USAID FROM THE AMERICAN PEOPLE

SARI/EI

IRADe Integrated Research and Action for Development

Brief Report
On
SARI/EI Participation in the
Myanmar Green Energy Summit
"Gearing Up the Green Energy Development: New Directions and Strategies"

15th -16th August, 2016
Hotel Sule Shangri-La
Yangon, Myanmar

USAID FROM THE AMERICAN PEOPLE

SARI/EI

Integrated Research and Action for Development

Brief Report

Based on the invitation received from organiser of "Myanmar Green Energy Summit- Gearing Up the Green Energy Development: New Directions and Strategies" Mr. Rajiv Ratna Panda, Head-Technical, SARI/EI/IRADe participated as a speaker in the Session-3 on Powering Myanmar through hydropower held on 15th - 16th August, 2016 at Hotel Sule Shangri-la, Yangon, Myanmar.

Mr. Rajiv made a detailed presentation titled "Accelerating Cross Border Electricity Trade and Hydro Power Development between Myanmar and South Asia: Opportunities and Challenges". His presentation covered a) Overview of Myanmar Power Sector b) Cross Border Electricity Trade (CBET) in Myanmar c) Overview of South Asian Power Sector d) Cross Border Electricity Trade in South Asia and Key Message for Myanmar e)Why CBET for Myanmar-Potential Benefits of Cross Border Electricity Trade and Regional Hydro Power Development between Myanmar-South Asia-Mekong Region f) Opportunities: Why Myanmar should strive for Cross Border Electricity Trade and Hydro Power Development-Short, Medium and Long Term Outlook g) Challenges for Advancing CBET and Hydro Power Development between Myanmar and South Asia h) Way Forward for Accelerating Responsible Hydropower Development in South Asia & Myanmar; Comprehensive Regional Investment Policy Framework for CBET & Hydropower Development; Regional Regulatory Guidelines/Framework for Accelerating long term CBET between Myanmar & South Asia. His detailed presentation is attached as Annexure -1.

The session was chaired by Ms. Kate Lazarus, Senior Operations Officer, International Finance Corporation, World Bank. The other distinguished speaker of the session were Mr. U Wunna Htun, Deputy Director, Department of Hydro Power Implementation, Ministry of Electricity and Energy, The Republic of Union of Myanmar and he spoke on Myanmar Hydro Power: Development Needs and Challenges; Mr. Dave Mann, Managing Director, Mann Power Consulting Limited and he spoke on Ultra-Low Head Micro Hydro System for Rural Electrification.

It was noted from interactions during summit that while Myanmar is positive about CBET in medium and long term, however first Myanmar needs to develop adequate generation capacities to first meet

It's internal demand, subsequent to which it can export surplus electricity to South Asian countries and Mekong/ASEAN countries. Myanmar Power Demand is projected to be around 14,542 MW for which required installed capacity is around 23,594 MW by 2030.

Currently only 33% of the population has an electricity connection and average electrification ratio in rural areas is about 16%. The Per Capita Electricity Consumption is only around 263 KwH/Capita (2016). In the above context, in short term Myanmar is expected to explore more options for increasing import of electricity from South Asian countries and Mekong/ASEAN countries while balancing its energy security concerns and challenges. Recently, State Government of Manipur of India has started supplying 3 MW of power to a border town in Myanmar i.e. Tamu under a special bilateral arrangement from Moreh (Manipur). Cross-Border Electricity trade could improve electricity availability and provide mutual benefit near border towns in short term. Both India-Myanmar are planning to consider infrastructure strengthening of the transmission network to increase supply in future near border. India and Myanmar are also working towards the conclusion of a proposed Memorandum of Understanding between India and Myanmar on Cooperation in the field of Power. A deeper energy integration through expansion in Cross-border electricity trade can potentially improve the energy security and promote environment friendly socio-economic development in Myanmar and in South Asian countries by sharing energy resources, energy infrastructure in medium and long term. For higher level of CBET (both for import and export) there are various Policy, Regulatory, Technical, Commercial and Economic Issues/Challenges which needs to be addressed in an constructive manner for which more active engagement among South Asia and Myanmar Energy/Power Sector Agencies/Authorities/Professional and other stakeholders are needed.

Myanmar is blessed with technically feasible Hydro energy resources potential of 45,344 MW (apprx. only 5% of the potential has been developed so far) which can be exploited rapidly both for meeting internal demand and as well as for export of surpluses only, however there are various issues and challenges with the development of large scale hydropower in Myanmar which ranges from Land acquisition; Environment and Forest issues; Rehabilitation & Resettlement and Local issues to financial viability of large hydropower projects; Geological Uncertainties/Natural Calamities, Water and Flood Management etc.

Therefore Large Scale hydropower development in Myanmar must be developed by comprehensively addressing the above issues in a sustainable, responsible and transparent manner.

On regional front, Myanmar is the Energy sector leader in Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC[1]) and poised to play an important role for energy integration and power trade/exchange among BIMSTEC countries. Under BIMSTEC, a draft Memorandum of Understanding for Trans-power exchange and grid interconnection, hydropower development, energy security of the region needs to be concluded/signed by BIMSTEC member states, which will provide a strong policy and legal base for accelerating power trading among BIMSTEC countries. Myanmar shares 1624 km long border with India in its North-Eastern side and 72 km border with Bangladesh. It also shares 2185 km, 238 km and 1799 km border with China, Laos and Thailand respectively. Therefore it is strategically located and can be Energy Bridge between South Asia and South East Asia through regional energy integration and Cross Border Electricity Trade.

During the visit to Myanmar and based on interaction, it was noted that Myanmar is poised for change under the leadership of the first elected civilian president. The new government is committed to take Myanmar into new heights of development; boosting growth in Myanmar with high emphasis on capacity building, infrastructure development and improving rural livelihood and reducing poverty.

The Government of Myanmar is implementing National Electrification Plan which aims for universal electricity access by 2030 (apprx.7.2 million new connections either through grid connection or permanent off-grids electricity).Regional Energy Integration through Cross Border Electricity Trade with South Asia may help in Myanmar in achieving its electricity development and economic growth ambitions.

[1] The Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC) is an international organisation involving a group of countries in South Asia and South East Asia. These are: Bangladesh, India, Myanmar, Sri Lanka, Thailand, Bhutan and Nepal.

USAID
FROM THE AMERICAN PEOPLE

SARI/EI

IRADe Integrated Research and Action for Development

Annexure-1

Accelerating Cross Border Electricity Trade and Hydro power Development between Myanmar and South Asia: Opportunities and Challenges

Rajiv Ratna Panda

HEAD-TECHNICAL, SARI/EI/IRADe

MGES
MYANMAR GREEN ENERGY SUMMIT

Hotel Sule Shangri-la

15th-16th August,2016

Yangon, Myanmar

Content

- Brief About SARI/EI
- Overview of Myanmar Power Sector
- Cross Border Electricity Trade in Myanmar
- Overview of South Asian Power Sector
- Cross Border Electricity Trade in South Asia and Key Message for Myanmar.
- Opportunities: Why Myanmar should strive for Cross Border Electricity Trade (CBET) and Hydro Power Development-Short, Medium and Long Term Outlook
- Challenges for Advancing CBET and Hydro Power Development between Myanmar and South Asia.
- Way Forward :
  - Accelerating Responsible Hydropower Development in South Asia and Myanmar.
  - Comprehensive Regional Investment Policy Framework for CBET & Hydropower Development.
  - Regional Regulatory Guidelines/Framework for Accelerating long term CBET.

USAID FROM THE AMERICAN PEOPLE

SARI/EI

Integrated Research and Action for Development

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

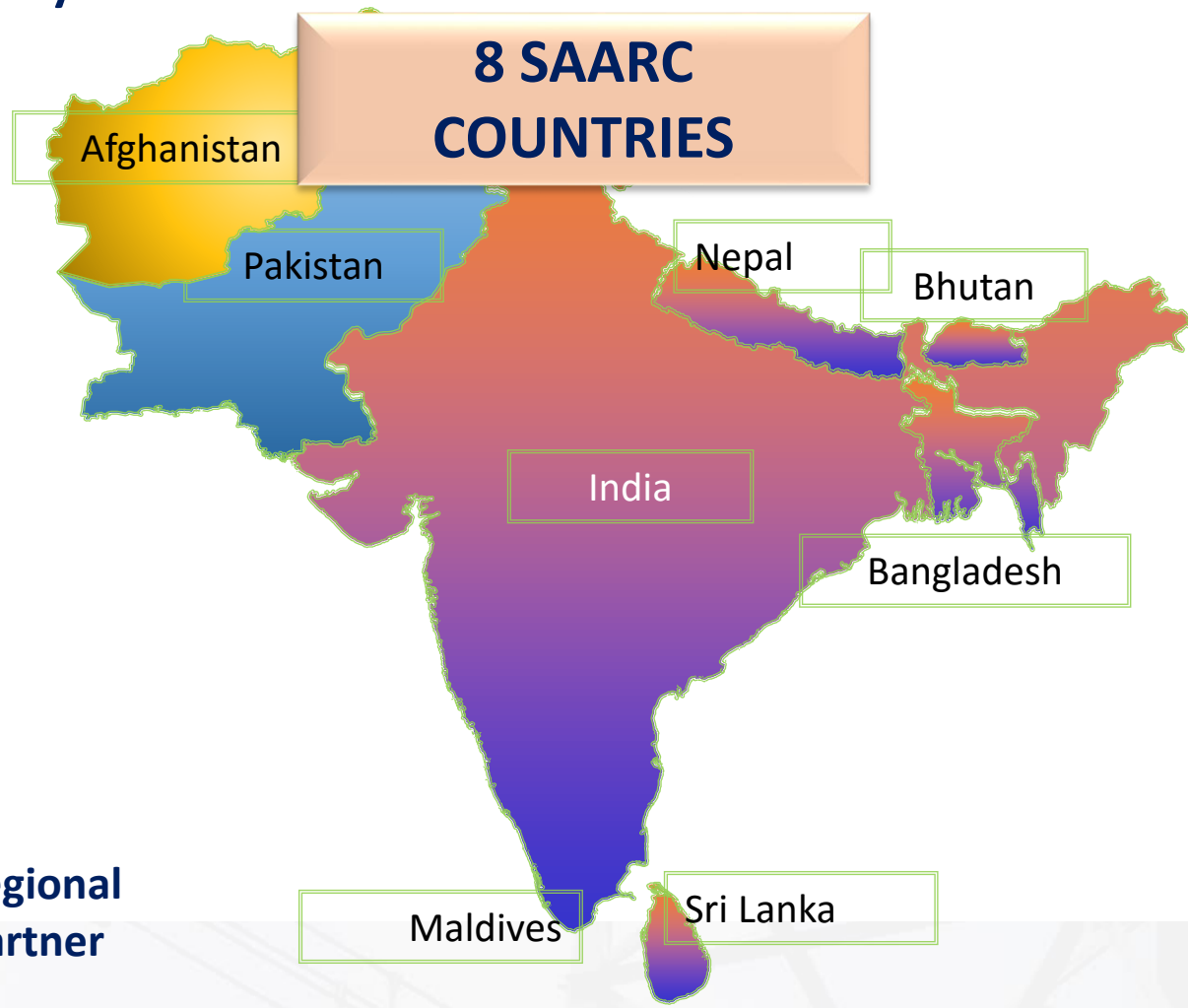
- **SARI/E is a long standing program of USAID started in the year 2000**

- **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*

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

- **Integrated Research and Action for Development (IRADe) , a regional energy think tank-based in Delhi, India is the implementing partner**



USAID FROM THE AMERICAN PEOPLE

SARI/EI

Integrated Research and Action for Development

SARI/EI:Overall Framework for development of CBET in South Asia

SAARC Framework Agreement on Energy (Electricity) Cooperation

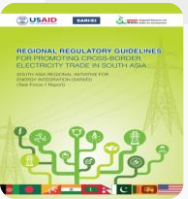
CBET facilitation through

Institutional Mechanism

- Regional Regulatory Guidelines
- Regional Investment Framework and Investment Policy Guidelines
- Harmonization of Grid Codes
- Assessment of Trading Potential
- Model framework for Open Access and Trading License Regime
- Transmission Pricing Rules & Methodology
- Model Regulation for Power Market Development
- Standard Contracts (Bankable PPAs/TSAs)
- Mock Exercise for SARPEX

Undertaken as part of the TF-1 and has been Published

Suggested Changes/Amendments in Electricity Laws, Regulations and Policies (L&R&P) of South Asian Countries.



SARI/EI/IRADe (Secretariat)

Project Steering Committee

TASK FORCE LEADERS

- AFGHANISTAN
  MEW,DABS
- BHUTAN:
  MoEA
- BANGLADESH
  MPEMR,BERC, PGCB
- INDIA:
  CEA, CERC PTC, PXIL

- NEPAL
  NEA, MoE
- PAKISTAN
  NEPRA,NTDC MoWP
- SRILANKA
  MPRE, CEB

International Consultants

Deloitte, KMPG

PRDC, PWC, ICF

Mercados, E & Y

Task Force-1 Coordination of Policy, Regulation and Legal frameworks

Task Force-2 Advancement of Transmission Interconnection

Task force-3 South Asia Regional Electricity Markets

Technical Studies

Macro-Economic Benefits of Cross Border Electricity Trade (CBET)

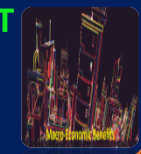
Analytical Studies

Task Force Recommendations/Outputs

- Regional Regulatory Guidelines;
- Suggested Amendments in Electricity Laws, Regulations and Policies;
- Regional Investment Framework; Model CBET-Power Market Regulation;
- Trading Potential; Harmonization of Grid Codes, Operating Procedures;
- Model framework for Open Access and Trading License Regime;
- Model PPAs/TSAs , Mock Exercise for Regional Power Exchange (SARPEX)

Findings: Macro-Economic Benefits of CBET

- India-Nepal CBET
- India-Bangladesh CBET

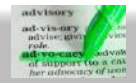


Synthesis, Consensus , Outreach and Dissemination

THINK TANK FORUM

Policy Advocacy, Media Engagement, Quantifying Impacts

- Policy Makers, Politicians
- Ambassadors and Diplomats
- Civil Society, Research Institutions
- Task Force Members, Power Utilities



- CBET :Linkages with Climate Change and Sustainable Development Agenda in South Asia
- CBET : Linkages with Energy Access and Gender

SARPEX: South Asia Regional Power Exchange; MEW-Ministry of Energy & Water, Afghanistan, DABS-Da Afghanistan Breshna Sherkat, MoEA-Ministry of Economic Affairs, Bhutan, MPEMR- Ministry of Power, Energy and Mineral Resources , BERC- Bangladesh Energy Regulatory Commission, PGCB-Power Grid Company of Bangladesh Limited, CEA-Cntral Electricity Authority, India, CERC-Central Electricity Regulatory Commission, India, PTC limited, Idian Energy Exchange Limited, NEA-Nepal Electricity Authority, MoE-Ministry of Energy, Nepal, NEPRA-National Electric Power Regulatory Authority, MOWP- Ministry of Water and Power NTDC-National Transmission And Despatch Company Limited , MPRE- Ministry of Power and Renewable Energy, CEB- Ceylon Electricity Board

USAID
FROM THE AMERICAN PEOPLE

SARI/EI

IRADe Integrated Research and Action for Development

Overview of Myanmar Power Sector

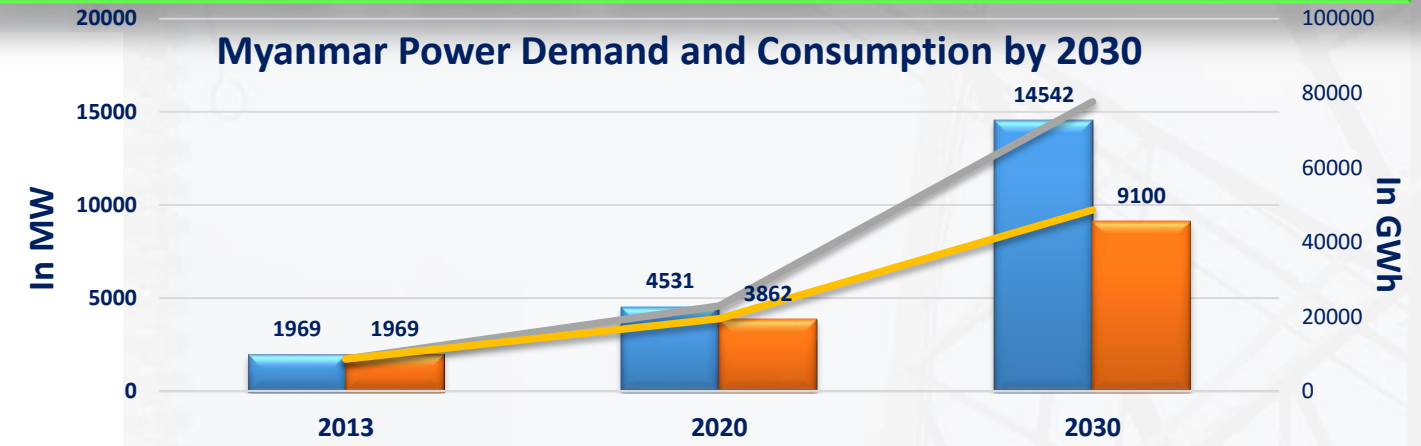
USAID FROM THE AMERICAN PEOPLE

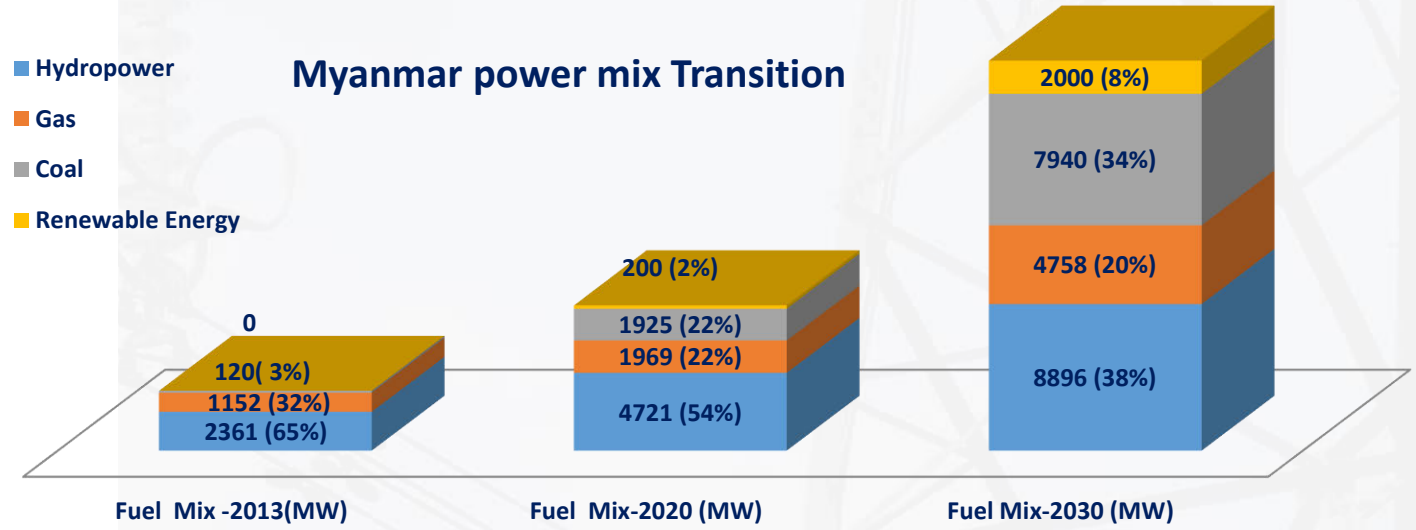
SARI/EI

IRADe Integrated Research and Action for Development

Overview of Myanmar Power Sector

- Myanmar Installed capacity as of 2015 is 4,719 MW
- Per Capita Electricity Consumption 263 Kwh/Capita (2016)
- *33 % of the population has an electricity connection (Avg. electrification ratio in rural areas is about 16%).
- Power Demand to be 14,542 MW & Installed capacity to be around 23,594 MW by 2030.
- By 2030, hydro share in the power mix will be reduced to 38% from 65 %. Coal share to go up from current 3 % to 34 %.





Installed Capacity 3633 MW **Installed Capacity 8815 MW** **Installed Capacity 23594 MW**

*http://www.worldbank.org/en/news/feature/2014/10/08/powering-up-myanmar-more-than-7-million-new-electricity-connections-needed-by-2030

Source: http://open_jicareport.jica.go.jp/pdf/12238754.pdf

Energy Resources and Geography of Myanmar

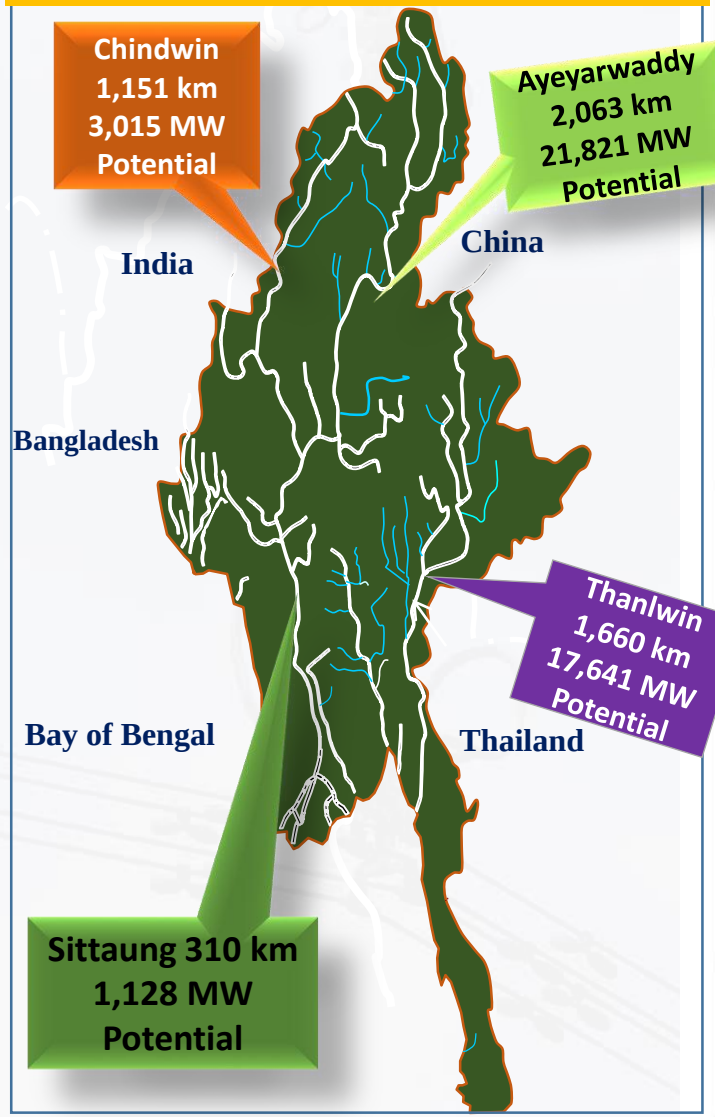
- **Myanmar -Hydro energy Resources- 45,344 MW- 5% has been developed.**
- **There are significant gas resources.**

Myanmar Energy Resources	
Hydro(MW)	45344
Gas(BCF)	16600
Oil(MMBL)	459
Coal (Million Tones)	468
Wind (MW)	4000
Solar (MW/m2 a)	748.3
Biomass(MT)	38.3

