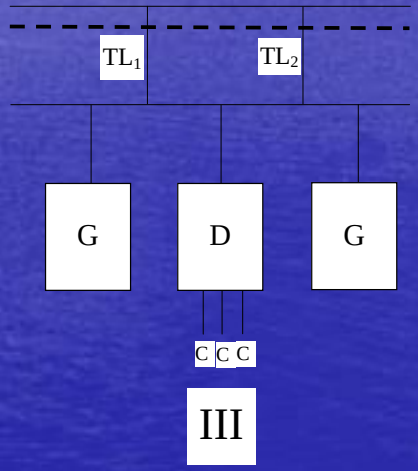
Nodal Agencies



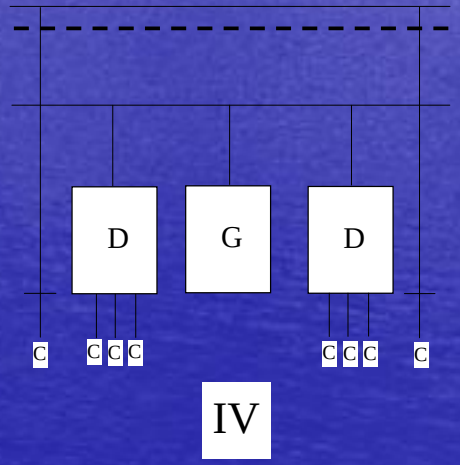
Deemed Trading Licensees



Trading Licensees



Eligible Consumers



G – Generator[#]

D – Distribution Utilities

C – Consumer

N – Nodal Agencies

DL's – Deemed Licensees[*]

