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Developing a Regional power market in South Asia

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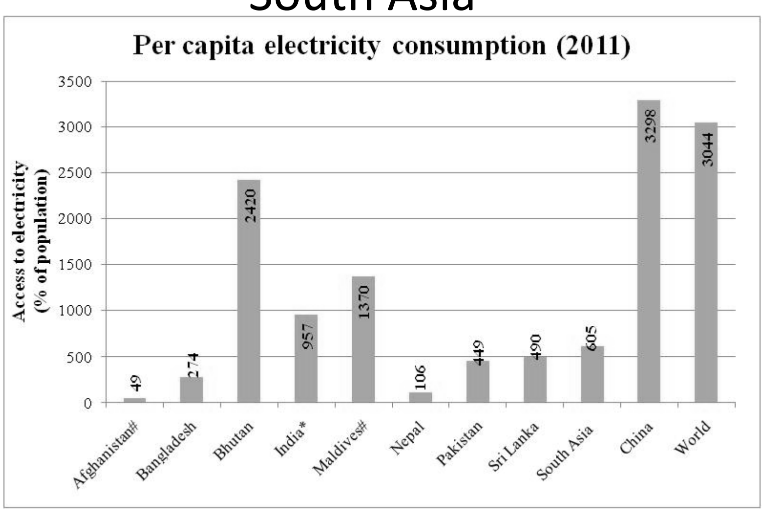
Outline

- Energy and Socio-economic development
- Drivers
- Status and Opportunities for Electricity Trade
- International experience
- Cross Border Electricity Trade in SA
- Strategy for South Asia
- Conclusions

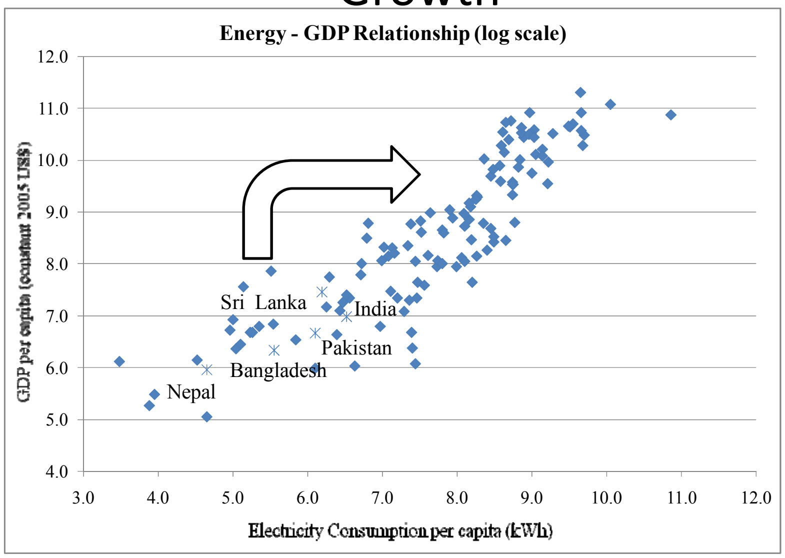
Energy and Socio-economic Development

Per capita electricity consumption in South Asia

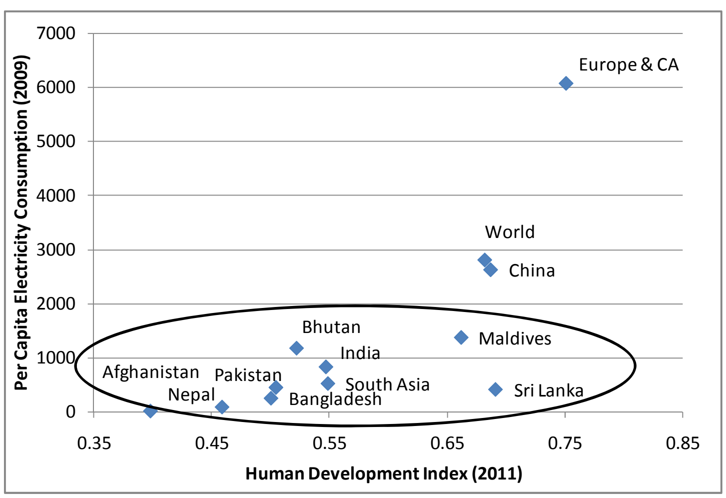


So: WDI (2015), RGoB (2012), CEA (2015)