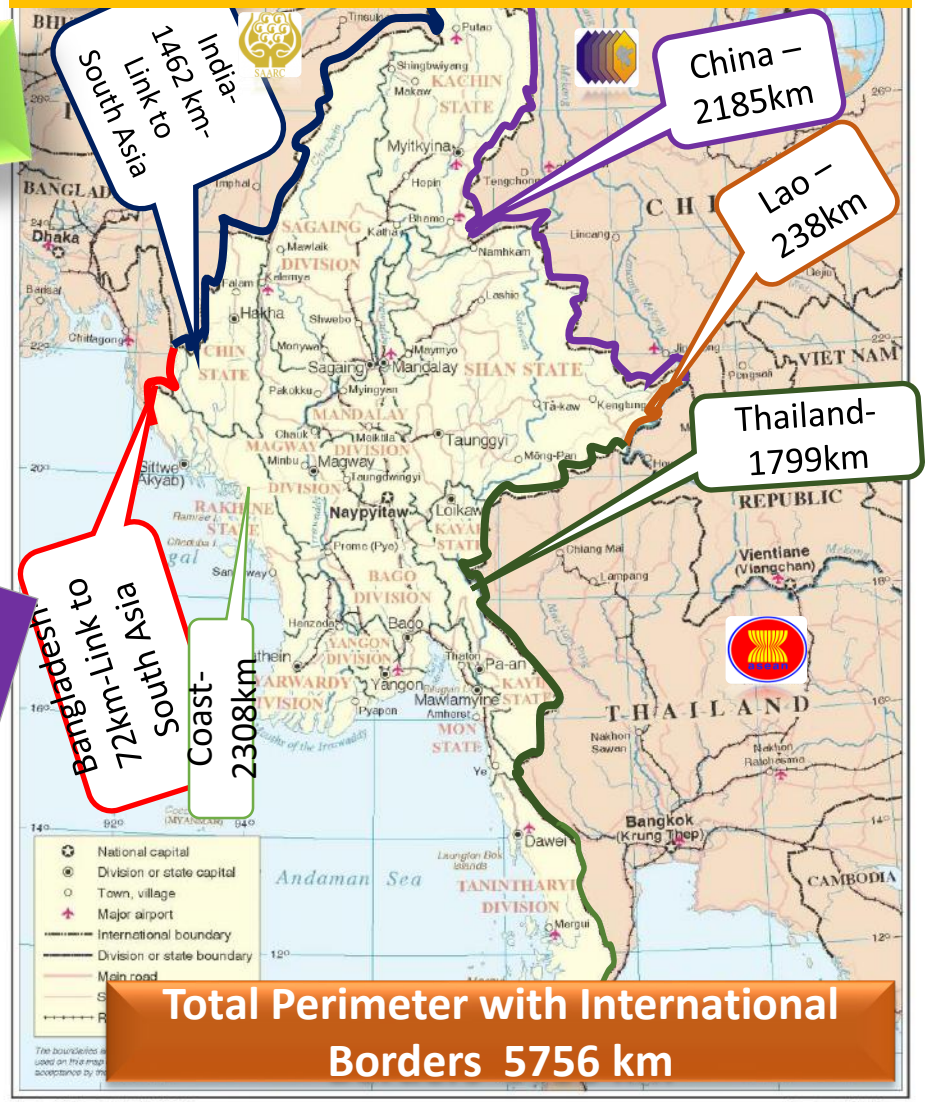
Source: ADB,MEMP

- **Myanmar share the border with Laos, China, India, Bangladesh and Thailand**

Myanmar (Major Rivers & Potential)



GEOGRAPHY OF MYANMAR (Location)



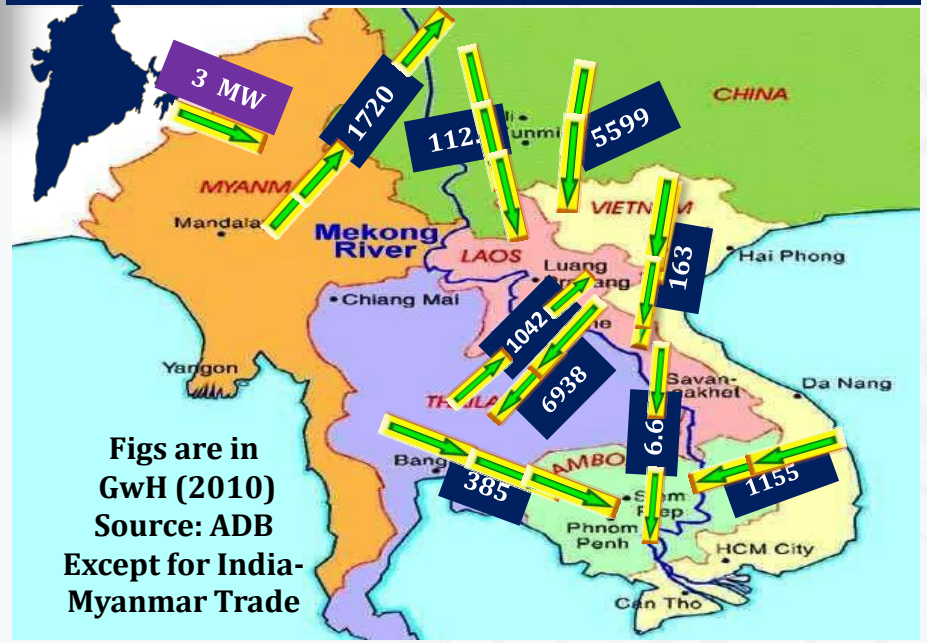
Hydro Power and Cross Border Electricity Trade in Myanmar and Mekong Region

- Myanmar is exporting apprx. 520 MW at maximum to China
- Myanmar is importing 3 MW of electricity from Manipur state of India.
- Myanmar has significant Hydro energy Resources 45,344 MW-only 5% has been tapped so far.
- Myanmar is a part of the GMS region and is expected to be the largest exporter of hydro electricity by 2025
- Shares border with Laos, China, India, Bangladesh and Thailand

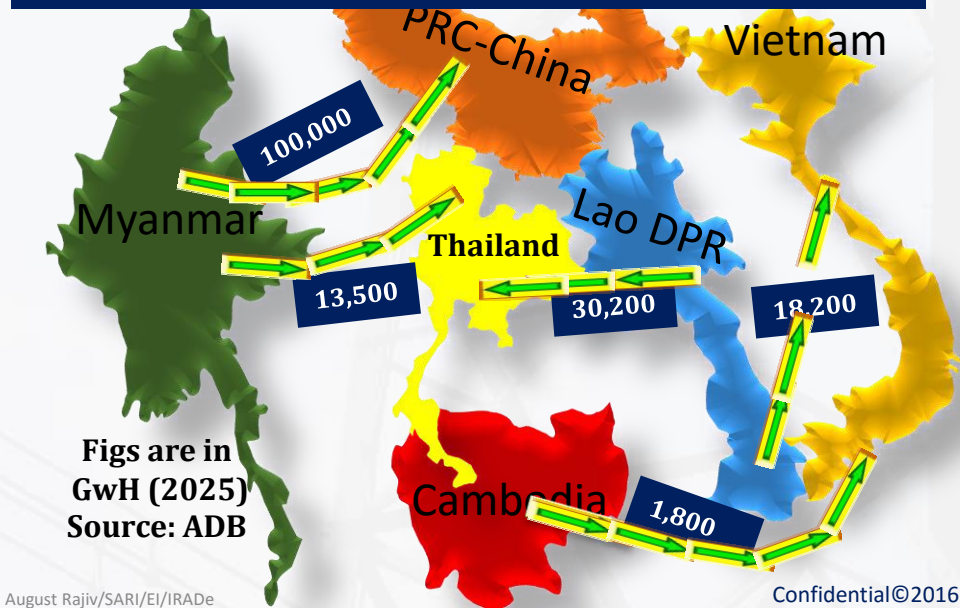
Potential Hydropower Plants near Borders of Myanmar			
Northern Borders		Other Borders	
Project	Capacity (MW)	Project	Capacity (MW)
Myitsone	6000	Dapein–2	168
Chipwi	3400	Kunlong (Upper Thanlwin)	1400
Wutsok	1800	Naopha	1000
Kawnglanghpu	2700	Mantong	200
Yenam	1200	Shweli–2	520
Pisa	2000	Keng Tong	96
Laza	1900	Wan Ta Pin	25
Chipwinge	99	So Lue	165
Gawlan	100	Mong Wa	50
Wu Zhongze	60	KengYang	28
Hkankawn	140	He Kou	88
Tongxinqiao	320	Namkha	200
Lawngdin	435	Mong Ton (Upper Thanlwin)	7110
Tamanthi	1200	Htu Kyan	105
Nam Tamhpak (Kachin)	200	Henna	45
		Tha Kwa	150
		Palaung	105
		Bawlake	180
		Nam Tamhpak	180
		Ywathit	4000
		Hutgyi	1360
		Tanintharyi	600
Total	21554		17775

Source: RTE International (2010b), ADB.

Electricity Trade-2010 (GwH)-GMS Region

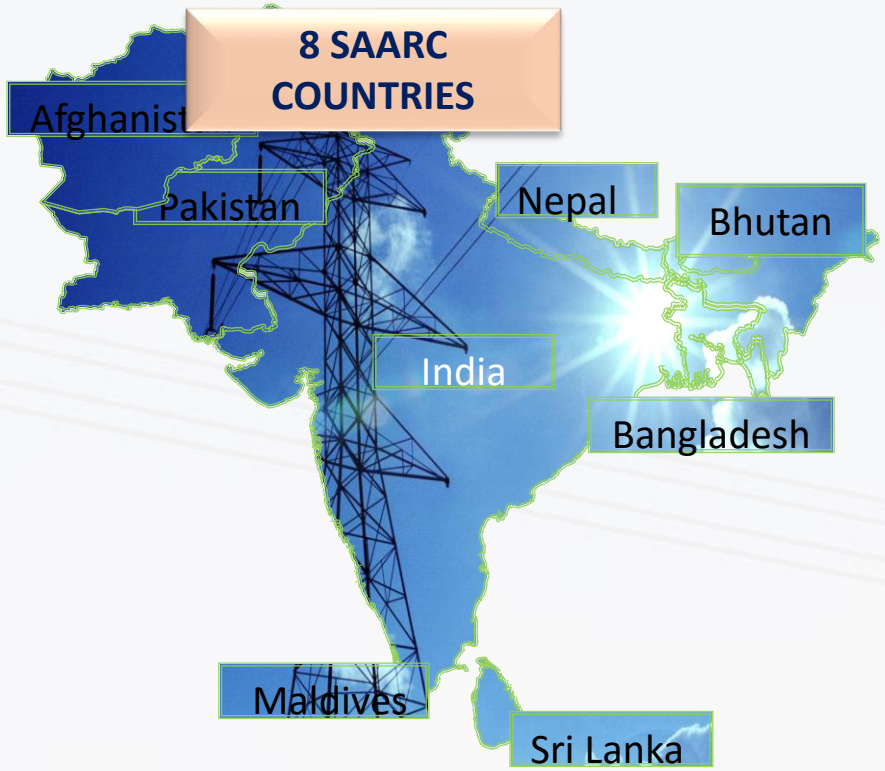


Possible Electricity Trade-2025 (GwH)-GMS Region



GMS: Greater Mekong Sub Region

Overview of South Asian Power Sector



Disclaimer : By making any reference to a particular geographic area or by using the term "country'' and Map in this document,IRADe/USAID does not intend to make any judgement as to the legal or other status of any area/Map. The map used is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries, and to the name of any territory, city or area.

Overview of South Asian Power Sector

Total Installed capacity of around 3,47,593 MW

Afghanistan: Small Power system (1341 MW);High Electricity Imports high, Hydro Dominated.

Bhutan: Small Power system (1614 MW);Hydro Dominated; Surplus Hydro; Exporting to India. Leading Exporter of Hydro Electricity.

Bangladesh: Gas Dominated; Resource Crunch; Imports Electricity from India; will remain as one of the Leading importer

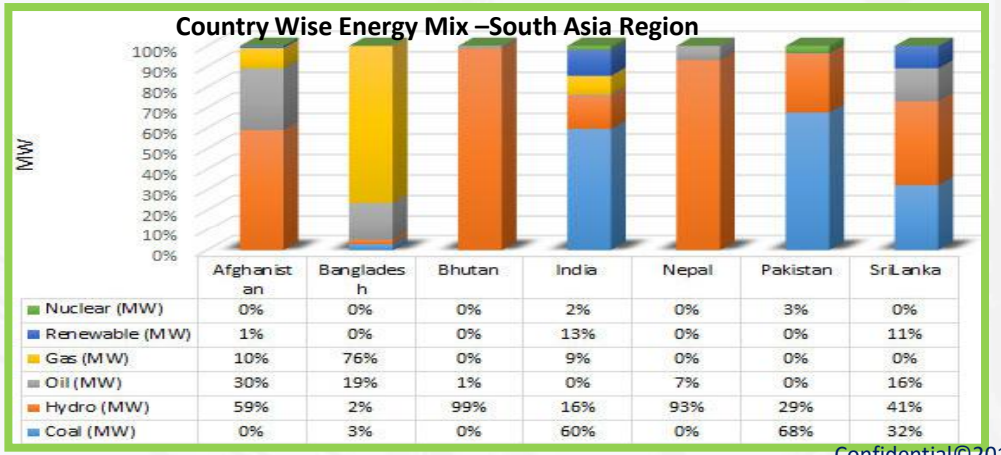
India: Large Power System; Coal dominated; reducing deficits; Long terms electricity demand are huge and potential large market. The Leading importer & exporter of electricity. 44 GW of RE.

Nepal: Very small power system (765 MW); Hydro based, very high deficits; Importing Electricity from India; Potential exporter hydro Electricity in medium term and importer of electricity in Short Term.

Sri Lanka: Hydro dominated but the flex mix is changing; High peak demand.

Country	Installed Capacity (MW)
Afghanistan	1341
Bhutan	1,614
Bangladesh	12,071
India	3,04,760
Nepal	765
Sri Lanka	4050
Pakistan	24,829
Maldives	90
Total	**3,49,520**

Source : Compiled form various sources PGCB, DGPC,CEA,Annual Report NEA, Status of Industry Report NEPRA, Task Force 1 Report IRADe Report on CBET south Asia: Challenges and investment



	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%

Confidential©2016

USAID FROM THE AMERICAN PEOPLE

SARI/EI

IRADe Integrated Research and Action for Development

Regional Resource Potential: Hydro Potential :350 GW !

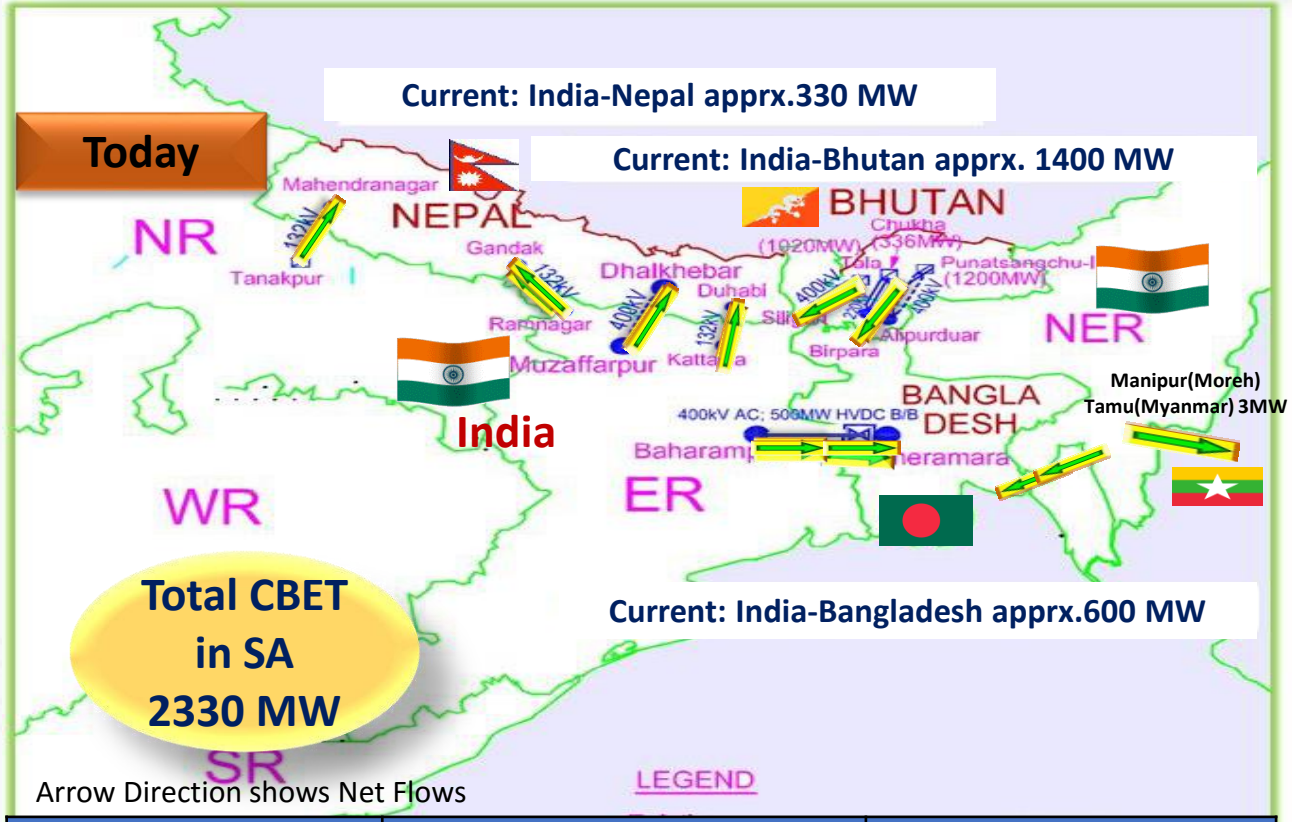
- Vast potential of hydro power:350 GW
- Bhutan, Nepal, Pakistan, India have 30,83, 59, 150 GW respectively.
- Nepal and Bhutan can build exported oriented hydro plants.
- Significant Coal deposits in India and Pakistan.
- Coal deposits in Bangladesh yet to be exploited effectively.
- In addition ,there is a 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

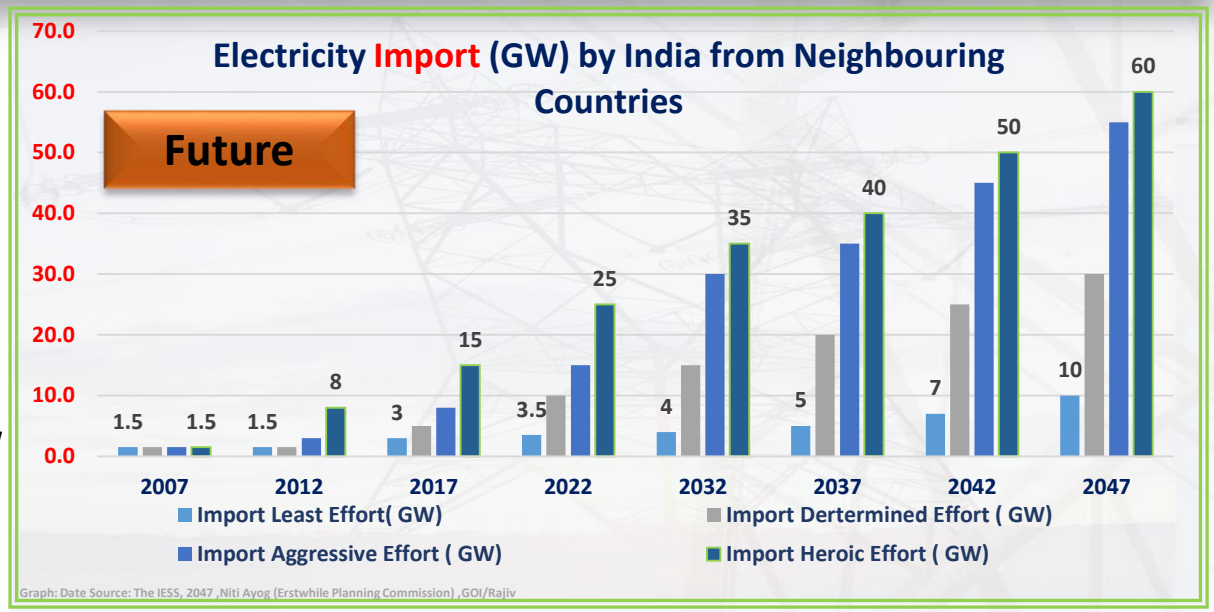
Renewables	Bangladesh	India	Nepal	Bhutan	Pakistan	Sri Lanka
Solar Power (Kwh/sq. m per day)	3.8 - 6.5	4 - 7	3.6 - 6.2	2.5 - 5	5.3	NA
Wind (MW)	limited potential	151,918	3,000	4,825	24,000	25,000

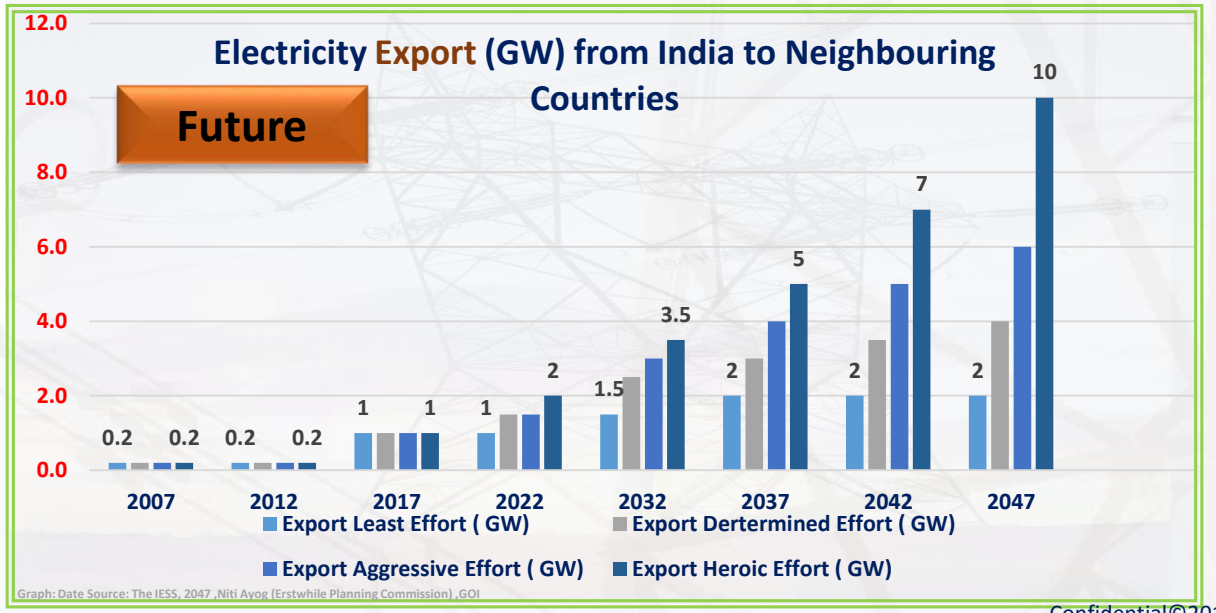
Current Status of Cross Border Electricity Trade (CBET) and Future Trading Scenarios



Bhutan→ India	India→ Bangladesh	India→ Nepal
• Tala: 1.80 INR/kWh for 1st year (now 1.98 INR/kWh) **(0.003 US$/KWH)** • Dagachhu: 2.40 INR/kWh for 1st year (started in 2015) **(0.04 US$/KWH)**	• NVVNL: 2.40-2.86 INR/kWh (Aug'14-May'15) **(0.04 US$/KWH)** • PTC: 4.26-5.00 INR/kWh (Dec'13-May'15) (0.071 US$/KWH) • Tripura-Bangladesh Rs 5.50 per unit **(0.091 US$/KWH)**	• Treaty/Bilateral: Current 5.40 INR/kWh **(0.09 US$/KWH)** • PTC: 4.55, 4.35, 4.30, 3.75 INR/kWh (FY11-14) • NVNL-NEA PPA (80 Mw) INR/kwh 3.44 **(0.05 US$/KWH)**

Source: Compiled from various resources, News Paper articles etc.