TL's – Trading Licensees

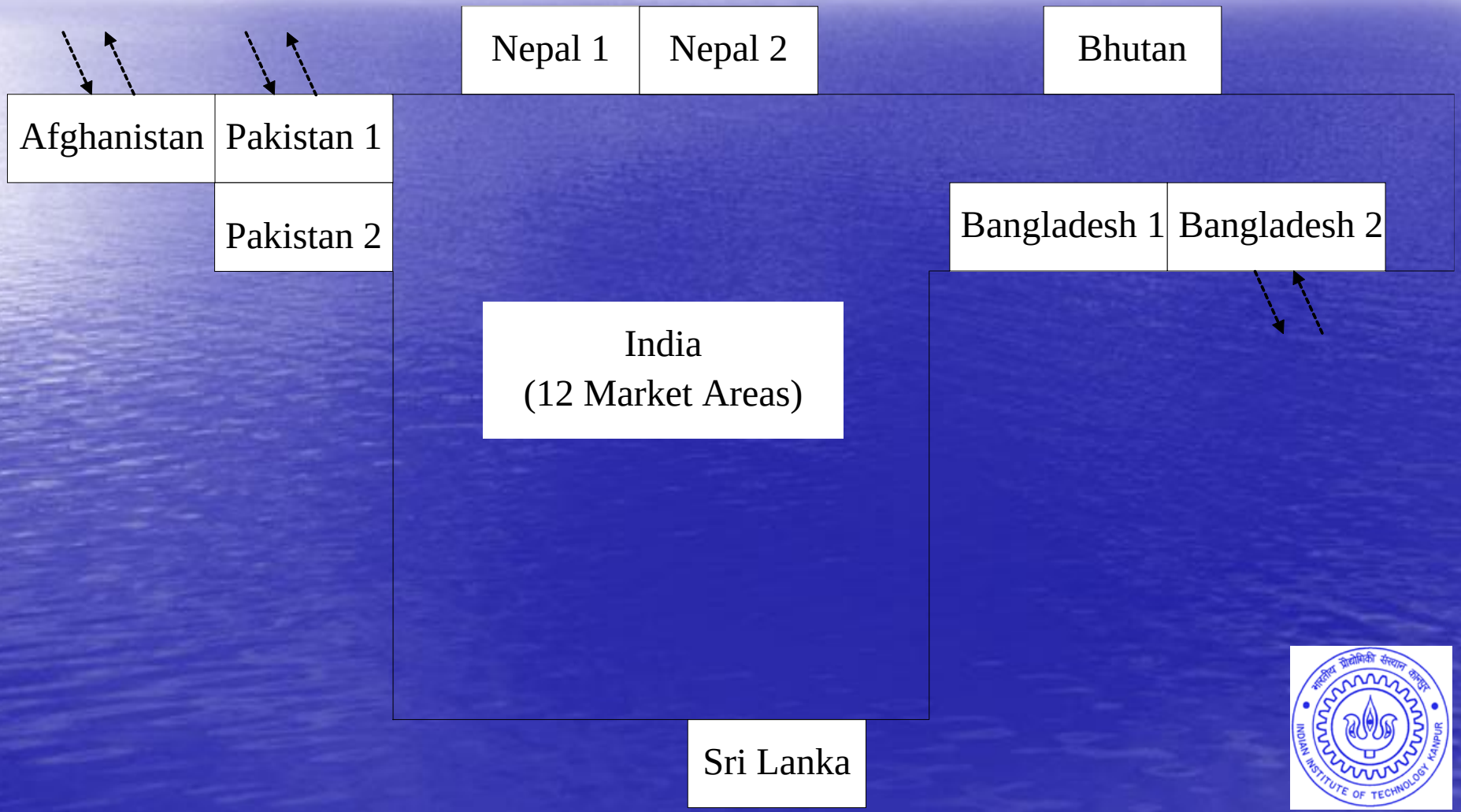
Including Captive Generation

*Generators and Distribution Utilities

Options for Market Design

- South Asian Regional Power Exchange (SARPX) or South Asian Power Exchange (SAPX)
- “Regional Contracts” on the Power Exchanges in India
- New 'Market Areas' on the Indian Power Exchanges
- Coupling of All 'Power Exchanges' across South Asia

New 'Market Areas' on the Indian Power Exchanges



Towards Regional Power Market Development in South Asia

Prerequisites for Development of a SA power market

- Accessible Energy Resources & easy licensing
- Transmission inter-linkages (who would invest?), and its access
- Coordinated scheduling and despatch
- Treatment of imbalances from schedule
- Metering and Energy Accounting
- Clearing and Settlement, and banking transactions
- Export / Import licensing
- Common currency and currency risk
- Treatment of export tax, import duty and transit tax
- Harmonised regulatory and policy framework
- Dispute Settlement

Evolving cross-border electricity trade

- Government to Government – Bhutan & India
- Power utility and trader (short-term) - Nepal & India (PTC)
- Power utility and trader (long-term) - Bangladesh (BPDB) & India (NVVN)

- Traders can offer relatively long-term supply contracts but price discovery is an issue. Useful for short to medium agreements.
- Indian experience demonstrates short-term opportunities. PXs can play a crucial role – transparent and competitive price discovery.
- SA Contractual breakthrough - PPA between NVVN and BPDB, as it addresses many critical issues including currency, balancing, UI and dispute resolution.

Key regulatory/legal changes needed to facilitate cross-border trading

S. No.	Key Changes
	SHORT TERM MEASURES
1	Nodal agency for cross-border trading/ Access to PX
2	Investment framework
3	Regulation of Power Procurement from a PX
4	Settling imbalances
5	Duties and taxes
6	Commerce trading license restrictions
7	Dispute resolution
8	Tariff determination

	MEDIUM TERM MEASURES
1	Deemed trading licenses
2	Open access in transmission
3	Regulatory guidelines
4	Commercial mechanism to Settle imbalances
5	Transmission charges
6	Grid code
7	Transmission plan
	LONG TERM MEASURES
1	Trading license to other parties
2	Open access in distribution

So: Singh et al. (2013, 2016)

Approach to Develop Regional Power Market

- Socialising initial investment in cross-border inter-connections backed by medium/long-term bilateral between governments/government entities.
- Early demonstrated ‘benefits’ to bring in political acceptability.
- From ‘power exchange’ to ‘Power Exchange’.
- Different stage of reform and unbundling
  - Accommodate differences in terms of licensing and market access
- Long-term regional transmission plan
- Regional coordination forum to harmonise technical, and regulatory framework.
- Dispute settlement mechanism

'Disruptive' Suggestions on the table!

- Coordinated Investment in Generation (South Asia Power Generation Co Ltd.?)
- Agreement for transit of (hydro) power between India and Bangladesh reciprocated with easing physical congestion at the chicken's neck for setting up transmission linkages.
- Multi-country owned cross-border transmission interconnections to reduce exposure to financial and operational risk. (South Asia Power Transmission Co Ltd.?)
- Regional mechanism/forum for coordination and dispute resolution.

Selected Readings

- Anoop Singh, Priyantha Wijayatunga, and P. N. Fernando, Improving Regulatory Environment for a Regional Power Market in South Asia, ADB South Asia Working Paper series No. 45, 2016
- Anoop Singh, Tooraj Jamasb, Rabindra Nepal, and Michael Toman, Cross-Border Electricity Cooperation in South Asia, World Bank Policy Research Working Paper (PRWP), #WPS7328, 2015.
- Anoop Singh, Jyoti Parikh, K.K. Agrawal, Dipti Khare, Rajiv Ratna Panda and Pallavi Mohla, "Prospects for Regional Cooperation on Cross-Border Electricity Trade in South Asia", 2013, IRADe, New Delhi

Thank You

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