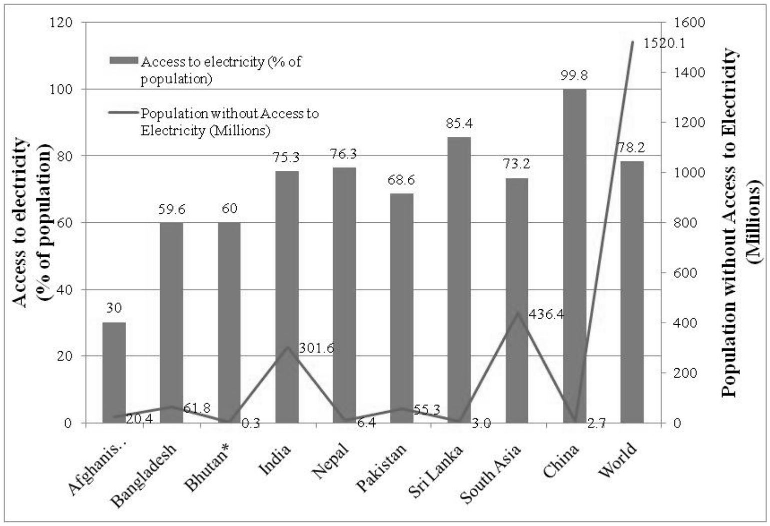
Electricity Consumption and Economic Growth



Electricity Consumption and Human Development Index

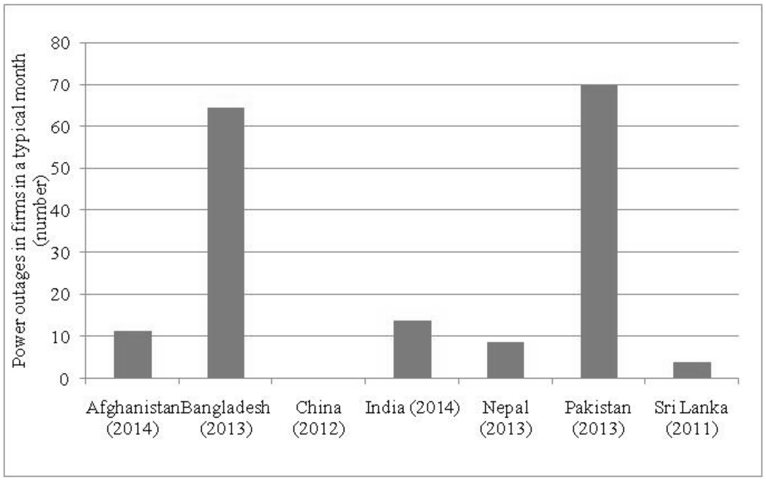


Access to Electricity in South Asia (2011, So: WD)



Drivers for Energy Cooperation in South Asia

Power outages in firms in a typical month (number)



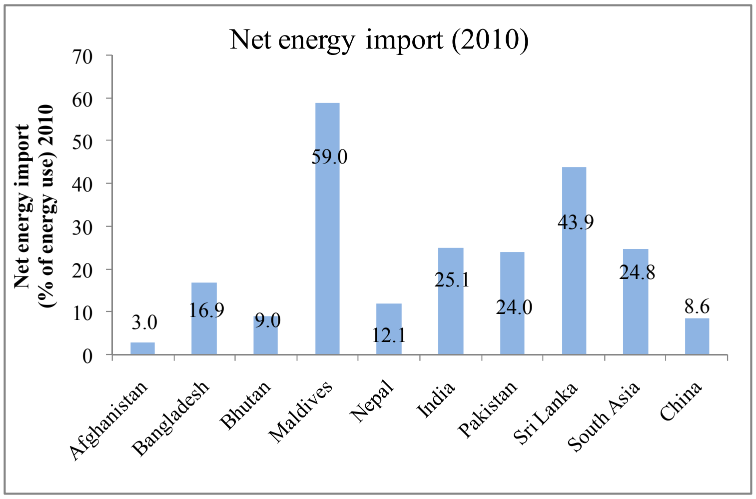
So: WDI (2015)