Key Drivers for CBET and Regional Exploitation of Energy Resources

- Low per Capita electricity consumptions
- Electricity Shortages.
- Poor access to electricity.
- Optimal utilization of energy resources.
- Economic Growth & Regional Integration
- Opportunity -regional electricity market.
- Seasonal complementarities

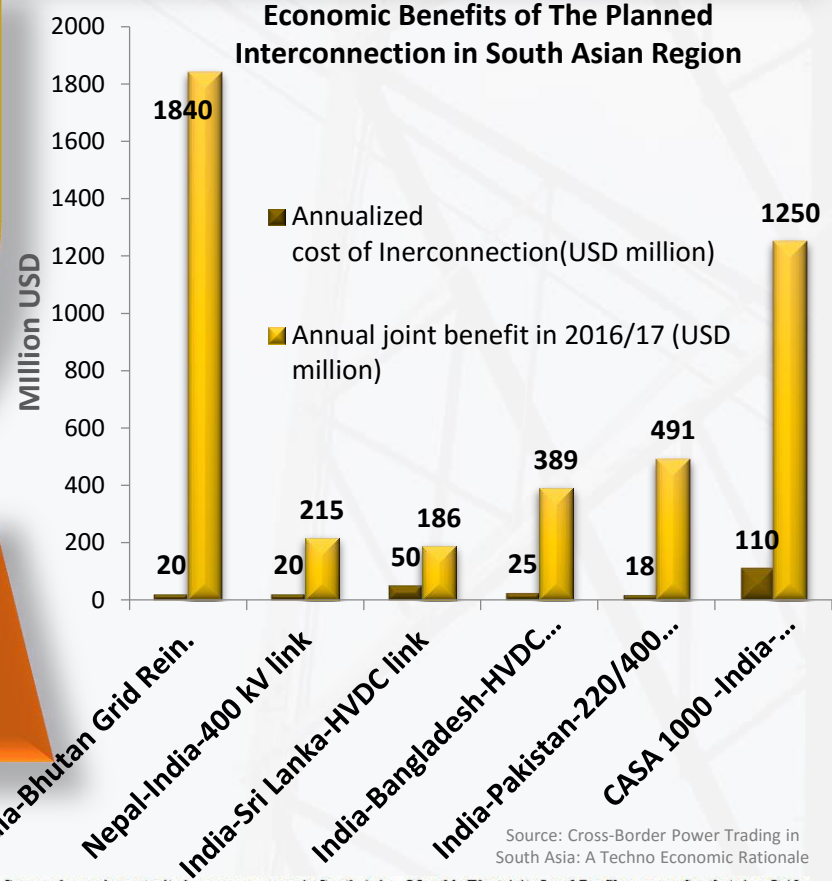
Nepal and Bhutan Large hydropower resources; Nepal -severe power shortages , Economic benefits of Trade

Bangladesh :Power shortages, Large Suppressed Demand, heavy reliance on natural gas and plans for large coal power

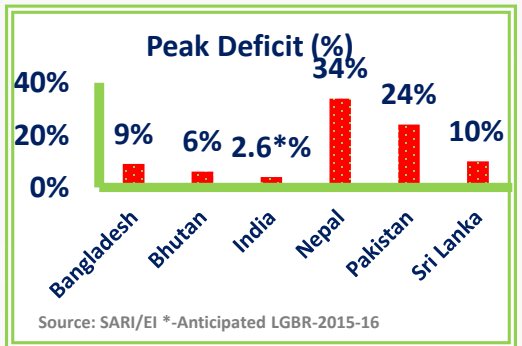
Afghanistan and Pakistan Access to large hydropower resources, Severe power shortages, High Demand Growth

Sri Lanka Heavy reliance on liquid fuel and plans for large coal power development

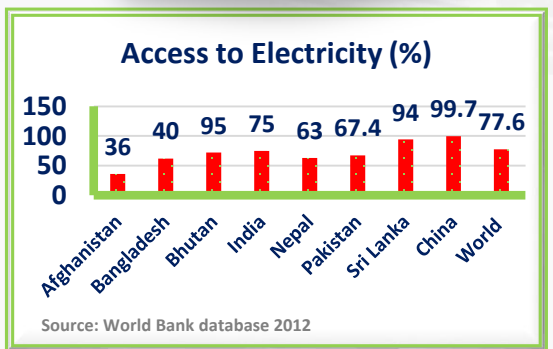
India :High demand growth, coal power dominated, Renewable energy Growth



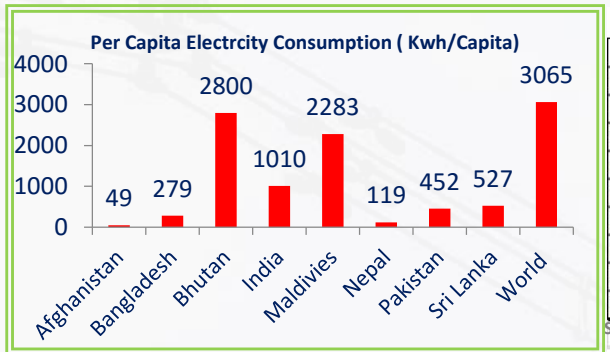
Source: Cross-Border Power Trading in South Asia: A Techno Economic Rationale

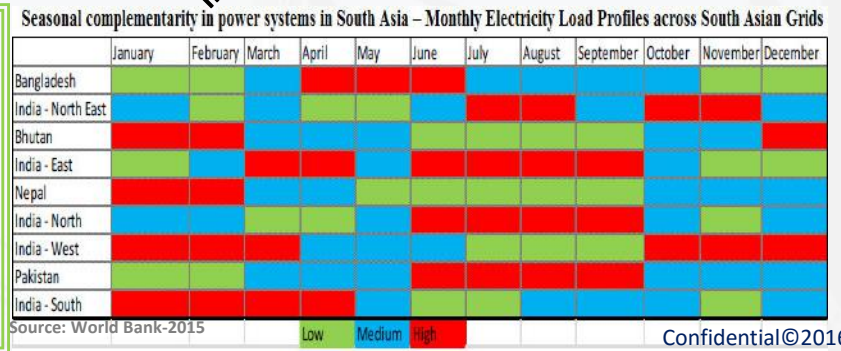


Source: SARI/EI *-Anticipated LGBR-2015-16



Source: World Bank database 2012





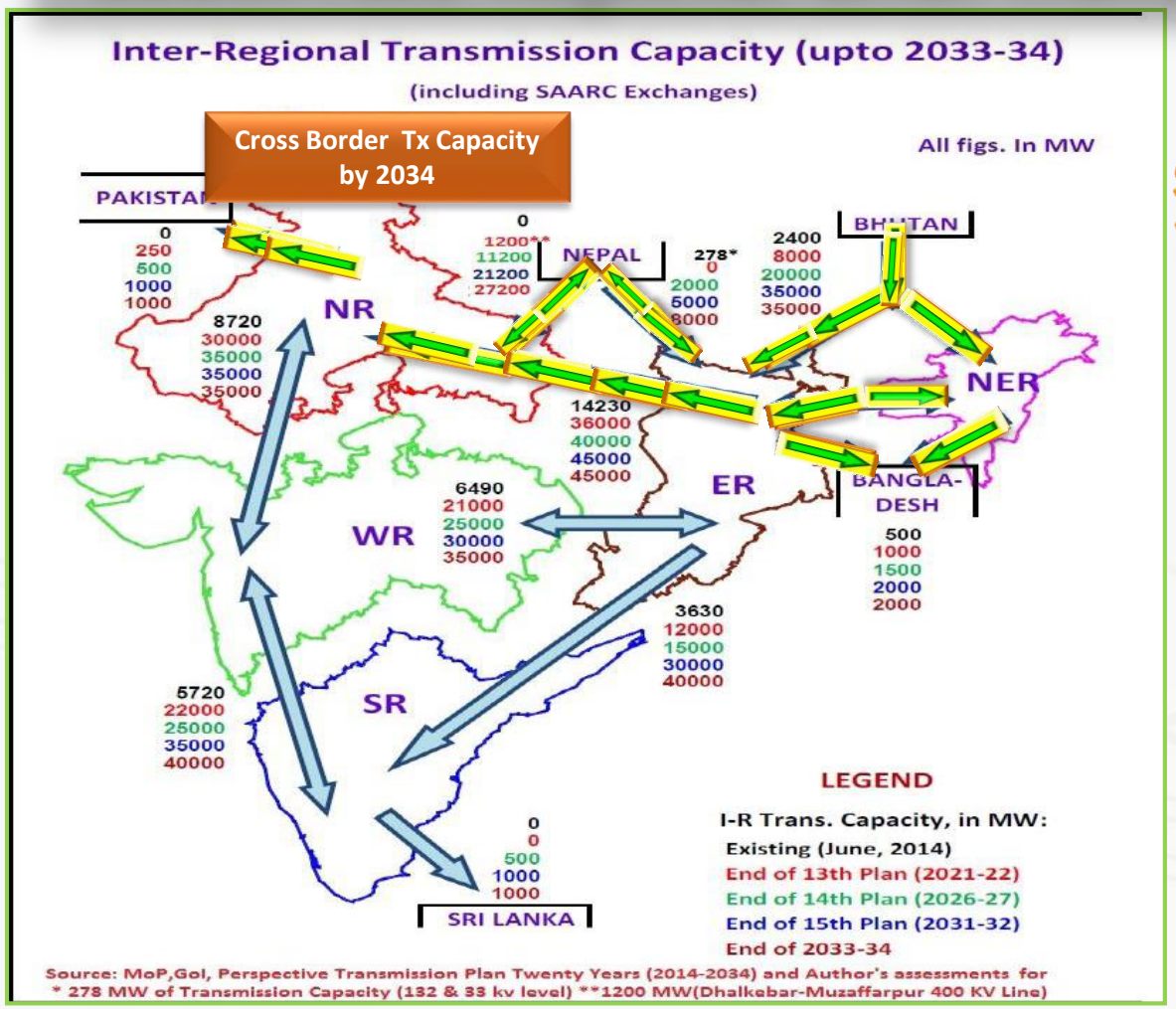
Source: World Bank-2015

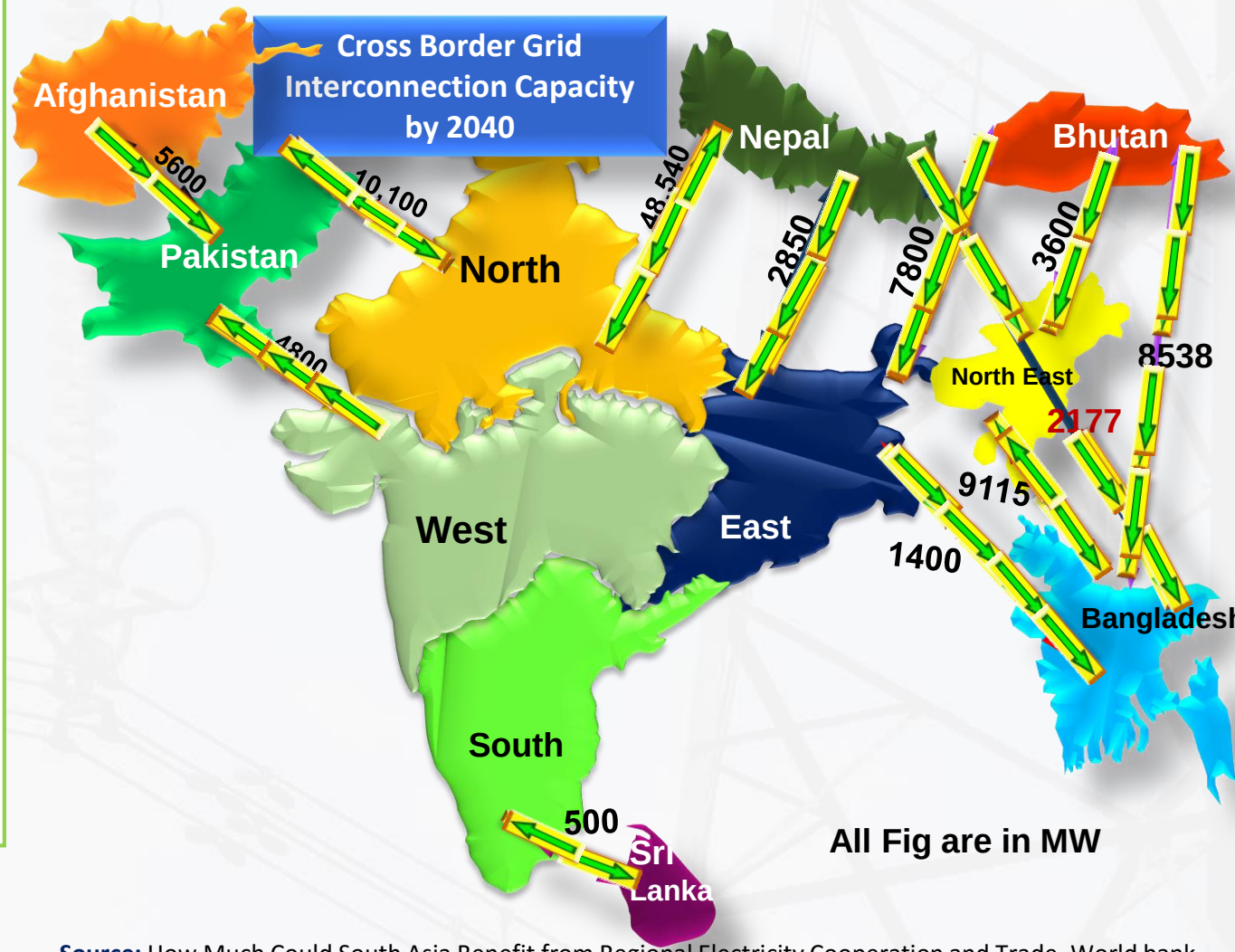
USAID FROM THE AMERICAN PEOPLE

SARI/EI

Integrated Research and Action for Development

South Asia Regional Grid: Transmission Capacity by 2033-34 & 2040





Significant Transmission System Interconnection (Both AC and DC) are being Planned and Proposed. Bangladesh is in the process of Planning to Import around Apprx. 6000 MW by 2034 (PMSP 2015-JICA Presentation,4th June,2015)

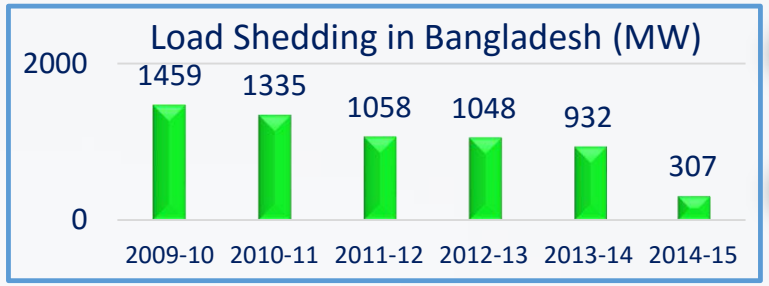
Source: How Much Could South Asia Benefit from Regional Electricity Cooperation and Trade, World bank

Cross Border Electricity Trade in South Asia and Key Message for Myanmar

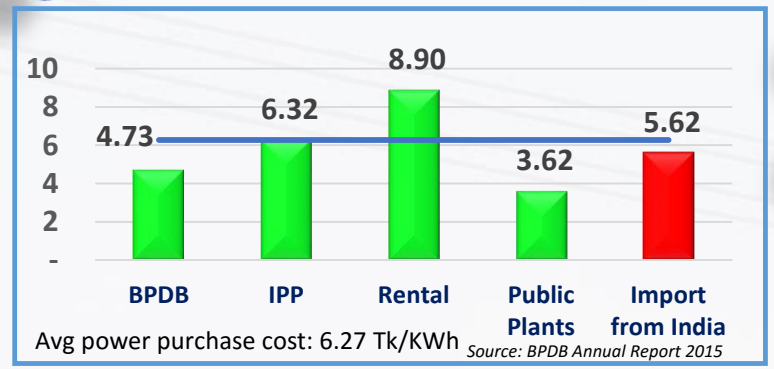
Cross Border Electricity Trade in South Asia and Key Message for Myanmar

India-Bangladesh Interconnection

- Reduction in load shedding with round the clock availability of power from India (500 MW: 5th October, 2013)(100 MW: March 23, 2016)



- Access to Cheaper source of Electricity



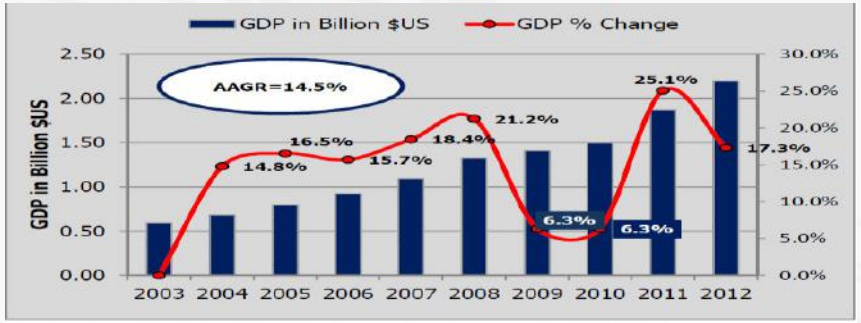
Avg power purchase cost: 6.27 Tk/KWh *Source: BPDB Annual Report 2015*

- The estimated Annual savings would be around Taka 40 billion (US$500 million approx.) (Shahi 2014).

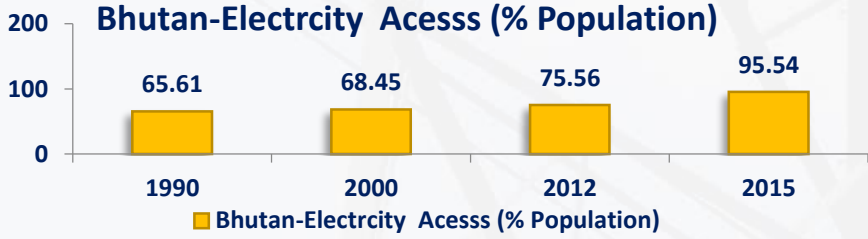
Source: http://www.ideasforindia.in/article.aspx?article_id=1589

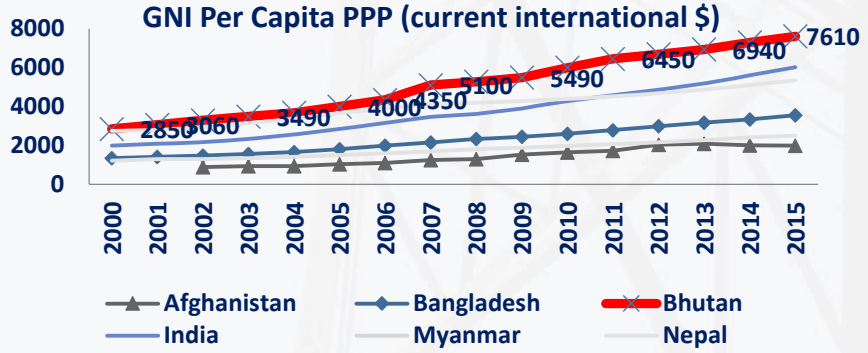
India-Bhutan Interconnection

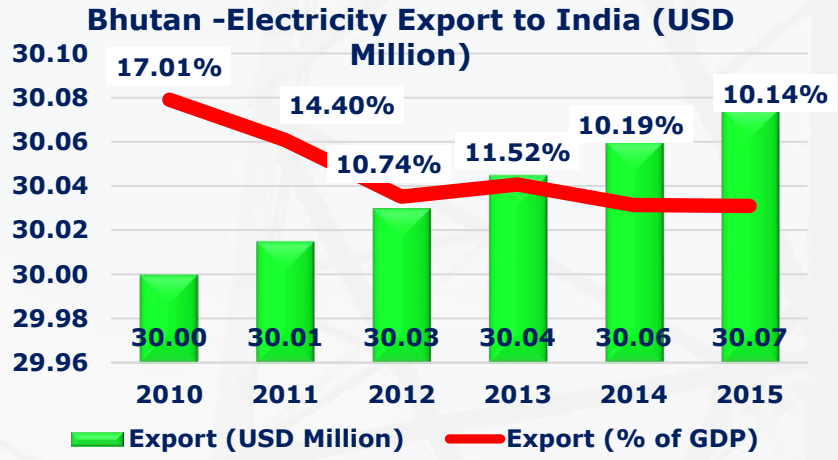
- Bhutan envisages the development of at least 10,000 MW by 2020.
- 95% of Population Electrified.
- Close to 75% of all electricity generated is exported to India.
- Hydropower exports (only surplus) provided more than 40% of Bhutan's revenues, and constitute 25% of its GDP *. Now it is around average 12.28%. Since 2010.
- Helps in Sustaining High GDP Growth Rate, Modernization of power infrastructure.
- Emergency Support -During the 2012 blackout in India**



Nominal GDP Growth Rate, Bhutan. Source: World Economic Outlook, IMF







** http://thediplomat.com/2016/06/india-and-bhutan-cross-country-power-connectivity/

* http://www.oecd.org/countries/bhutan/48651659.pdf

Opportunities: Why Myanmar should strive for Cross Border Electricity Trade-Short Term Outlook

Why CBET for Myanmar and Hydro Power Development

- **Resource Complementarity with South Asia Region.**
- **Enhance availability of electricity and increase electricity access. Bringing people (50% on generator) on power grid through expansion in power system.**
- **Hydro Power-Clean form of energy, Addressing climate change.**
- **Revenue earning , Accelerating economic growth, Modernization of power infrastructure-** ***Electric power transmission and distribution losses (% of output) in Myanmar was 26.71 as of 2013. Its highest value over the past 42 years was 39.10 in 2005, while its lowest value was 16.61 in 2010*.***
- **Long term domestic demand likely to be less than the potential.**

Complementarity of Resources: South Asia and Mekong Region

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

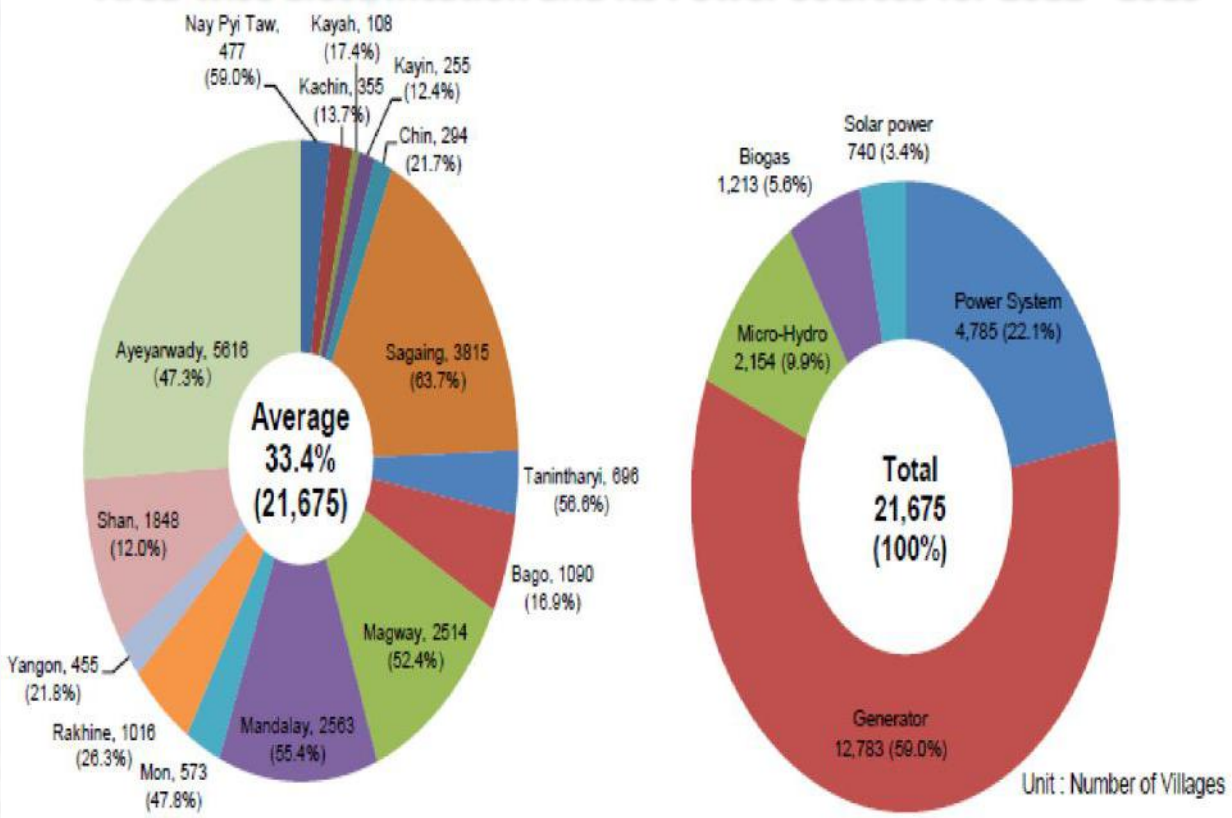
Source: SAARC Secretariat (2010) for Bangladesh, Bhutan, India, Nepal, Sri Lanka; CWC (2005) for Indian States and WAPDA (2011) for Pakistan

	Coal(Mts)	Oil(Mts)	Natural gas (BCM)	Hydro(MW)
Myanmar	468	64.26	464	45344
Lao DPR	503			17979
Yunnan Province(PRC)	23994			104370
Guangxi Zhuang Autonomous Region(PRC)	2167	173		17640
Vietnam	150	626	217	35103
Thailand	1239	50	340	4566
Cambodia	10			9703
Total	28531	913.26	1021	234705

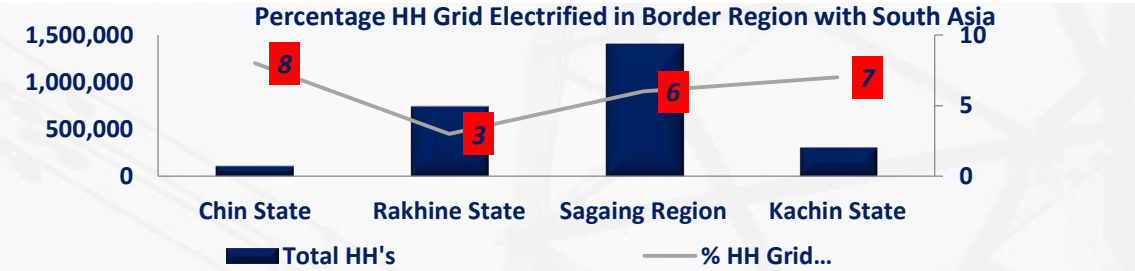
*http://www.indexmundi.com/facts/myanmar/electric-power-transmission-and-distribution-losses

Source: ADB

Area-wise Electrification and its Power Sources for 2012 - 2013



21,675: Actual Number of Electrification Villages until 2012-2013



Source: The Project for Formulation on the National Electricity Master Plan in The Republic of the Union of Myanmar. Draft Final Report. JICA et al., July .

Why CBET -Potential Benefits of Cross Border Electricity Trade and Regional Hydro Power Development between Myanmar-South Asia-Mekong Region

Strategic, Technical and Operational

- ✓ **Optimum Utilization of Energy Resources.**
- ✓ **Improved Energy security**
- ✓ Diversified **generation mix**
- ✓ Reduction in **Load Shedding**
- ✓ Reduction in **spinning reserves**
- ✓ Mang. of **peak energy deficit**
- ✓ Ancillary Service & Emergency Support.

Economic and Financial

- ✓ Power availability at **competitive price**
- ✓ **Export income/revenue**
- ✓ Avoided **generation capacity** and **T&D infrastructure**
- ✓ Accelerate economic growth
- ✓ Less exposure to **volatile** international **energy prices**

Environmental Benefits:

- ✓ Reduction in **CO_2 emissions**
- ✓ Less Impact on Local and Global environment
- ✓ Renewable Energy Development
- ✓ Improvement in Social Indicators

Market Dev.

- ✓ Bringing Resources to the Market.
- ✓ Market Development and integration
- ✓ Efficient Pricing

Regional Hydro Power Dev.

- ✓ Flood Control
- ✓ Water Security
- ✓ Multi-purpose use of the resource
- ✓ Strategic Development

Regional Stability

- ✓ Regional Stability

USAID FROM THE AMERICAN PEOPLE

SARI/EI

Integrated Research and Action for Development

Opportunities: Why Myanmar should strive for Cross Border Electricity Trade-Short Term Outlook

- Taking Steps to increase import of electricity form South Asia (i.e. through India) to ease out power shortage situation and increase the power availability.
- Establish more number of cross border interconnection at higher voltage level across borders and build adequate evacuation capacity to transfer power to the main load centers.
- Accessing Power Market in India, A Vibrant power market & power exchange exist . Prices are competitive. India APCC= 3.40 INR (0.05 US$/Kwh) Myanmar= 0.08 US$/Kwh (9 cents)

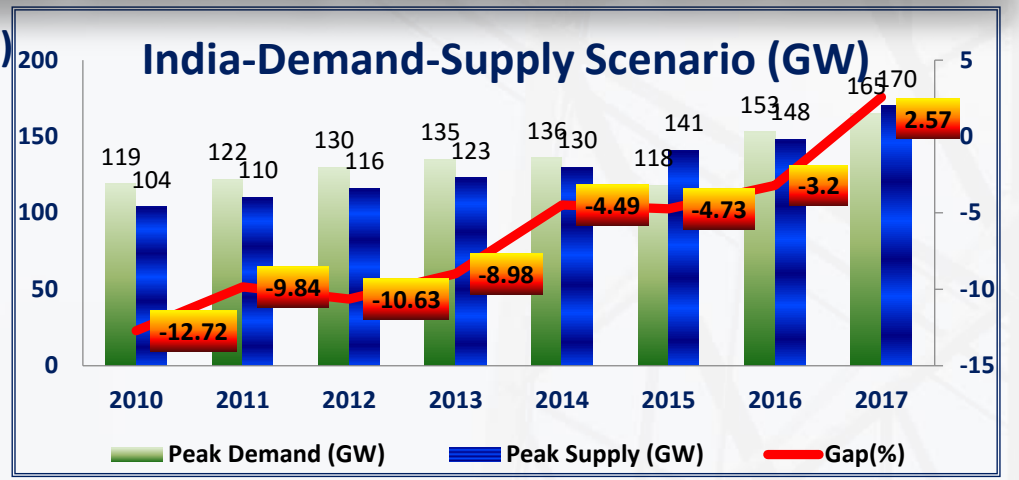
Potential Saving of 0.04 US$/Kwh

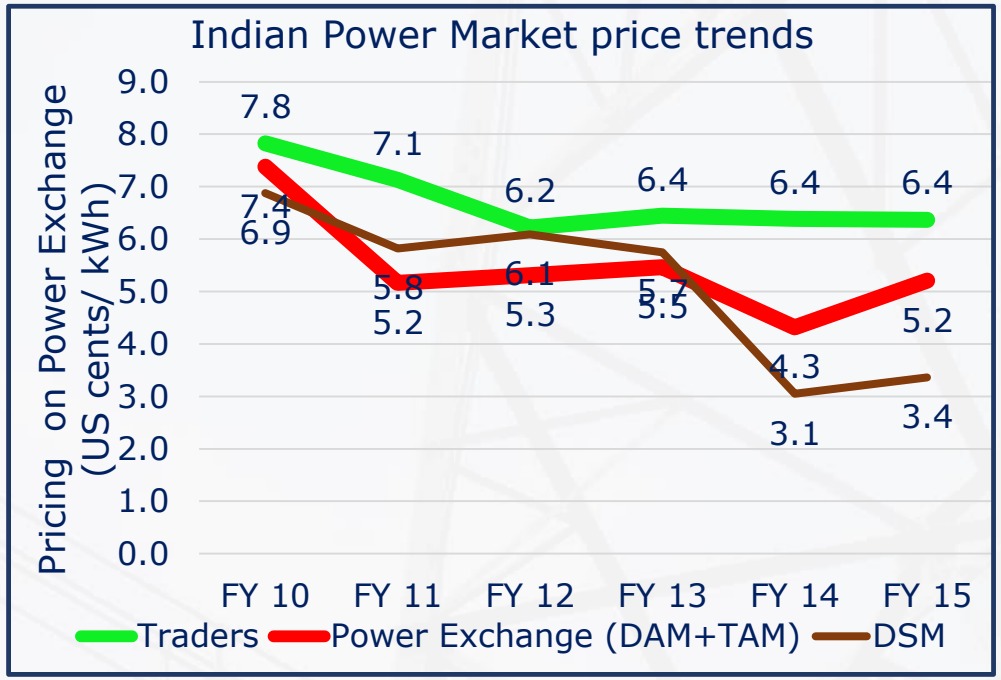
Multiple source for best Price Pick

600+ Generating Stations
2 Power Exchanges
43 Trading Licensees

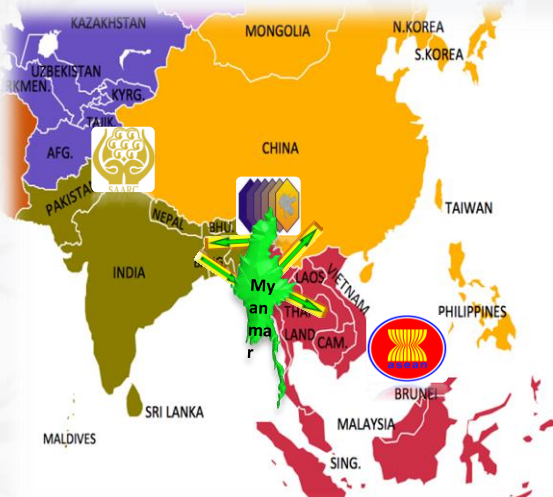
http://www.vidyutpravah.in/

Electricity Tariffs: Wide range 35 – 150 kyats/kWh ;
"Domestic tariffs" – largely residential customers 35-50 kyats/kWh; Non-residential customers 75-150 kyats/kWh.





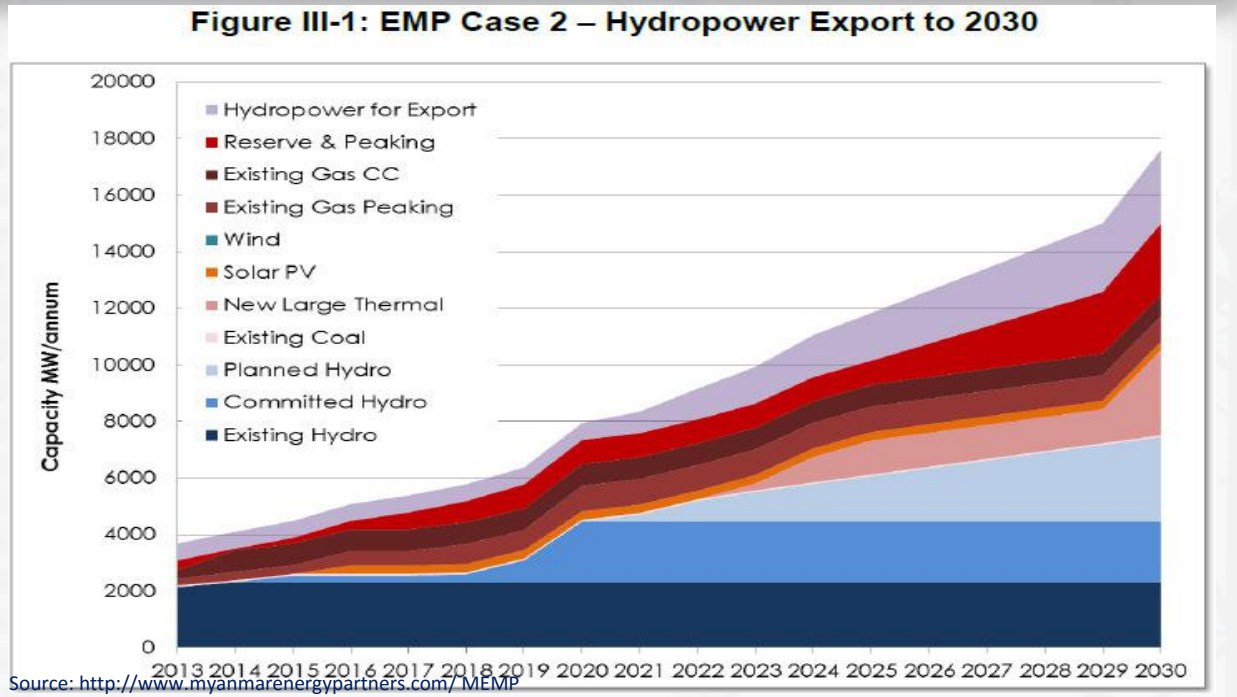
Opportunities: Why Myanmar should strive for Cross Border Electricity Trade-Medium Term Outlook



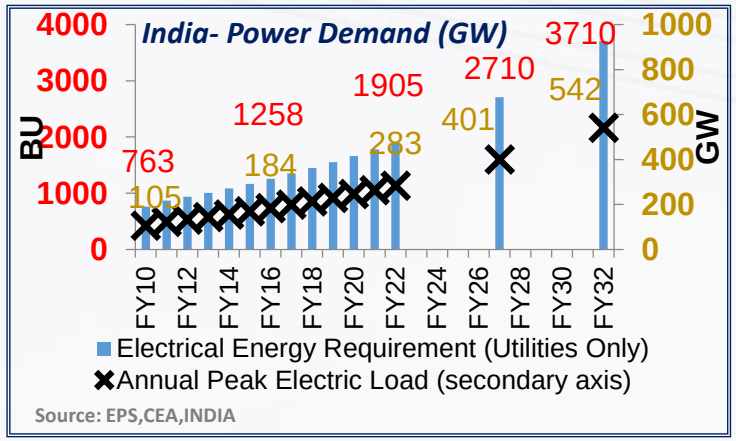
Disclaimer : By making any reference to a particular geographic area or by using the term "country'' and Map in this document, IRADe/USAID does not intend to make any judgement as to the legal or other status of any area/Map. The map used is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries, and to the name of any territory, city or area.

Opportunities: Why Myanmar should strive for Cross Border Electricity Trade-Medium Term Outlook

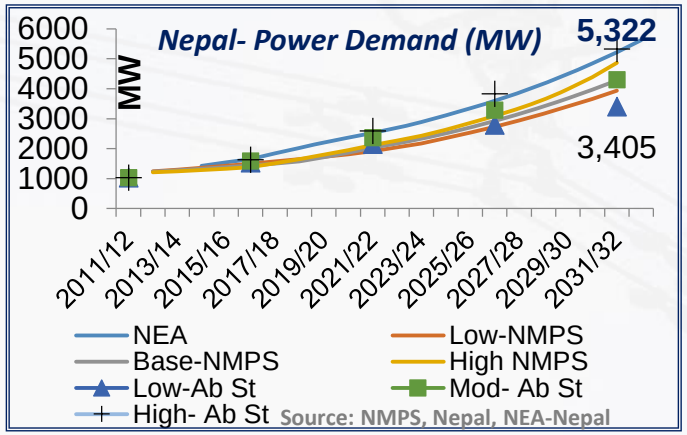
- To take steps to accelerate the development of hydro power for **Export of Surplus Only.** South Asia Power Demand is high, build transmission interconnection (India, Bangladesh)
- Myanmar has been actively developing in hydropower for export. However the export is primarily targeted at the ASEAN/Mekong Market. Focusing to tap the SA Market.
- Myanmar hydro can provide balancing support for the regional grid which shall help in renewable energy integration. Exploiting the Ancillary Market in India.



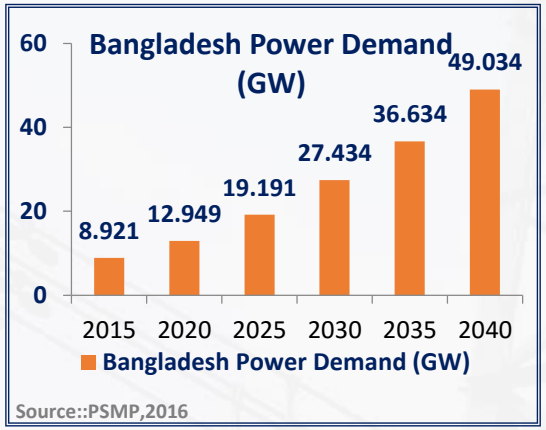
Source: http://www.myanmarenergypartners.com/ MEMP



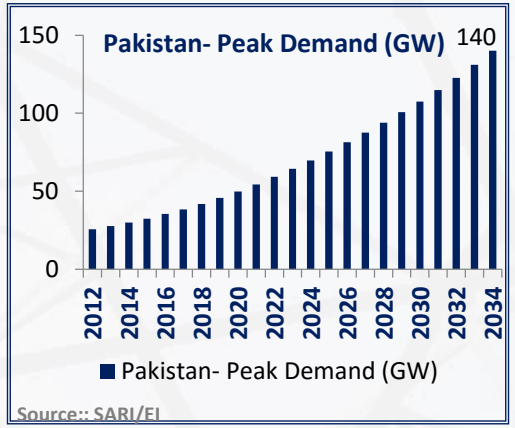
Source: EPS,CEA,INDIA



Source: NMPS, Nepal, NEA-Nepal



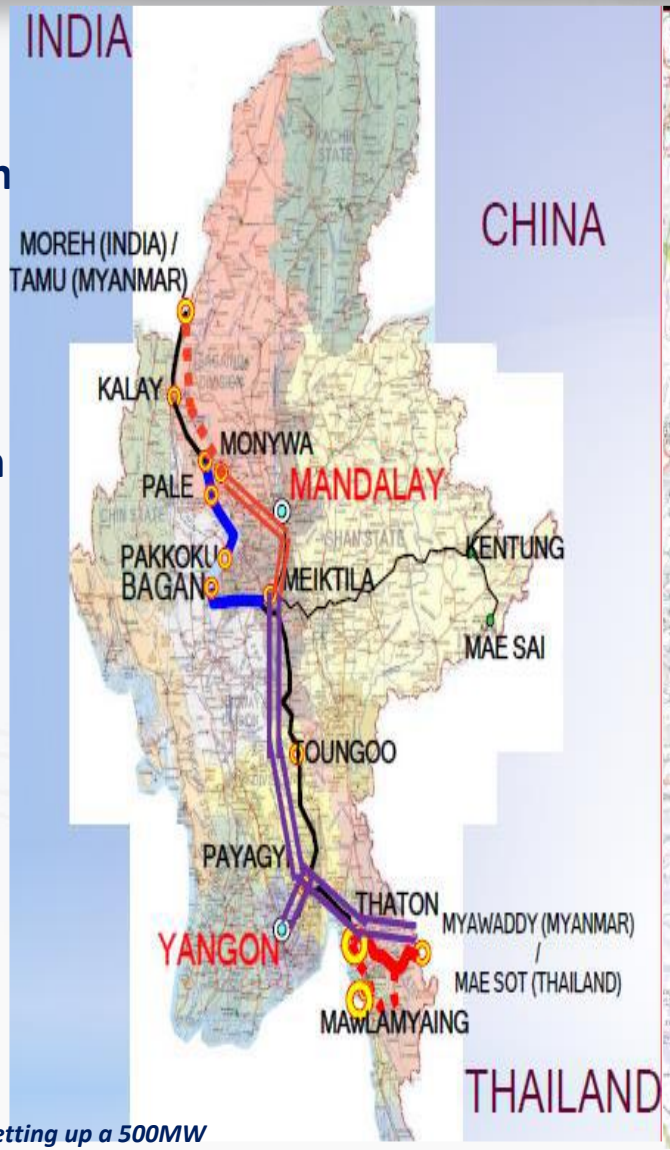
Source::PSMP,2016

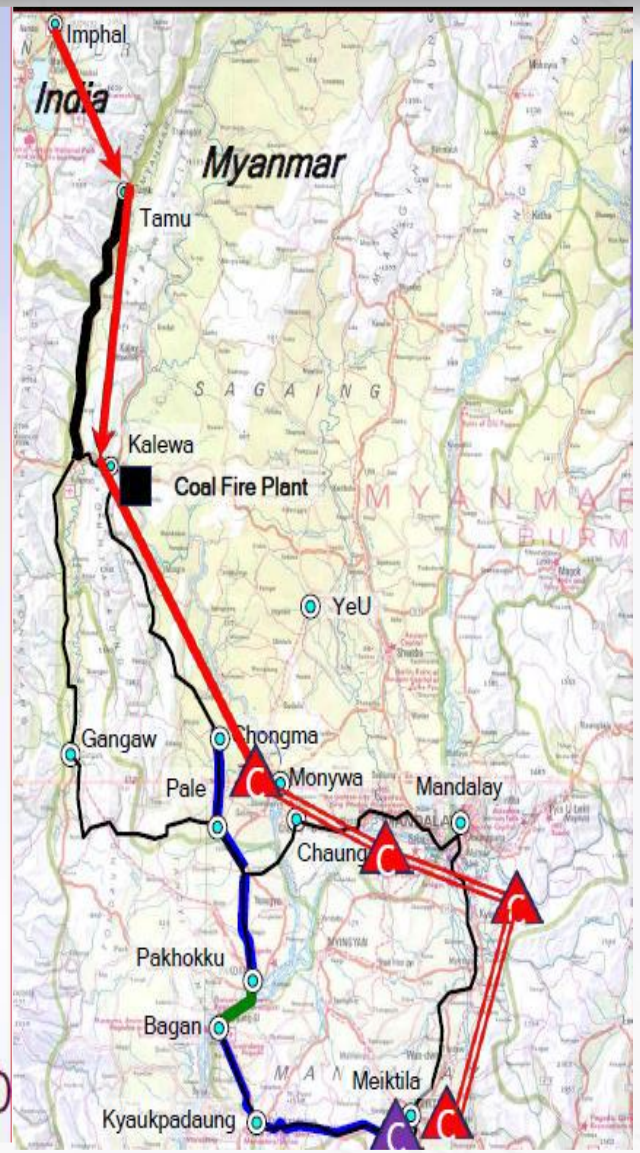


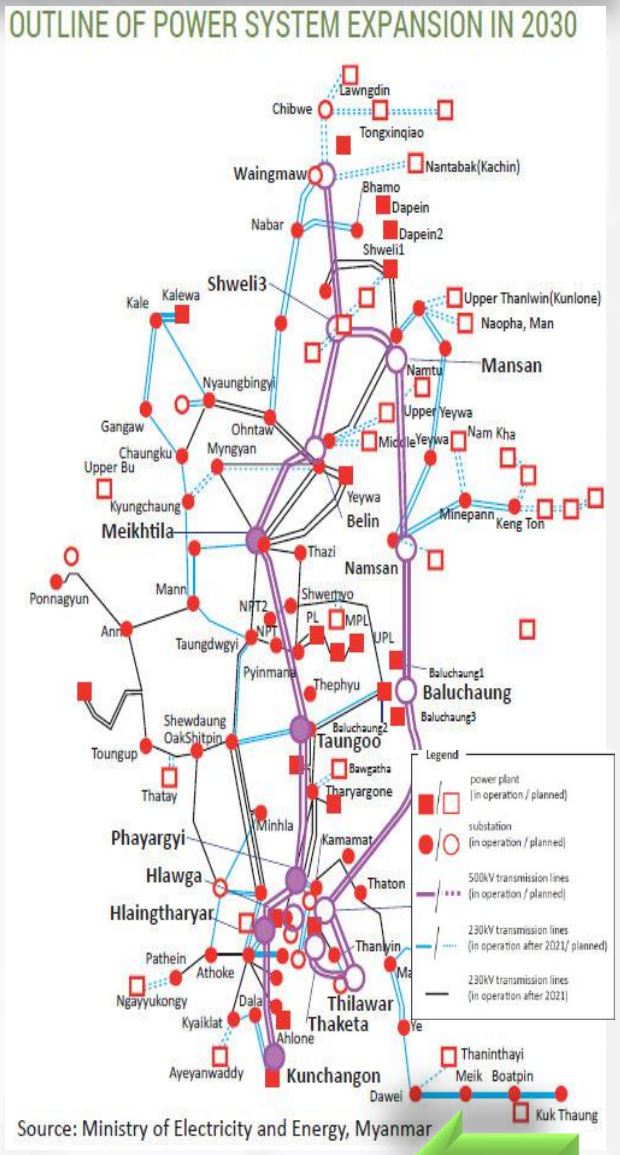
Source:: SARI/EI

Possible Interconnection with South Asia

- Considering the terrain, possible interconnection with India could be through the state of Manipur /Mizoram(India)
- The interconnection possibility with Bangladesh is also needed.
- While larger interconnection will take time, steps should be taken to increase more no. of border town interconnection with India.







Source: Ministry of Electricity and Energy, Myanmar

India and Myanmar exploring the Possibility of developing a coal based power plant at Kalewa

Shwe Taung Development Co Ltd has shown interest in setting up a 500MW hydroelectric power plant in the Rakhine state and export electricity to Bangladesh.