Economic growth continues to suffer

Country	Value lost due to electrical outages (As a % of sales)
Afghanistan (2007)	6.49
Bangladesh (2007)	10.56
Bhutan (2009)	4.33
India (2006)	6.62
Nepal (2009)	26.95
Pakistan (2007)	9.16
Sri Lanka (2011)	3.0

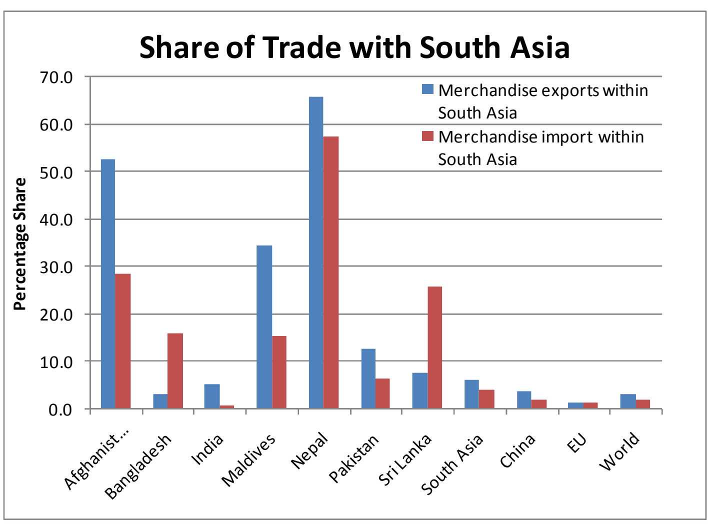
So: World Development Indicators (2013)

Concerns for Energy Security

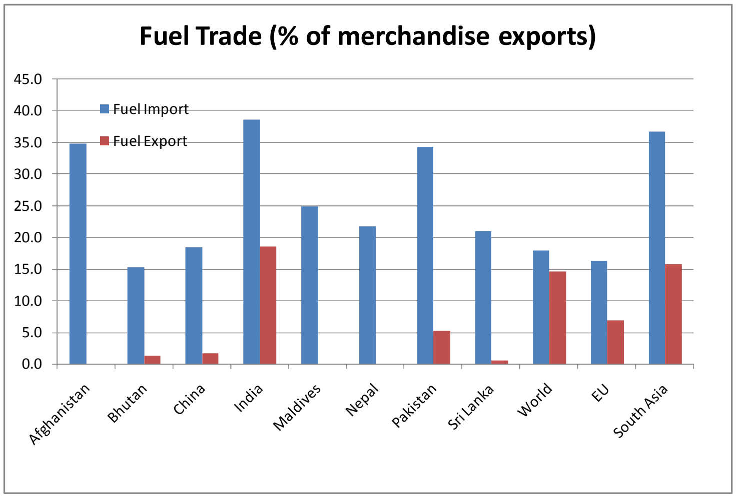


So: World Development Indicators, 2013

Economic Integation in South Asia – Share of Merchandise Trade



Fossil fuel led energy import draining forex earning



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)

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

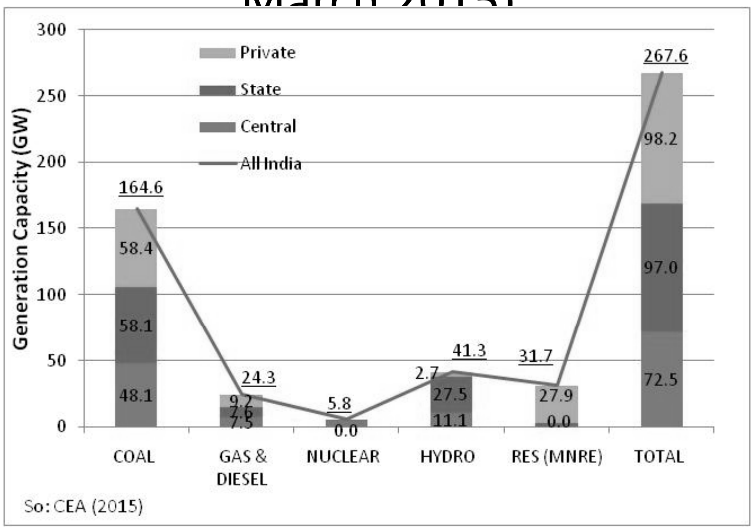
Electricity Sector in SA – A Status

	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. (Forthcoming) as WB's PRWP