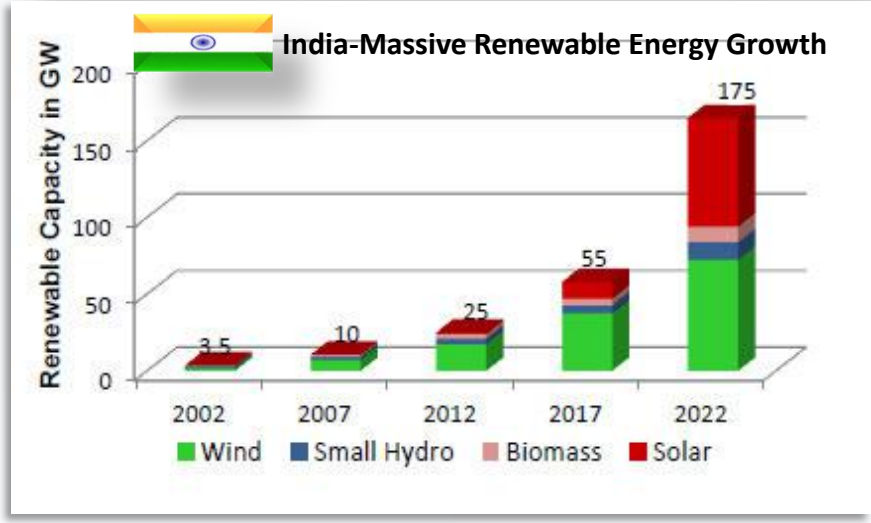
Source: Presentation by Myanmar Electric Power Enterprise, Ministry of Electric Power

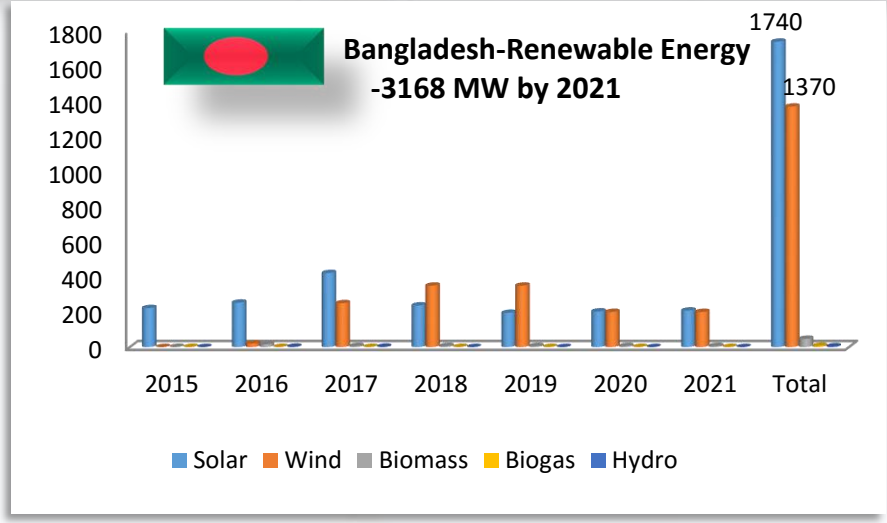
USAID FROM THE AMERICAN PEOPLE

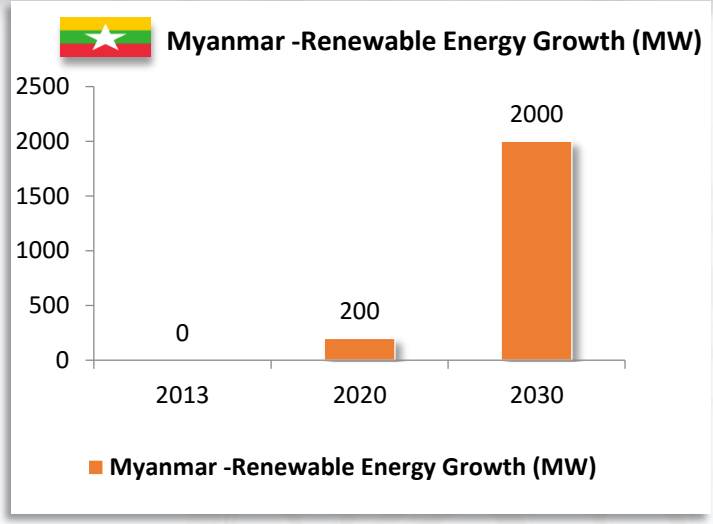
SARI/EI

IRADe Integrated Research and Action for Development

Non Energy Benefits of Hydropower in South Asia and Myanmar: Policy Making Perspective

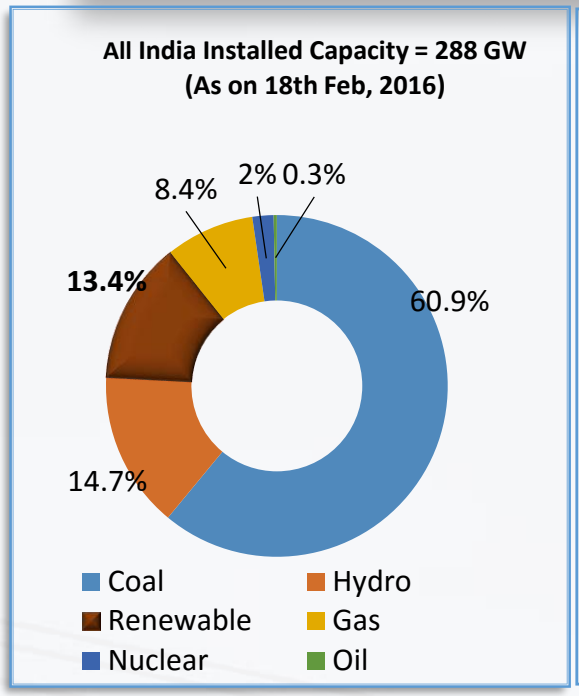


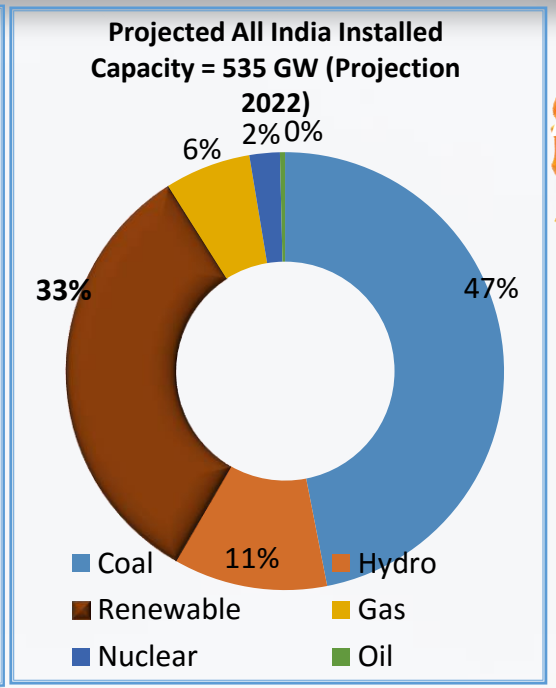


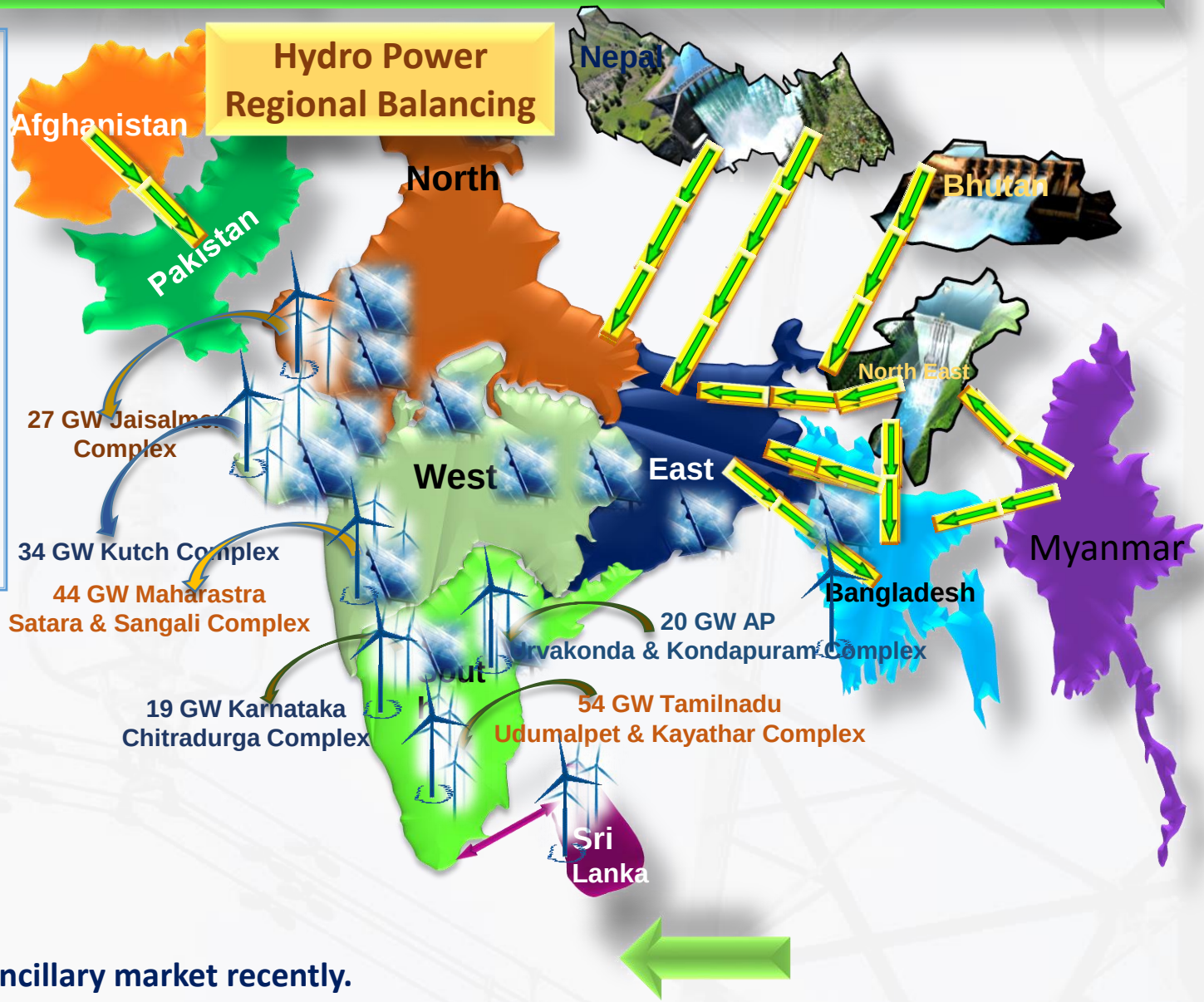


- High Renewable Energy Growth in SA and in Myanmar power system needs a flexible, fast responsive with Demand response power system.
- Both reservoir and pumped storage hydropower and gas are flexible sources of electricity that can help in handle the variability of other renewable energy such as wind power and photovoltaic electricity.
- Storage hydropower (including pumped storage) represents 99% of the world's operational electricity storage.

Regional Hydro Power (Myanmar and South Asia) can help in Renewable Integration and Grid Balancing







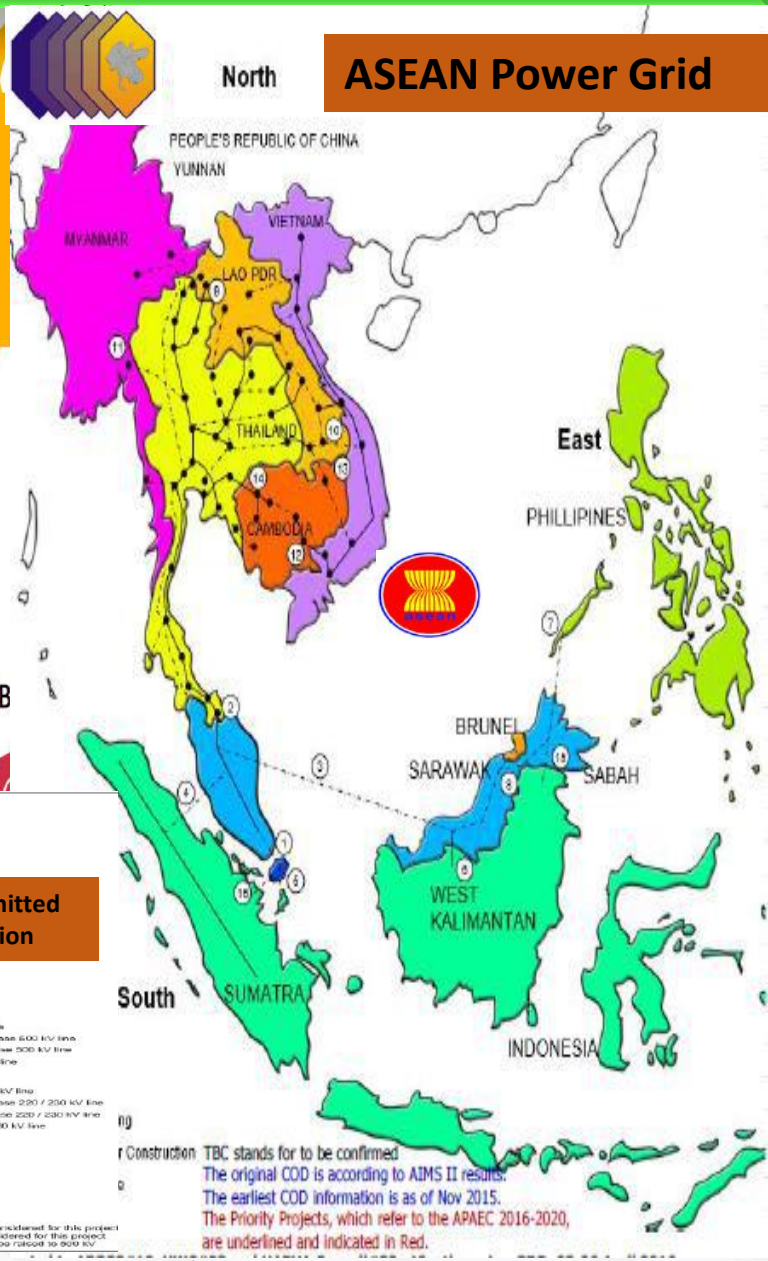
- Hydro share in India has been declining over the years (45% in 1970 to Apprx 15% in 2015)
- National Electricity policy (GoI), spinning reserves at 5%. The quantum of reserves estimated*-
  - 4 GW of primary reserve
  - 3.6 GW of secondary reserve
  - 7 GW of other reserves.
- Developing Regional Ancillary Market- India has started ancillary market recently.

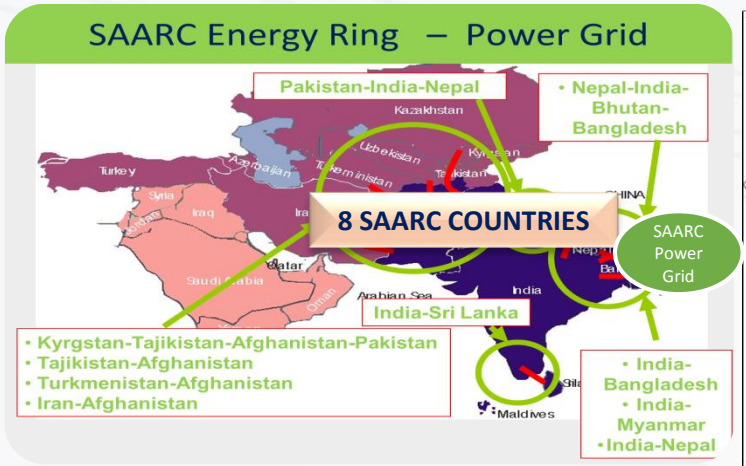
Source: *with *275 GW generating capacity and nearly 150 GW peak demand , Technical Committee for "Large Scale Integration of Renewable Energy, need for balancing, Deviation Settlement Mechanism (DSM) and associated issues"

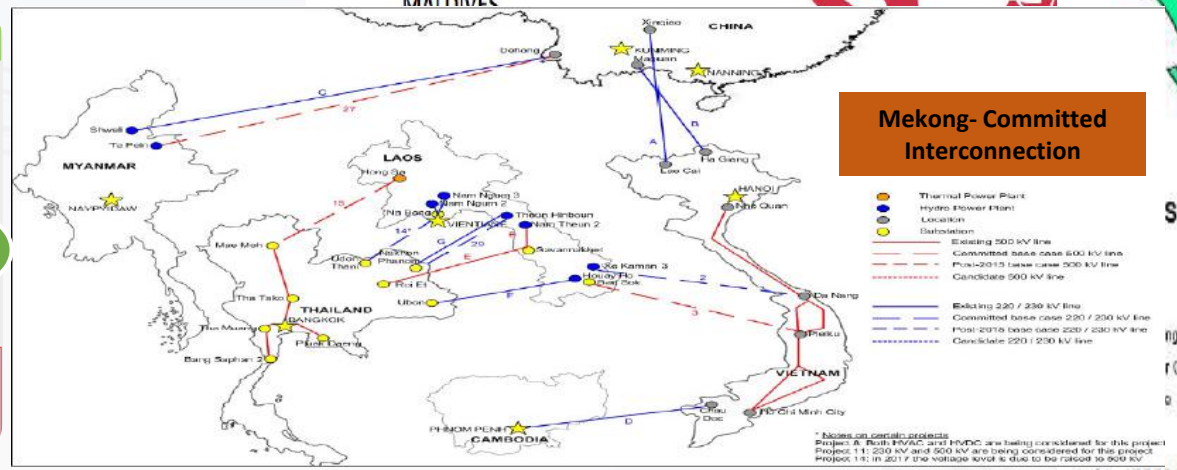
Opportunities: Why Myanmar should strive for Cross Border Electricity Trade-Long Term Outlook

Myanmar-Hub for Connecting South Asia and South East Asia

- Strategically located and can be energy bridge between South Asia and South East Asia through development of Clean Hydropower Energy.
- Difference in energy endowments; energy consumption needs has pushed for sharing of resources, CBET,cross border hydro power (GMS, ASEAN,SAARC, BIMSTEC)
- Potential for possible integration of Regional grids- SAARC –Greater Mekong –ASEAN Power Grid.
- Neighbouring Countries like PRC, Bangladesh, India, Thailand are Potential partner for hydro power development and importer of electricity.



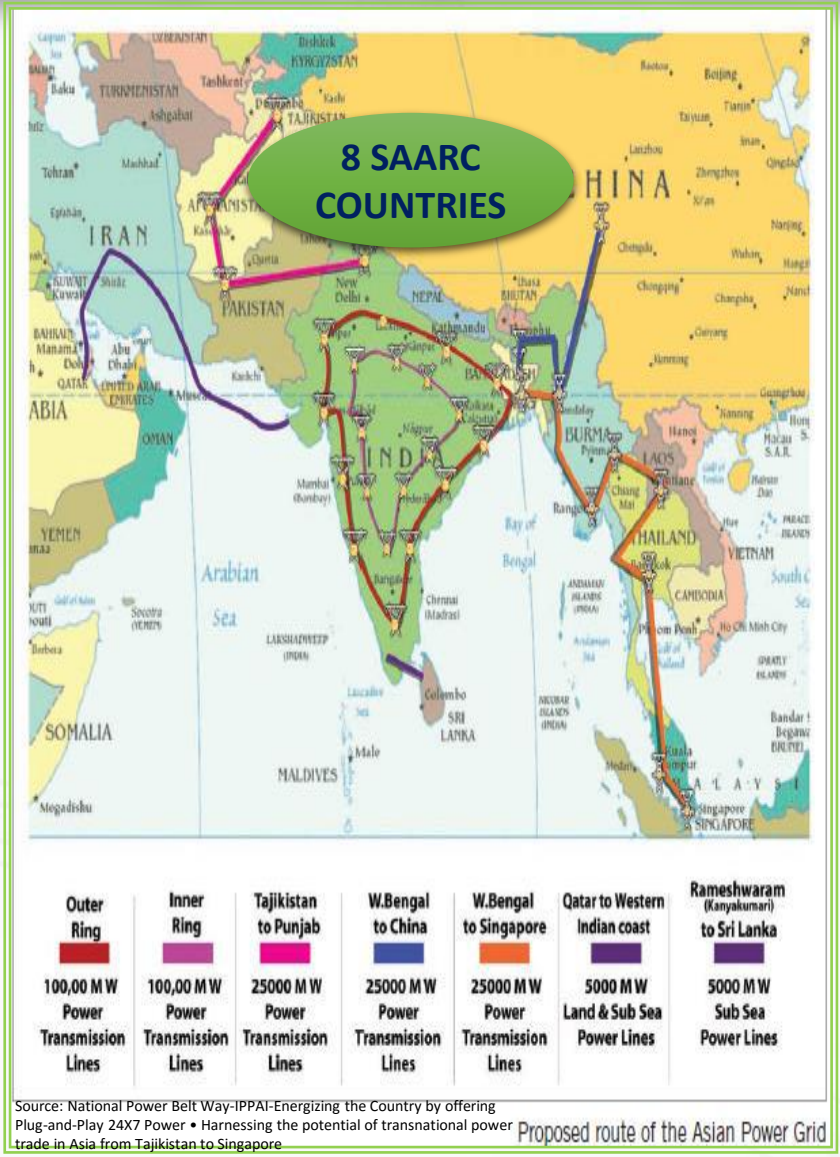




Why Myanmar should strive for Cross Border Electricity Trade-Long Term Outlook:

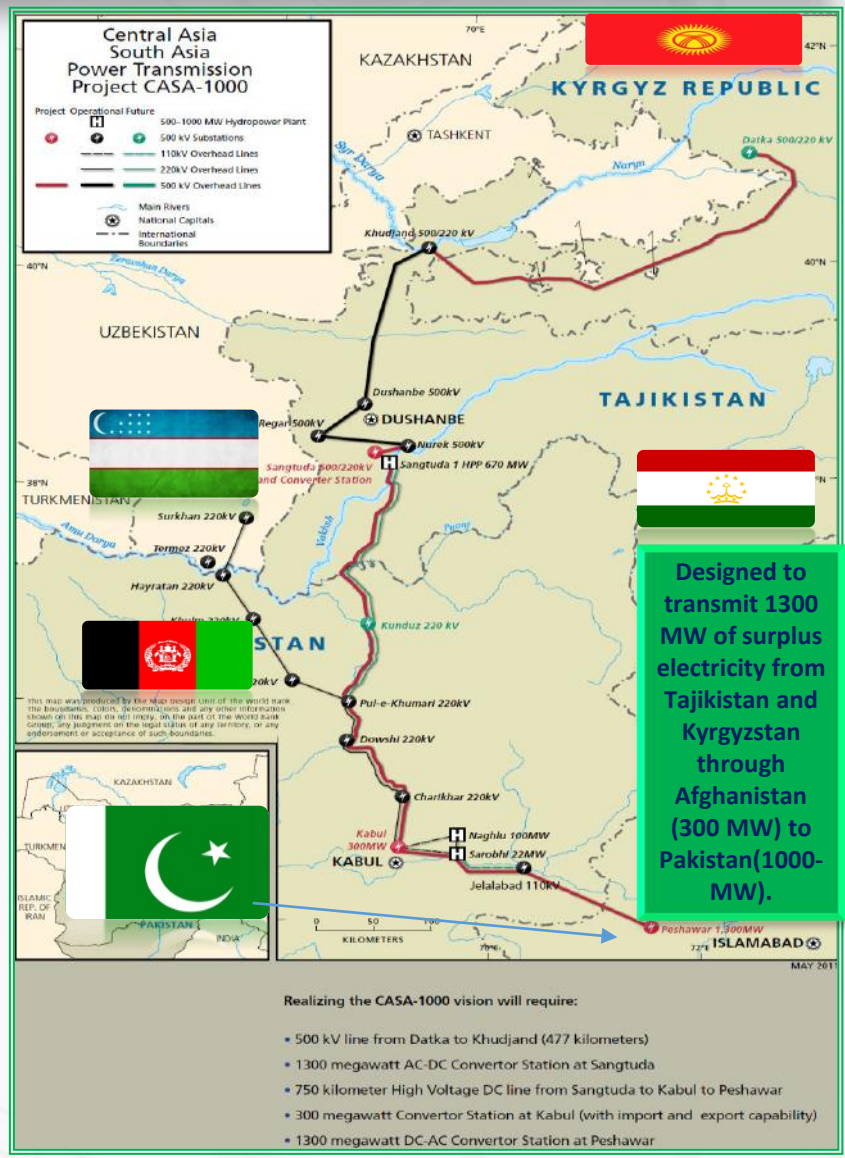
Prospects of creating a Regional Energy Grid: Integration of South Asia-South East Asia-Central Asia

- Cross Border Power Trade is Increasing Significantly in the South Asia and South East Asia and GMS Region. These region complementarity is very high.
- CASA-1000- Central Asia-South Asia.
- Pakistan-Iran Power Link
- India-Myanmar Grid Connection
- Myanmar the Energy Bridge between Regions (SA- SEA)
- Many countries in the region per capita electricity consumption and access of electricity is among the lowest in the world.
- Asian region untapped energy resource availability is very good.