Installed Electricity Generation Capacity in India (GW) (As on 31 March 2015)



Status of Electricity Sector Reform

Country	*Nominal generation market structure*	*Initiation of private ownership and/or participation:* Genera-tion	Trans-mission	Distri-bution	*Introduction of legally independent regulator*	*Transmission Arrangement*
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 owner
Sri Lanka	Multiple sellers, single buyer	1996			2002	Vertically integrated

So: Singh et al. (Forthcoming) as WB's PRWP

Status and Opportunities for Electricity Trade

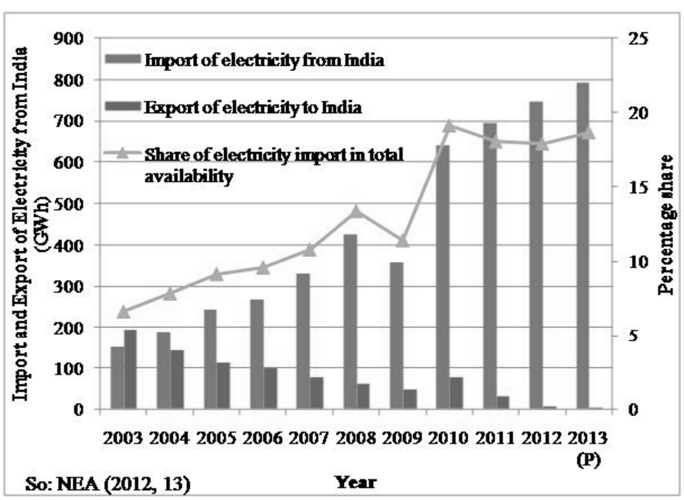
Status of Electricity Trade in SA

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.

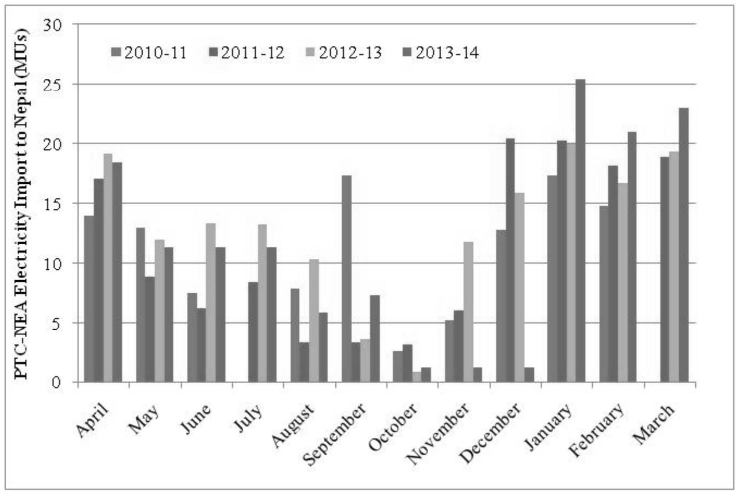
Status of Electricity Trade in SA (Contd.)

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 tp 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 on negotiated price and market based price.