Source: National Power Belt Way-IPPAI-Energizing the Country by offering Plug-and-Play 24X7 Power • Harnessing the potential of transnational power trade in Asia from Tajikistan to Singapore

Proposed route of the Asian Power Grid

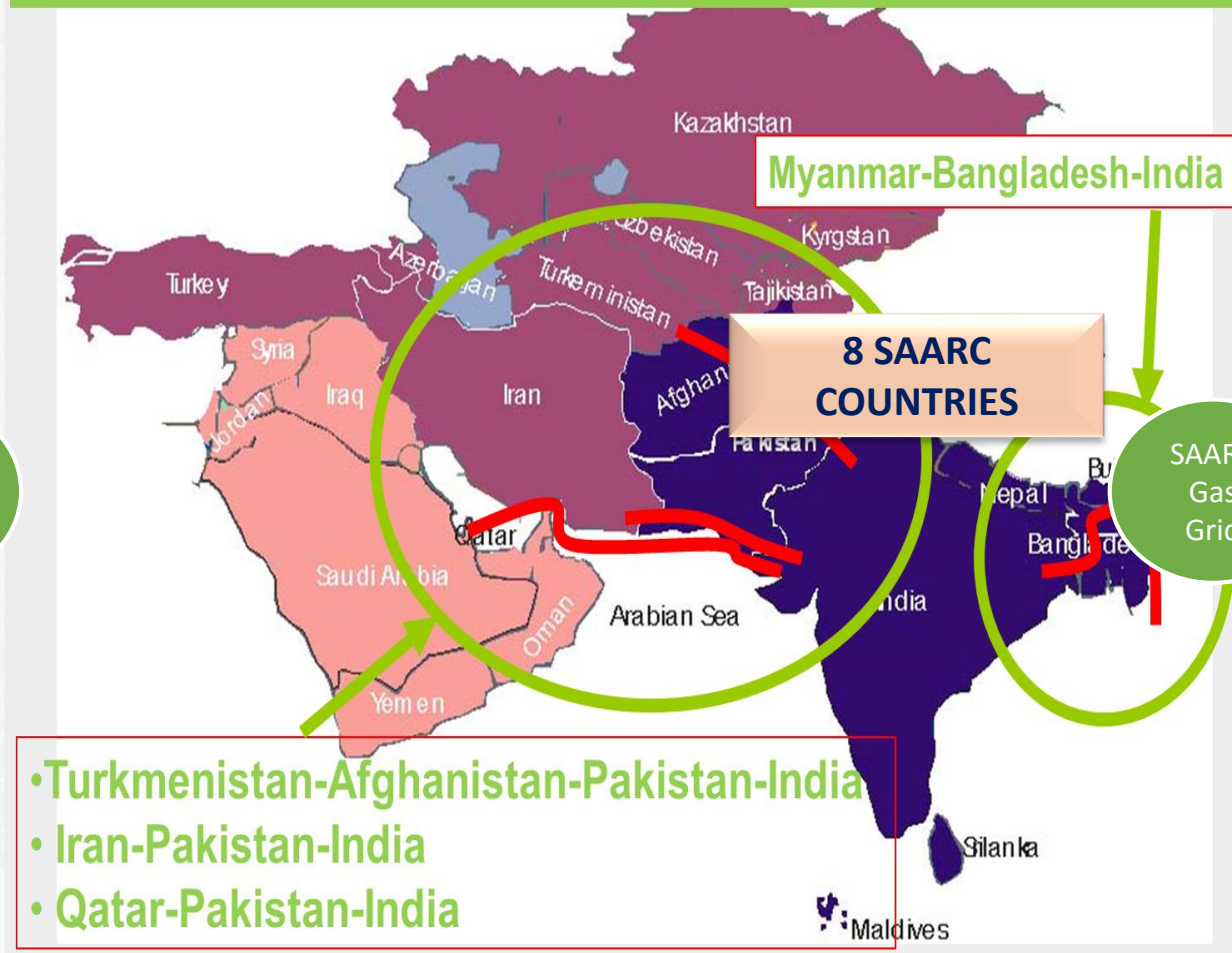


Source: http://www.casa-1000.org/Docs/CASA1000Brochure.pdf

SAARC Energy Grid: Power and Gas Grid

SAARC Energy Ring – Power Grid

SAARC Energy Ring- GAS GRID



Pipelines from the east and the west can further be extended to Nepal

USAID FROM THE AMERICAN PEOPLE

SARI/EI

IRADe Integrated Research and Action for Development

Key Challenges and Risk for CBET between Myanmar and South Asia

Key Challenges and Risk: Cross Border Electricity Trade Investments: Risk

Why Cross-border Electricity Trade Investment are Risky

- Project risks in general tend to be high with out a comprehensive Policy, Regulatory framework for **large CBET project development.**
- Cross-border element greatly amplifies the risks due to **geopolitical, economic and trade related factors.**
- Even projects that appear to have feasible , rationale, economical **in practice struggle to get it financed and built.**
- Project risks in general tend to be high in **countries without wide experience on large project development.**

Political: What happens if for political reasons the flow is prevented in the exporting, intermediary (if relevant) or importing country ?

Regulatory: What happens if the domestic Policy, regulatory framework changes which impacts CBETproject/Investment ? What is the protection available to buyers/sellers/Investor ?

Economic: What happens if the economic assumptions on the project changes? What is the protection available to buyers and sellers ?

Trade Barrier: What happens if a tax or duty that affects the economic fundamentals is imposed ?

Infrastructure: What happens if the infrastructure to transfer the energy is not built or is not available when needed ?

Example: Some Key Issues

Tariff determination for power from projects across the border ? Competitive bidding vis-à-vis negotiation

Power Procurement Policy- Buyers' requirements.

* Competitiveness of Hydropower- High Tariff in Initials Years .

	Bhutan-India	India-Bangladesh	India-Nepal
Principle of determination	The tariff for both Tala and Dagachhu PPAs was determined on a negotiated basis	The tariff for NVVNL PPA is as per CERC regulations (agreed based on negotiation). On the other hand, tariff for PTC PPA was determined through competitive bidding	The tariff in both Treaty/Bilateral arrangement and PTC PPA was agreed based negotiation

* New Tariff Policy - 5.8 The Appropriate Commission shall provide for suitable regulatory framework for incentivizing the developers of HEPs for using long-term financial instruments in order to reduce the tariff burden in the initial years.

Key Challenges and Risk: CBET Between Myanmar and South Asia

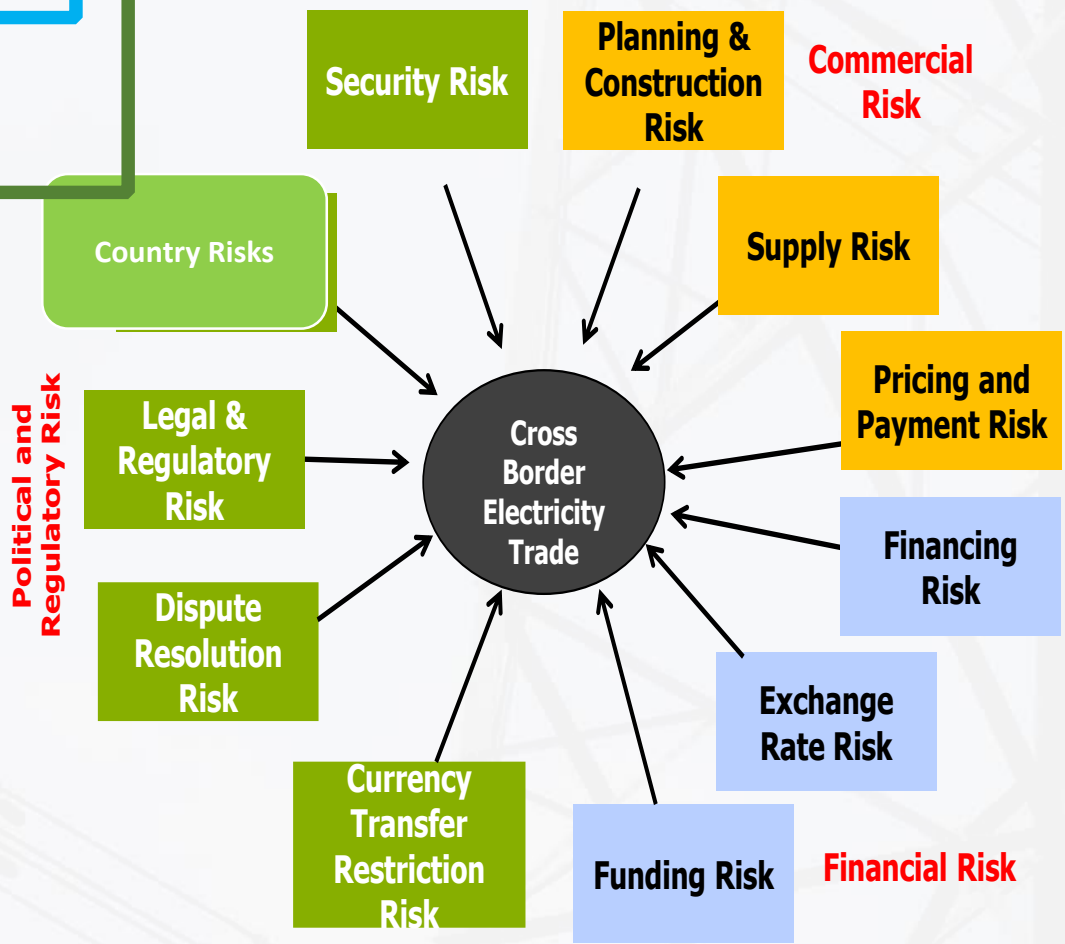
Need of Policy Framework/Instruments/Mechanism

1. Political Conesus: Need of Bilateral Treaties, Regional Cooperation and Recognition of CBET/Trade in the National Policy, Law etc.
2. Government Commitment & Policy Coordination
3. Financial Challenges, Investment, Technical and Financial Viability
4. Mechanism of Inter-connection
5. Market form of Trade
6. Regional Cooperation on Regulatory and Contractual Aspects
7. Open Access in Transmission
8. Transmission Charges/Pricing
9. Transmission Plan
10. Commercial Mechanisms to Settle Imbalances
11. Dispute Resolution

Challenges at Initial Stages

Challenges during the Transition towards higher level of CBET and when it reaches the Mature Stages

Motivation behind these Policy Framework/Instruments/Mechanism is to address the typical Risks in Cross-Border Projects.



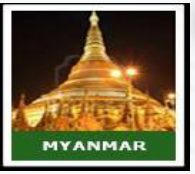
Note: At present, implementation of Tamanthi and Shwezaye H.E Projects, has been suspended temporarily by Ministry of Electric Power (MOEP), Myanmar as DPRs of Tamanthi and Shwezaye H.E Projects submitted by NHPC have negative Social and environmental impacts and are economically unviable. (Source: CEA, GoI)

USAID FROM THE AMERICAN PEOPLE

SARI/EI

Integrated Research and Action for Development

BIMSTEC Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation

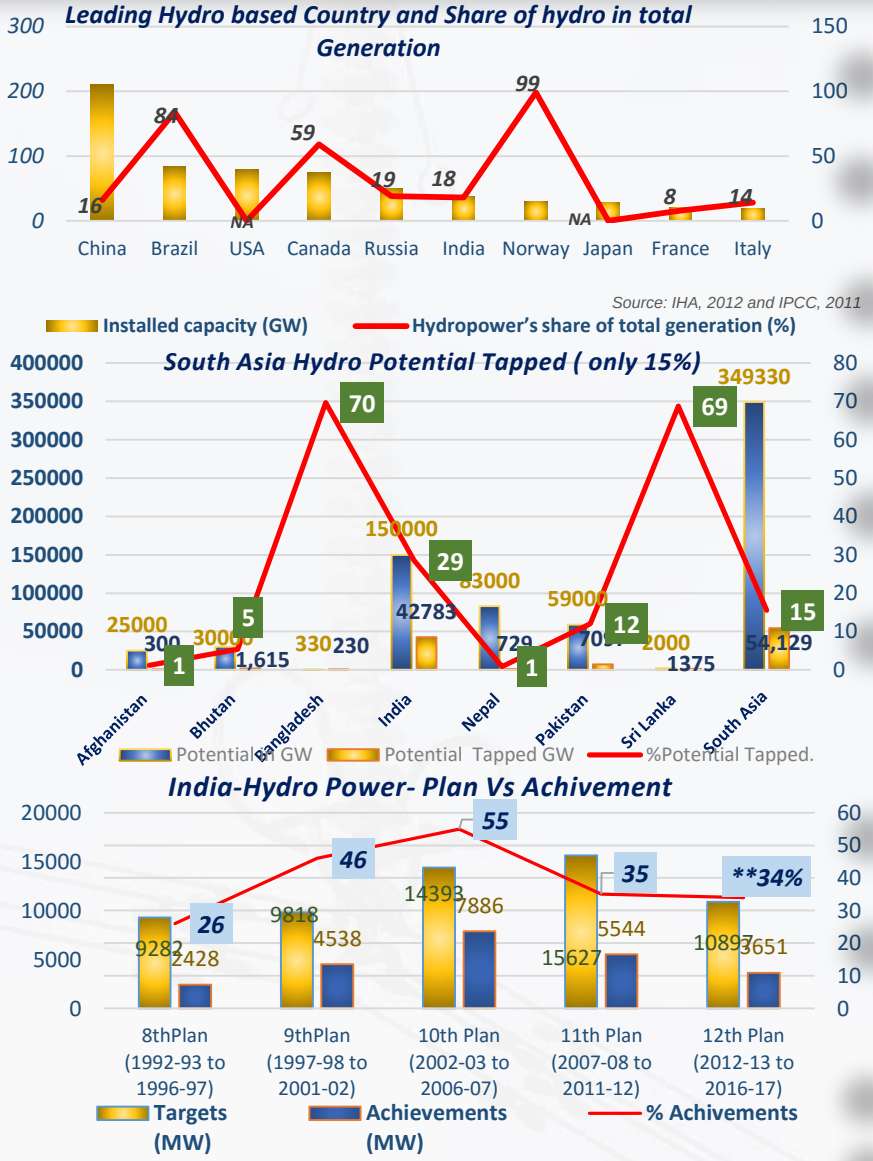


- Myanmar is the Energy sector leader in BIMSTEC.
- The draft MOU for Trans-power exchange and grid interconnection, hydropower development, energy security of the region need to be finalized
- It aims to facilitate the setting up of power grid connections for reliable, secure and economic electricity supply and trade among its seven member countries.
- Need to expedite the signing of the MOU for Trans-power exchange and grid interconnection, hydropower development.
- Need to expedite the establishment of BIMSTEC Energy center

For faster implementation BIMSTEC may need to develop strategic /technical partnership with other regional organization/forums in the region such SAARC, GMS

Hydro Power Project : Not been easy to Crack

- Globally, around *19% of the potential has been developed.
- However ,countries which have actively developed hydropower , has been benefiting successfully - 99% generation come from Hydro in Norway;84% in Brazil
- South Asia, only 15% of the resources has been developed. Nepal and Bhutan have developed 1% and 5% of their potential. India 29% of their potential.
- Mismatch Plan Vs Achievement: India on an average 50 % target has been achieved.
- Bhutan like to achieve 50 % target i.e. 5000 MW by 2020.



- Geological uncertainties / Natural Calamities
- Land Acquisition / Environment and Forest issues
- Rehabilitation & Resettlement / Law & order problem & Local issues
- Difficult Terrain, Poor Accessibility & Limited working season
- Contractual problems / Delay in award of works.
- Poor performance of Contractor- Inadequate mobilization of man/ machinery, inadequate experience, labour disputes etc.
- Funds constraints with developer/ contractor
- Delay in supply of major equipment / Delay in arrival of foreign engineers/ technicians
- Inter-state issues (India)
- Delay in power evacuation arrangement

While there are Challenges, but continuous development is the key to success of hydropower development.

* http://www.iea.org/publications/freepublications/publication/hydropower_essentials.pdf ** Till 31.10.15 6746 (62%)-Estimated

Way Forward: Accelerating Responsible Hydropower Development in South Asia and Myanmar

Way Forward: Accelerating Responsible Hydropower Development in South Asia and Myanmar : Policy Making Perspective

Governance framework

- ✓ Efficient coordination for implementation of policy goals and targets
- ✓ Planning for integrated river basin development
- ✓ Project allocation procedures

Regional and Integrated planning Forum
Regional Regulatory Framework
Comprehensive cost-benefit analysis
MoU vs Competitive bidding

Benefit Sharing Mechanism

- ✓Focus on responsible development
- ✓Public private people participation
- ✓Benefit-sharing with PAPs

Social and environmental impact assessments
Involvement of project affected persons
Optimal & balance mechanism for sharing:
• Revenue sharing • Local development funds
• Ownership structure • Preferential electricity

Facilitate investment and Financin

- ✓Streamlining clearance , land acquisition
- ✓Fiscal incentives
- ✓Evacuation infrastructure
- ✓Innovative financial products

Single Window
Long-term debt financing, Tax-free bonds
Green funds etc.

Facilitate Market Developmen

- ✓Regional Power market and Trans Power Exchange.
- ✓Hydropower purchase obligations
- ✓Market for ancillary services

Regional Trading Platform
Commercial Pricing of Non Energy Benefits

Technical Capacity Developme t

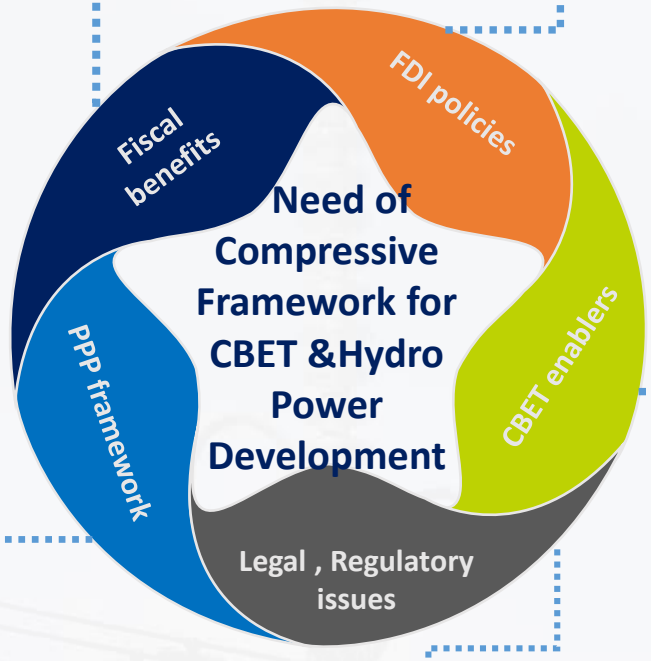
- ✓State-of-the-art investigation and
- ✓construction techniques , skilled manpower

Detailed geological and seismic mapping
Drilling Techniques , Skill Development

Way Forward: Need for Compressive Investment Friendly Regional Policy Framework for CBET Hydropower Development between South Asia and Myanmar

Incentives offered to developers

- Fiscal benefits - Tax holidays
- Concessional interest rates
- Incentives – Export incentives, Exemption of electricity duty and excise duty



Policy drivers and inhibitors

- Repatriation of profits and tax on expatriates income
- Minimum capital requirement
- Protection of foreign investment
- Outward direct investment
- Limits on foreign equity participation

PPP attractiveness

- Contractual framework
- Risk-reward profile
- Royalty regimes

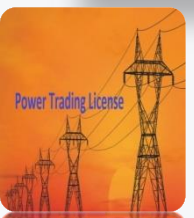
For investment protection

- Protection of Investment
- Dispute settlement mechanism
- Contract enforcement
- Regulatory framework
- Regional Investment Protection Treaty

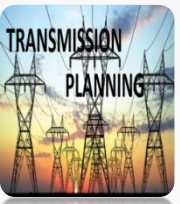
Cross border power trade

- Guidelines/ procedures/ frameworks for undertaking CBET projects
- Technical & Operation challenges - grid code
- Transmission pricing framework
- Open access rights
- Deviation settlement mechanisms
- Legal & Regional regulatory framework for CBET.

Way forward : Need for developing Regional Regulatory Guidelines/Framework for Accelerating long term CBET between Myanmar and South Asia.



Regional Regulatory Guidelines /Framework



1 **Licensing for CBET: (***Important Regulatory Tool for Trading)*

- *Recognition of Trading as a* ***separate licensed business activity***
- *Grant of license for CBET* ***through a well defined process***
- ***License requirements*** *and the underlying rules/limitations*

2 **Open Access (OA) to transmission system:** *(Competitive Market)*

- ***Setting of fair rules and procedures*** *for non-discriminatory open access*
- ***Modification/amendment of applicable regulations and gradually legally binding provisions***
- *Defining* ***application process, eligibility criteria, priority order*** *and nodal agency for OA*

3 **Transmission Pricing:** (*cost reflective & efficient)*

- *Transmission pricing mechanism based on a* ***country's requirement and acceptability***
- *Setting up* ***principles and mechanism for determination of economically efficient transmission pricing regime*** *and gradually adopting methods based on the concept of location specific pricing*
- *Adoption of* ***tariff framework in respective country power system through enabling regulations***

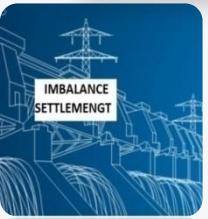
4 **Transmission Planning:** *(coordinated Regional Planning)*

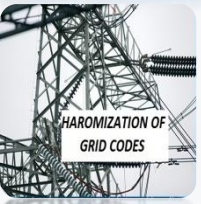
- ***Development of a regional coordination forum of National Transmission Utilities*** *to coordinate between Member Countries on transmission planning aspects*
- ***Development of a database of information that enables coordination*** *and cooperation towards transmission planning*
- ***National Transmission Plans*** *to also* ***include details of cross border transmission lines*** *(specifically for CBET) & associated infrastructure*
- *Sharing of the national transmission plan at the regional level and progress towards* ***developing a regional level master plan***

Short Term Efforts

Medium/Long Term Efforts

Need for Regional Regulatory Guidelines/Framework for Accelerating long term CBET between Myanmar and South Asia.





Regional Regulatory Guidelines/Framework

Short Term Efforts

Medium/Long Term Efforts

5 **Imbalance Settlement**: *(transparent common procedure)*

- ***Develop a common set of procedures for Imbalance Settlement for** CBET transactions*
- *This will include **preparation of scheduling, dispatch, energy accounting and settlement procedures** for both AC-AC & AC-DC interconnections in the region*

6 **Harmonization of codes**: *(safe and reliable regional integrated system operation)*

- ***Harmonization** through **formulation of guidelines on technical standards for interconnection of power systems** on aspects related to voltage standards, frequency tolerance, thermal limits etc.*
- ***Sharing of technical characteristics and system specific data** among the member countries*
- ***Rules on metering standards, communication technologies**, Protection Schemes etc.*

7 **Dispute Resolution**: *(transparent and fair legal framework)*

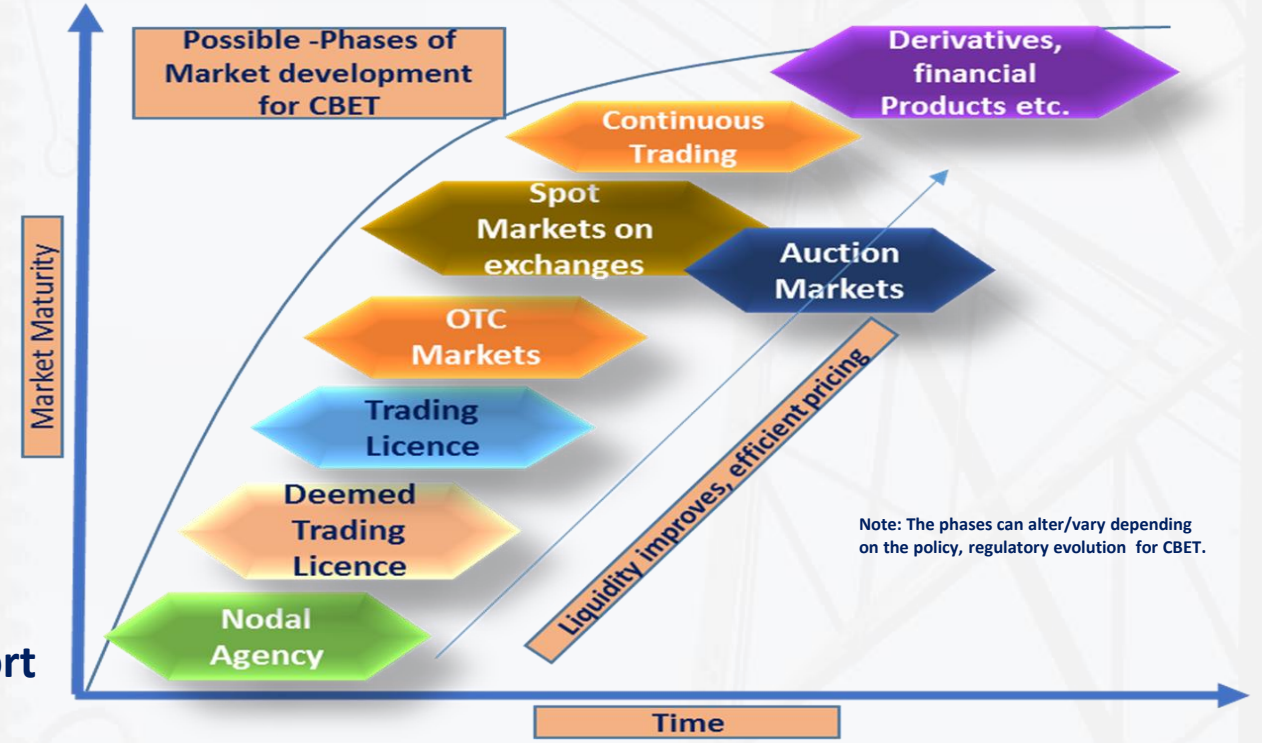
- *Dispute Resolution process should primarily be in accordance with the **agreements or through amicable settlement***
- ***Referring the disputes to the any other Appropriate Arbitration process or SAARC Arbitration Council in case the member countries are unable to resolve disputes** through amicable settlement.*

8 **Taxes & Duties**: *(for fostering investment and removing trade barriers)*

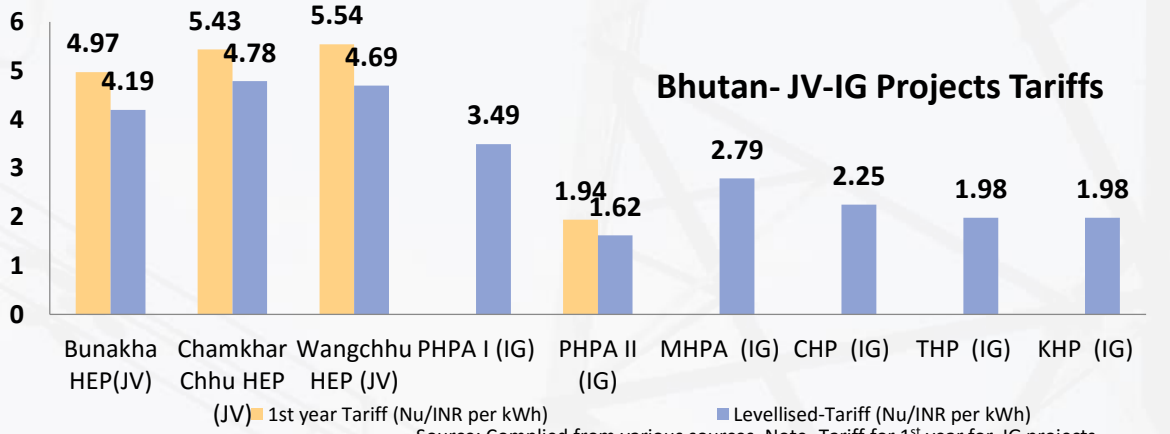
- *Countries to **gradually move towards a zero tax regime for CBET.***

Way Forward: Taking steps for towards Market Form of Development of CBET

- Most of the Cross Border Electricity Trade projects are backed by government to begin with and rightly so as it brings confidence.
- Currently trade is facilitated by G2G bilateral agreements, Nodal agencies facilitates the trade.
- However looking at the scale of investment required, there is need for market form of development of CBET with Government playing a strong facilitator role.
- There is a need to create a Regional Power Market to support these development.
- Development of power exchange in India opens up new oppourtinutes for CBET and building Trans Power Exchange



	Bhutan-India	India-Bangladesh	India-Nepal
Principle of determination	The tariff for both Tala and Dagachhu PPAs was determined on a negotiated basis	The tariff for NVVNL PPA is as per CERC regulations (agreed based on negotiation). On the other hand, tariff for PTC PPA was determined through competitive bidding	The tariff in both Treaty/Bilateral arrangement and PTC PPA was agreed based negotiation



Source: Complied from various sources. Note- Tariff for 1st year for IG projects of PHPA,MHPA,CHP,THP,KHP are not Available

Way Forward

- **Start with Bilateral and Simple:** Bilateral flows under a commonly accepted legal and contractual framework creates confidence. Prior to investing in specific cross-border assets, simple trading mechanism provide the confidence.
- **Political Consensus and Regional Treaty under BIMSTEC:** Expedite the signing of the Trans-power exchange and grid interconnection, hydropower development, energy security.
- **Learn by doing From the Experience:** Trade will throw valuable experiences. Create the institutional structure and capabilities that can record/retain that experience and put to use at the investment stage.
- **Keep up the Momentum and Visibility:** Large scale Investment will require much more than trade. Keep building on the institutional structures, treaties and agreements that will provide long term visibility.
- **Capturing the Need of Non-Energy Benefits of Hydro:** Non-Energy Benefits of Hydro needs to be captured in the context of Renewable Energy Integration and Grid Balancing. Need to build Market Mechanism. Declaring Hydro as Renewable Energy.
- **Harmonization/Coordination of Policy and Regulations:** Regional policy and regulatory framework, Regional Transmission master plan for CBET. Regional Regulatory framework.
- **Integration of power markets :** Development and Integration of Regional Power market in SA and Myanmar (Mekong Region).
- **Climate Change Mitigation:** CBET through Hydro can address climate change /INDC Targets/GHG emission of SA & Myanmar.

Thank You

USAID FROM THE AMERICAN PEOPLE

SARI/EI

Integrated Research and Action for Development

Demand Driven Studies 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. ***(1st Report on Regional Regulatory Guidelines and 2nd Report on Suggested Changes/Amendments in Electricity Laws, Regulation and Policies - Published.***
- **Study-2:** Study on Investment policies/guidelines for SA countries ***(Study has started-Ongoing)***

TF-2 :

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

TF-3 :

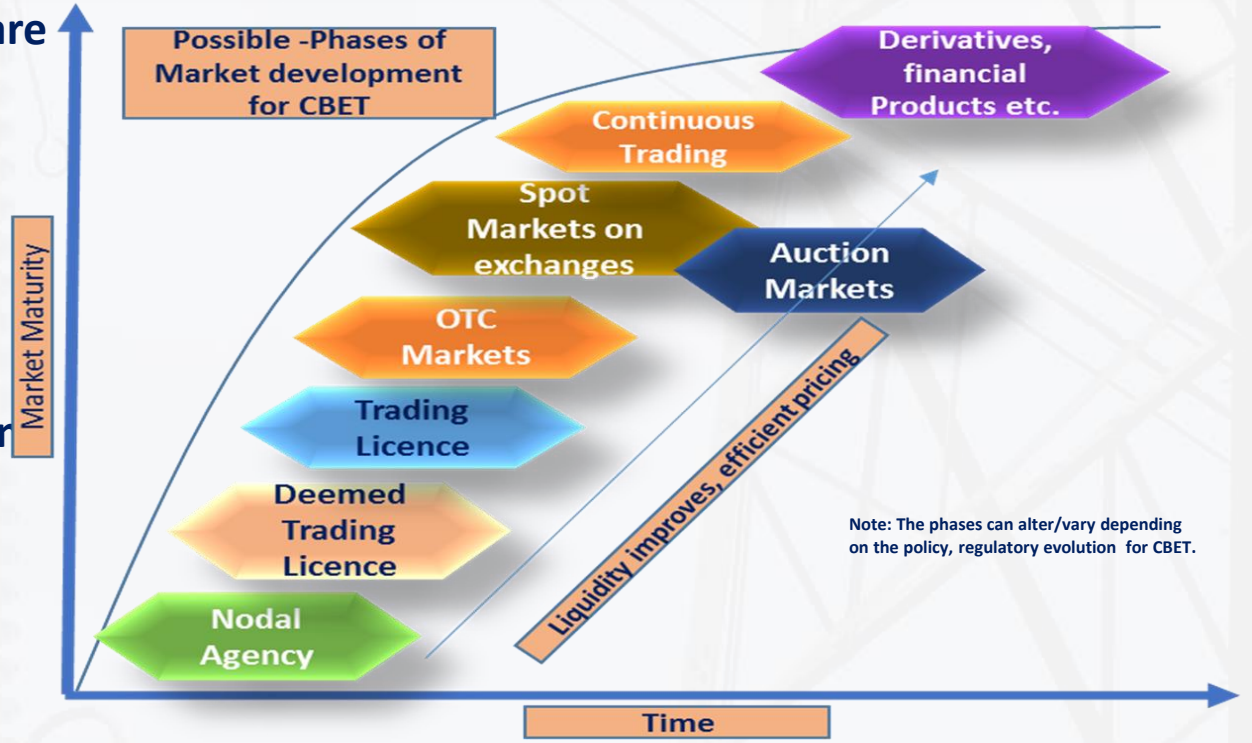
- **Study 1:** "Assessment and recommendation of commercial terms & conditions for Cross Border Electricity Trade (CBET) and suggesting the model of Power Exchange in South Asian region" ***(Draft Report Prepared – Ongoing)***
- **Study 2:** Implementation of Pilot Market – Mock Exercise for SARPEX ***(under the process of awarding)***

Future Activities to implement Task Force Recommendations

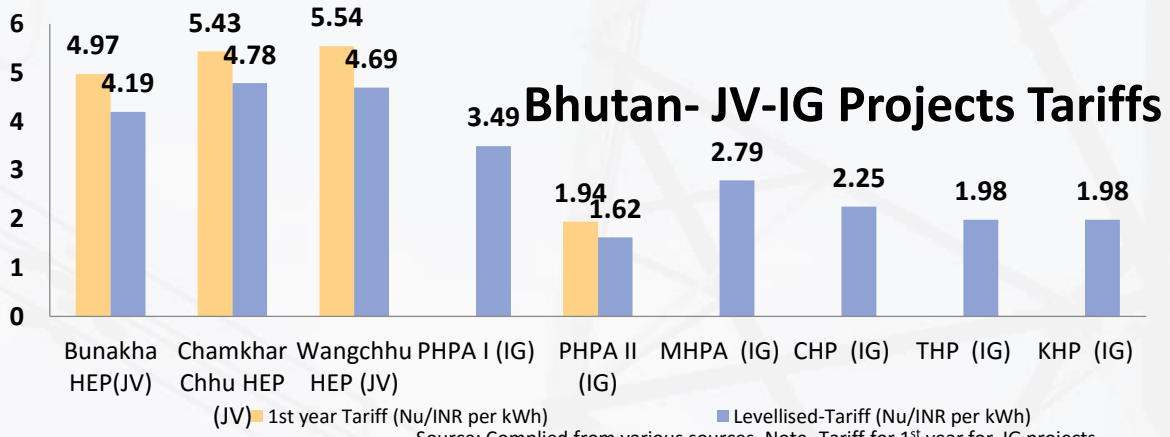
- **Building Consensus and Developing a White Paper on South Asian Forum of Electricity Regulators (SAFER)**
- **Development of Standard set of procedures, T&C for grant of trading license, open access etc.**
- **Regulatory Guidelines & Model Regulation for domestic power Market Development.**
- **Pilot Market: Mock Exercise for SARPEX. Development of Market Rules.**
- **Development of an appropriate regional dispute settlement mechanism for promoting CBET.**
- **Technical Advice to Regional Regulatory Institutional Mechanism under SAARC.**
- **White paper on creation of institutional mechanism on South Asia forum of Transmission and Generation planning and system operation.**

Way Forward: Taking steps for towards Market Form of Development of CBET

- Currently most of the Cross Border Electricity Trade projects are backed by government and rightly so as it brings confidence.
- Currently trade is facilitated by G2G bilateral agreements, Nodal agencies facilitates the trade.
- However looking at the scale of investment required, there is need for market form of development of CBET with Governmen playing a strong facilitator role.
- There is a need to create a Regional Power Market to support these development.
- Development of power exchange in India opens up new oppourtinutes for CBET and building Trans Power Exchange



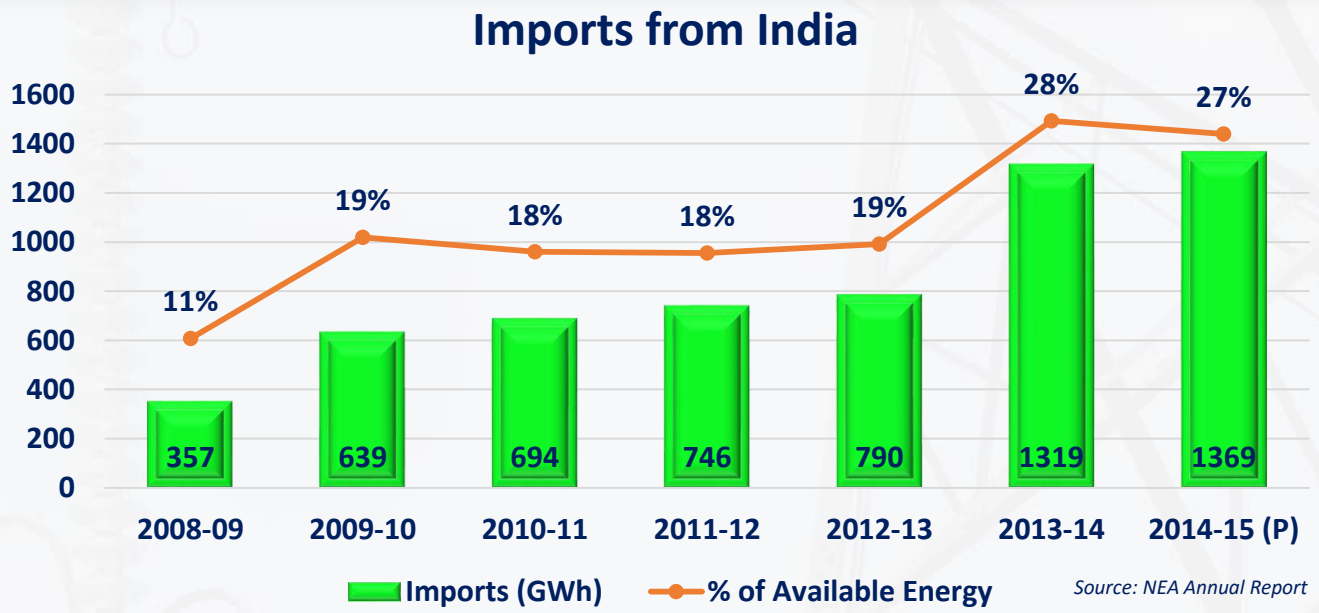
	Bhutan-India	India-Bangladesh	India-Nepal
Principle of determination	The tariff for both Tala and Dagachhu PPAs was determined on a negotiated basis	The tariff for NVVNL PPA is as per CERC regulations (agreed based on negotiation). On the other hand, tariff for PTC PPA was determined through competitive bidding	The tariff in both Treaty/Bilateral arrangement and PTC PPA was agreed based negotiation



Source: Complied from various sources. Note- Tariff for 1st year for IG projects of PHPA,MHPA,CHP,THP,KHP are not Available

India-Nepal CBET

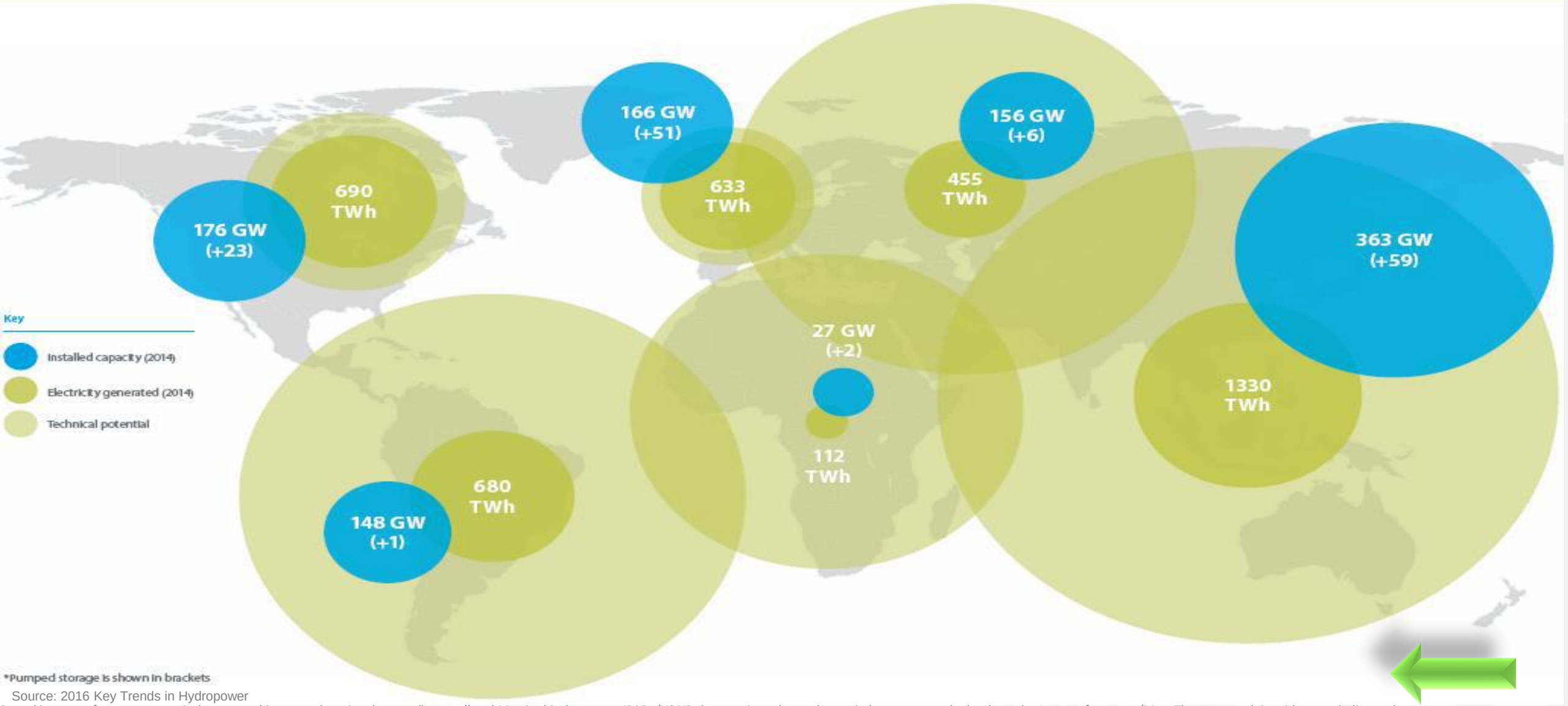
- Indo-Nepal power exchange began in 1971 with exchange of 5 MW of power to cater to isolated pockets on either side of the border
- The power exchange has been around 150 MW on radial mode at 11kV-132 kV levels between NEA and utilities on the Indian side
- Imports from India has been rising due to delays in domestic capacity additions in Nepal
- Dhalkebar (Nepal) – Muzaffarpur (India) 400 kV (132 kV) transmission line commissioned in Feb 2016 has added around 80 MW of import from India.
- The capacity will be enhanced to 1000 MW



•Nepal will continue to be a net importer of energy in the short term, specifically during the dry season (winter months).

•The power trading opportunities and option to sell to India will improve with the commissioning of domestic hydropower projects in Nepal

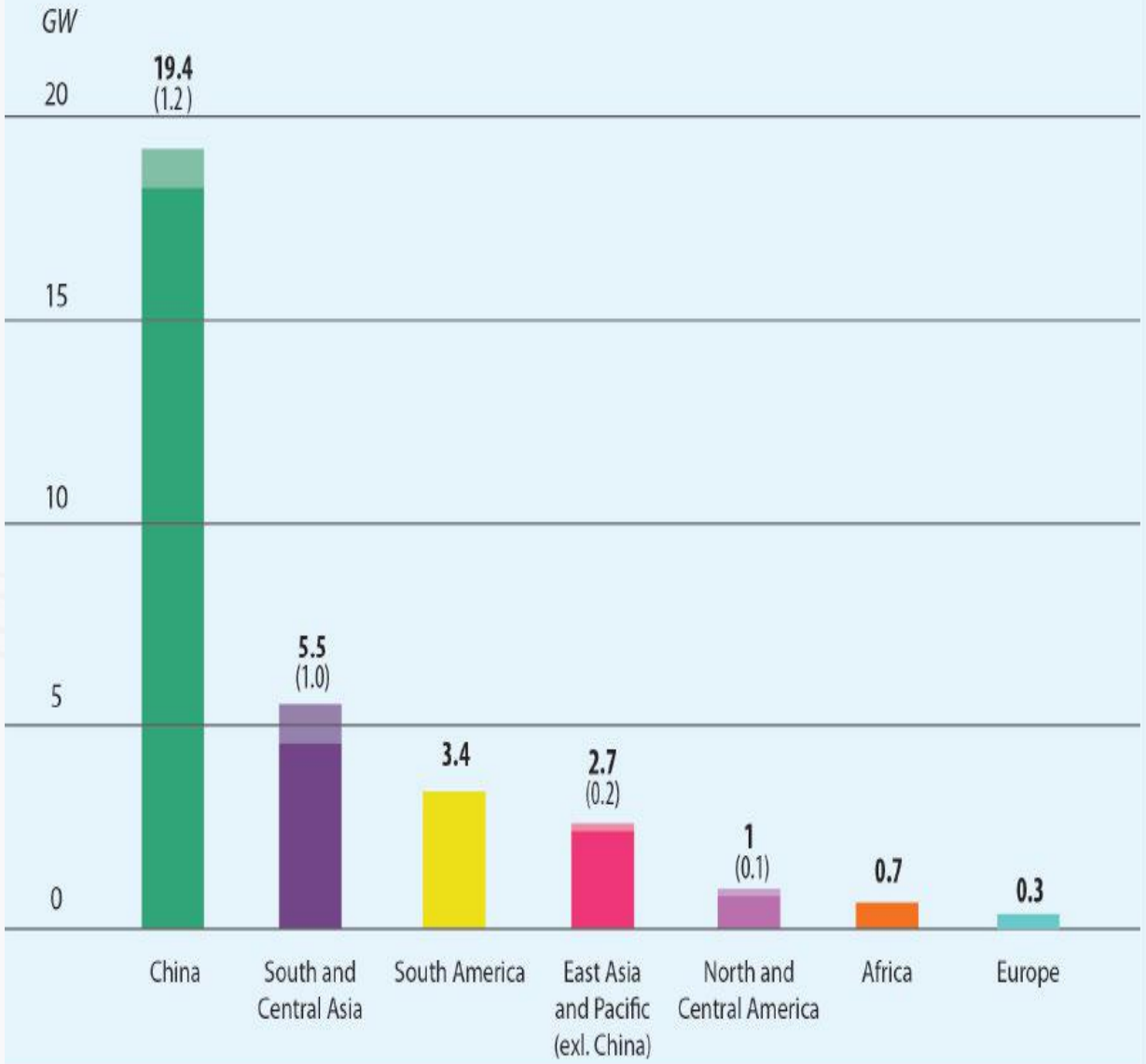
GLOBAL HYDROPOWER TECHNICAL POTENTIAL, GENERATION AND INSTALLED CAPACITY BY REGION*