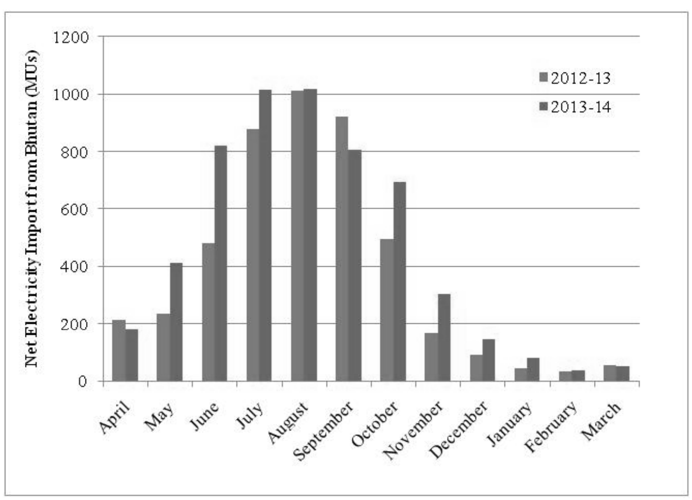
Growing Import Dependency in Nepal



Winter dependency of electricity import of Nepal



Seasonality of Export of Electricity from Bhutan



Cost-Benefit Estimation of Six Interconnection Projects in SAARC

S. No.	Case study	Key assumption	Total and annualised cost of transmission (USD million)	Annual benefit in 2016-17 (USD million)
1	India-Bhutan grid reinforcement	To evacuate Puna I & II, Mangdechhu and Dagachhu (3,066 MW) power to India	Total cost - USD 140-160 million. Annualised cost - USD 18-20 million pa is	Up to USD 1,840 million pa including USD 336 million in fuel/capacity benefit and USD 1,504 million savings due to unserved energy.
2	Nepal-Bihar (India) 400 kV link	(1) Surplus scenario - construction of all planned projects (2000 MW) to reach surplus state; and (2) Deficit scenario - 650 MW of planned capacity addition is delayed	Total cost USD 186 million including internal transmission upgrade costs. Annualised cost USD 20 million pa	Surplus scenario - Benefit of USD 105 million pa; Deficit scenario - Benefit of USD 215 million
3	India-Sri Lanka HVDC link	Addition of Puttalam Stage 2 (630 MW) and 400 MW by 2016. Trinco (1,000 MW) coal station is not considered is	Total cost - USD 339 million (2006 estimate) Annualised cost - USD 50 million pa (2010 estimate)	USD 186 million pa, including USD 96 million in benefits from reduction in unserved energy and USD 90 million in fuel/capacity benefits

So: ADB

Cost-Benefit Estimation of Six Interconnection Projects in SAARC (Contd.)

4	India-Bangladesh HVDC link	Three demand growth scenarios in Bangladesh between 9,000 MW to 12,000 MW in 2016-17	Total cost - USD 192 million to USD 250 million. Annualised cost - USD 25 million pa	Annual benefits of USD 145 to 389 million for three demand growth scenarios
5	India-Pakistan 220/400 kV link	Two scenarios: (1) Short term 250 MW transfer at 220 kV (2) Medium/long term, hundred megawatt transfer at 400 kV	Total cost (1) max USD 50 million for 220 kV option (45 km); and (2) Max USD 150 million for 400 kV. Annualised cost (1) USD 6 million (220 kV) (2) USD 18 million (400 kV).	Annual benefit (1) USD 335 million including USD 122 million in fuel cost savings (2) USD 491 million including USD 163 million in fuel cost savings
6	CASA 1000 and India-Pakistan 400 kV link	Two scenarios (1) Base Case CASA 1000; (2) Additional 850 MW hydro in Afghanistan	Total cost - (1) USD 893 million (2) USD 195 million for expanded India-Pakistan power transfer Annualised cost - USD 110 million	Combined Annual benefit - USD 1,250 million including USD 906 million in USE reduction and USD 306 million in fuel cost savings. Additional annual benefit of USD 90 million for the additional hydro scenario.

Regional Power Sector Cooperation – International Experience

Regional Electricity Arrangements

- Gulf Coast Countries (GCC)
- Greater Mekong Sub-region (GMS)
- Nile Basin Initiative (NBI)
- Nordpool
- Southern African Power Pool (SAPP)
- South East Europe (SEE)
- European Network of Transmission System Operators for Electricity (ENTSO-E)
- 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 and 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 ,and reliable future-oriented grid and adequate to meet energy policy goals.	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), 2010
SIEPAC	Create an integrated regional electricity market in Central America.	

Electricity Trade in GMS Region (GWh) - 2010

	Import	Export	Total Trade	Net Imports
Cambodia	1,546	–	1,546	1,546
Lao PDR	1,265	6,944	8,210	(5,679)
Myanmar	–	1,720	1,720	(1,720)
Thailand	6,938	1,427	8,366	5,511
Viet Nam	5,599	1,318	6,917	4,281
PRC	1,720	5,659	7,379	(3,939)
Total	17,069	17,069	34,139	

So: ADB, 2012

Bilateral to Regional Approach

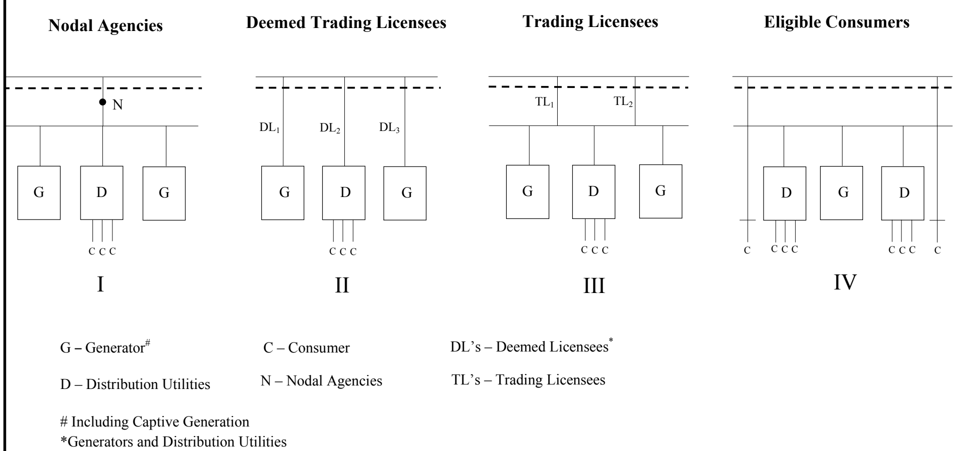
- SAPP was built upon historical bilateral interconnections in the 1950s and 1960s which witnessed development of interconnections projects between Democratic Republic of the Congo (DRC) and Zambia, and Zambia and Zimbabwe. Later, in 1975, between Mozambique and South Africa
- GMS' historical foundations 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

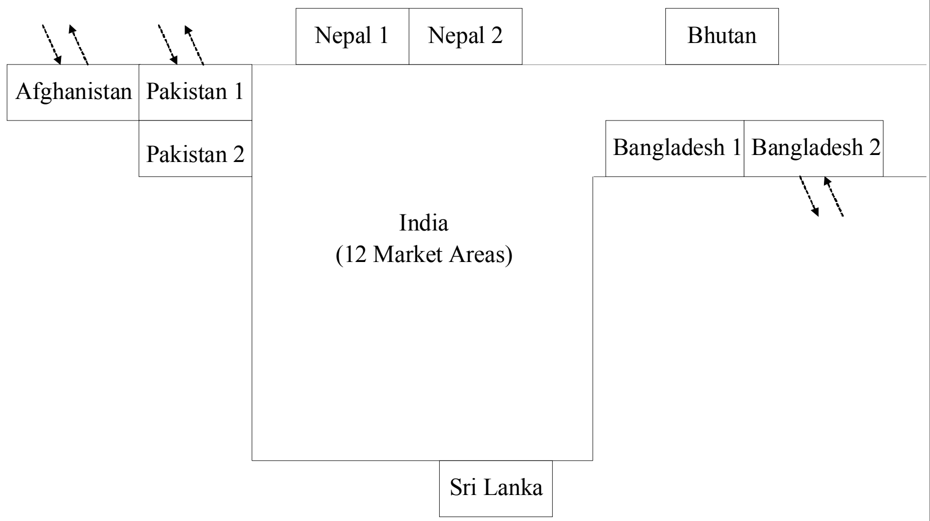
Choice of Being Cautious or Aggressive (Contd.)



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
- Volume and/or Price 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 (2013) – Project Report Submitted to ADB

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.

Thank You

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Output

Anoop Singh, Tooraj Jamasb, Rabindra Nepal, and Michael Toman, Cross-Border Electricity Cooperation in South Asia, **World Bank Policy Research Working Paper (PRWP) #7328 http://documents.worldbank.org/curated/en/2015/06/24687043/cross-border-electricity-cooperation-south-asia**	Published
Anoop Singh & Michael Toman, , International Experiences in Regional Electricity Market Development: Lessons for South Asia. **World Bank Policy Research Working Paper (PRWP)**	Drafts under review
Anoop Singh & Michael Toman, Benefits of and Barriers to Regional Electricity Cooperation: A Review of the Literature. **World Bank Policy Research Working Paper (PRWP)**	
Anoop Singh, Options for Market Design and Strategy for Developing a Regional Electricity Market in South Asia.	

Selected Readings

(some accessible from www.iitk.ac.in/ime/anoops)

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- "At a Crucial Juncture: A perspective on development of electricity and REC markets in India", 3 years of Indian Energy Exchange: Vision and Views of Industry Leaders, 2011, Powerline / IEX, New Delhi.
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