Source: 2016 Key Trends in Hydropower

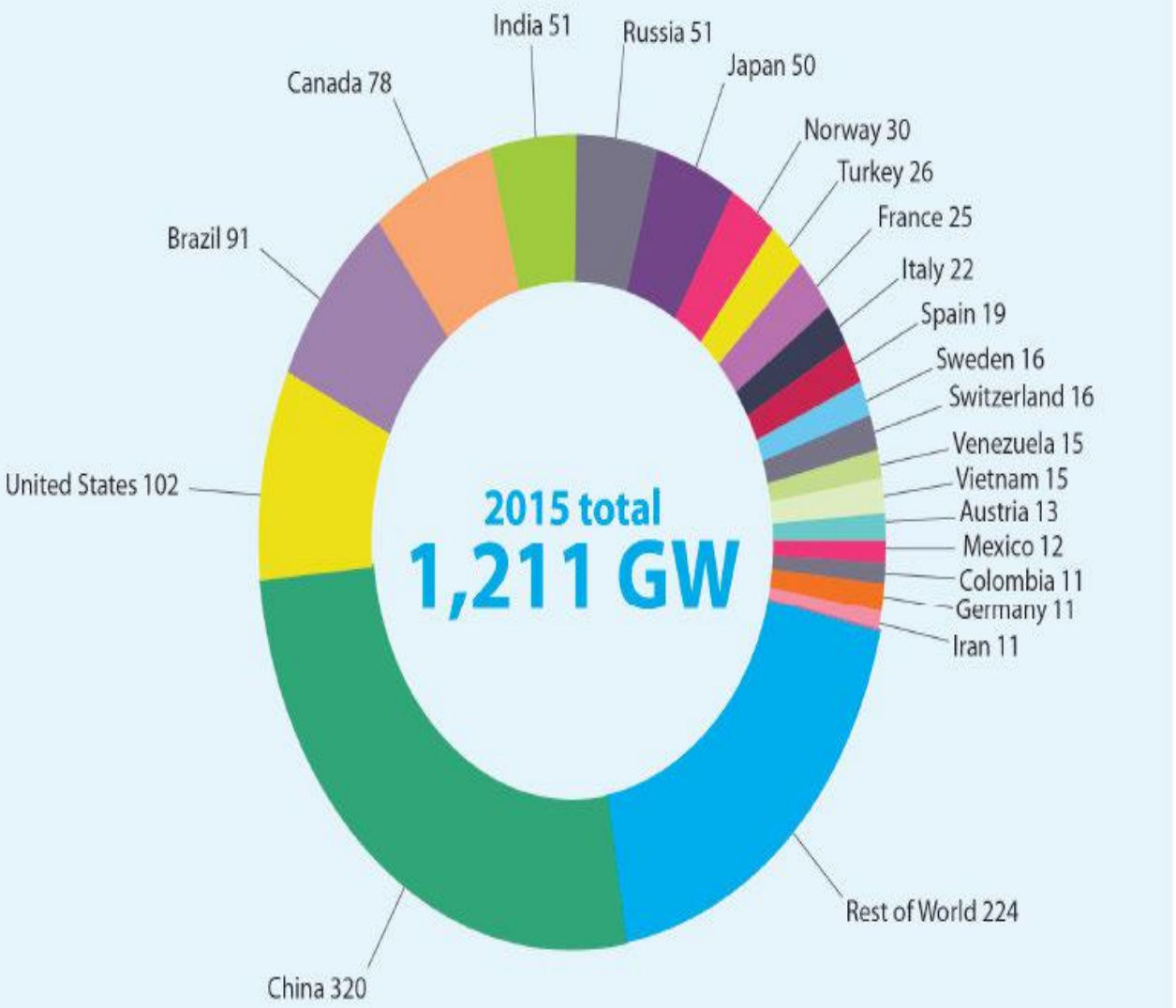
Total capacity added in 2015 by region:

33 GW hydropower capacity (including 2.5 GW pumped storage)

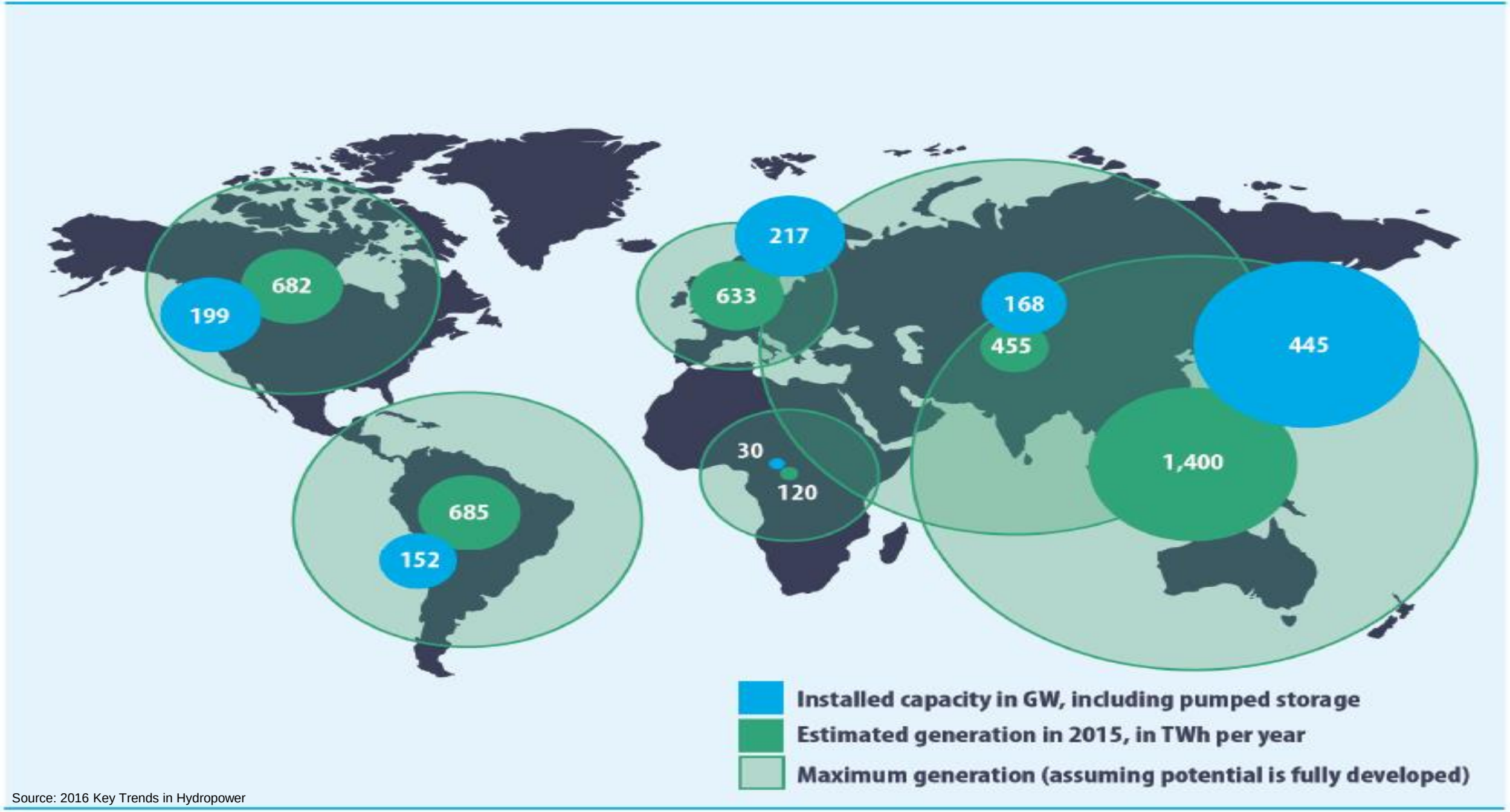


World installed hydropower capacity at the end of 2015:

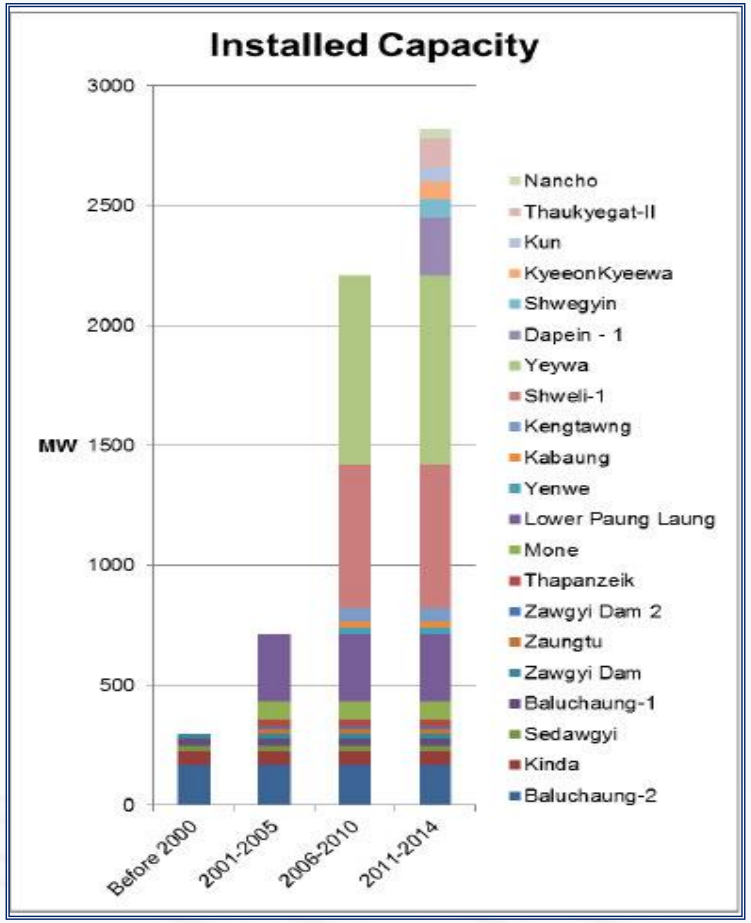
1,211 GW (including 145 GW pumped storage)

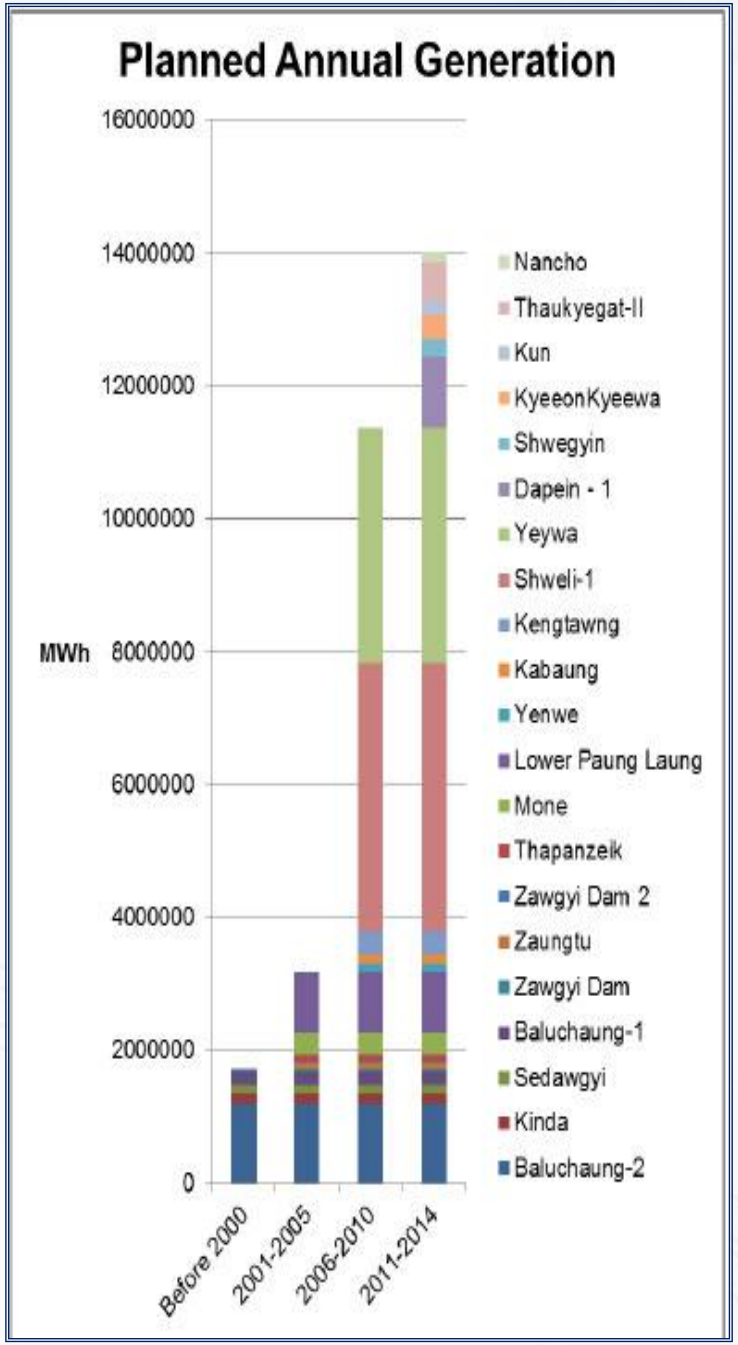


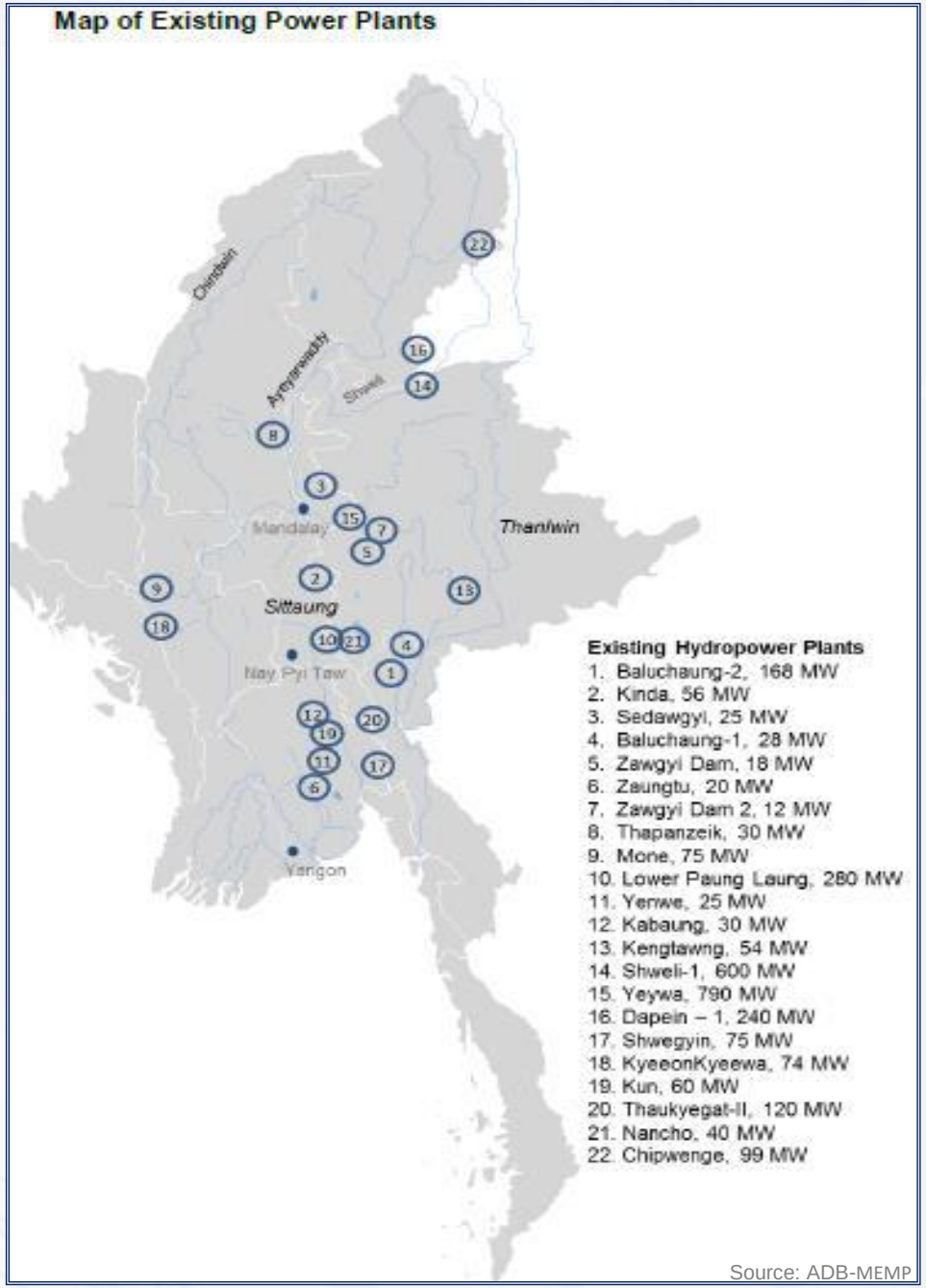
Source: 2016 Key Trends in Hydropower



Source: 2016 Key Trends in Hydropower

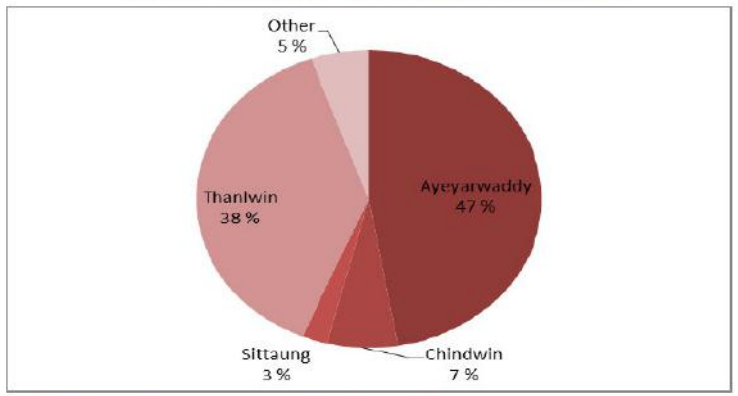






Source: ADB-MEMP

Figure V-2: Hydropower Potential by River System



Source: Consultant's analysis based on MOEP data

China: Expected Capacity Import from Myanmar

Site	Developer	Capacity (MW)	COD
Dapein (2)	Datang Co., Ltd	140	2014
Shweli (2)	Huaneng Group	520	2015
Saing Din	Datang Co., Ltd	47	2015
Nam Pawn and Nam Tamhpak	Datang Co., Ltd	765	2020
Ngaw Chan Kha	Yunnan Power Investment Co., Ltd	1200	2018
Northern Region	China Power Investment Corp.	21,500	2016–2021
Kunlong	Hanneng Holding Group	1,400	2018
Ywathi	Datang Co., Ltd	4,000	2019
Mongton	Three Gorges Corp./CSG/ Sinohydro	7,000	2023
Lemro 1 and 2	Datang Co., Ltd	690	Planning stage
Total		37,262	

COD = commercial operation date, CSG = China Southern Power Grid, MW = megawatt.

Source: Presentation by the PRC to the Regional Power Trade Coordination Committee.

Source: ADB

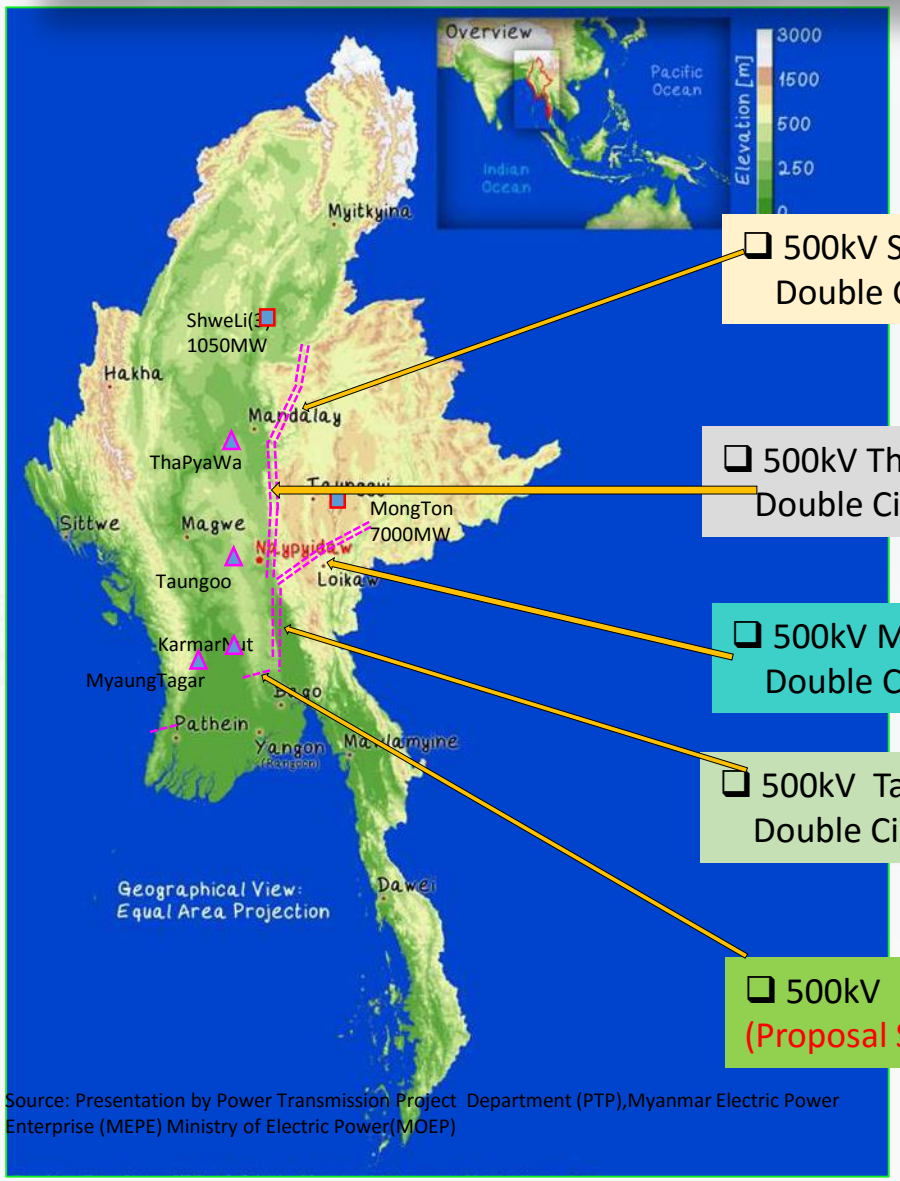
Institutional Structure and Level of Reform

Country	Corporatization	Unbundling	Regulation	Use of System
Cambodia	EDC is a wholly state-owned corporation.	The sector is fragmented, but the main transmission operator is also a generator and distributor.	There is a regulator with distinct legal identity.	None
Lao People's Democratic Republic	EDL-Gen operates as a private company and its shares are privately traded. EDL is a wholly state-owned corporation.	The sector is formally unbundled although there are substantial cross-share holdings.	There is no independent regulator.	There are no published use-of-system charges, but there seems no reason why they could not be introduced.
Myanmar	Electricity supply is a part of government.	Different government departments are responsible for hydro plants and the remainder of the system.	There is no independent regulator.	None
People's Republic of China (Guangxi and Yunnan)	This is largely the preserve of SOE and their corporatized subsidiaries.	Generation and transmission was unbundled since 2002.	Regulation is done by the State Electricity Regulatory Commission.	Set by the State Electricity Regulatory Commission.
Thailand	An initial corporatization of EGAT was reversed and it reverted to an SOE.	There is no unbundling of EGAT's generation and transmission activities.	There is a partially independent Energy Regulatory Commission.	There is no published use-of-system charge. There is no separate accounting of transmission.
Viet Nam	The Vietnam Electricity Group is a state-owned holding company.	Transmission is a separate accounting unit of the EVN holding, but will probably be separated. Many plants participate in a competitive generating market.	The Electricity Regulatory Authority of Vietnam (ERAV) is a department within the Ministry of Industry and Trade (MOIT).	None exists at present, but presumably will be developed in a competitive market.

EDC = Electricité du Cambodge, EDL = Electricité du Laos, EGAT = Electricity Generating Authority of Thailand, EVN = Electricity of Vietnam, SOE = state-owned enterprise.

Sources: Various country energy reports.

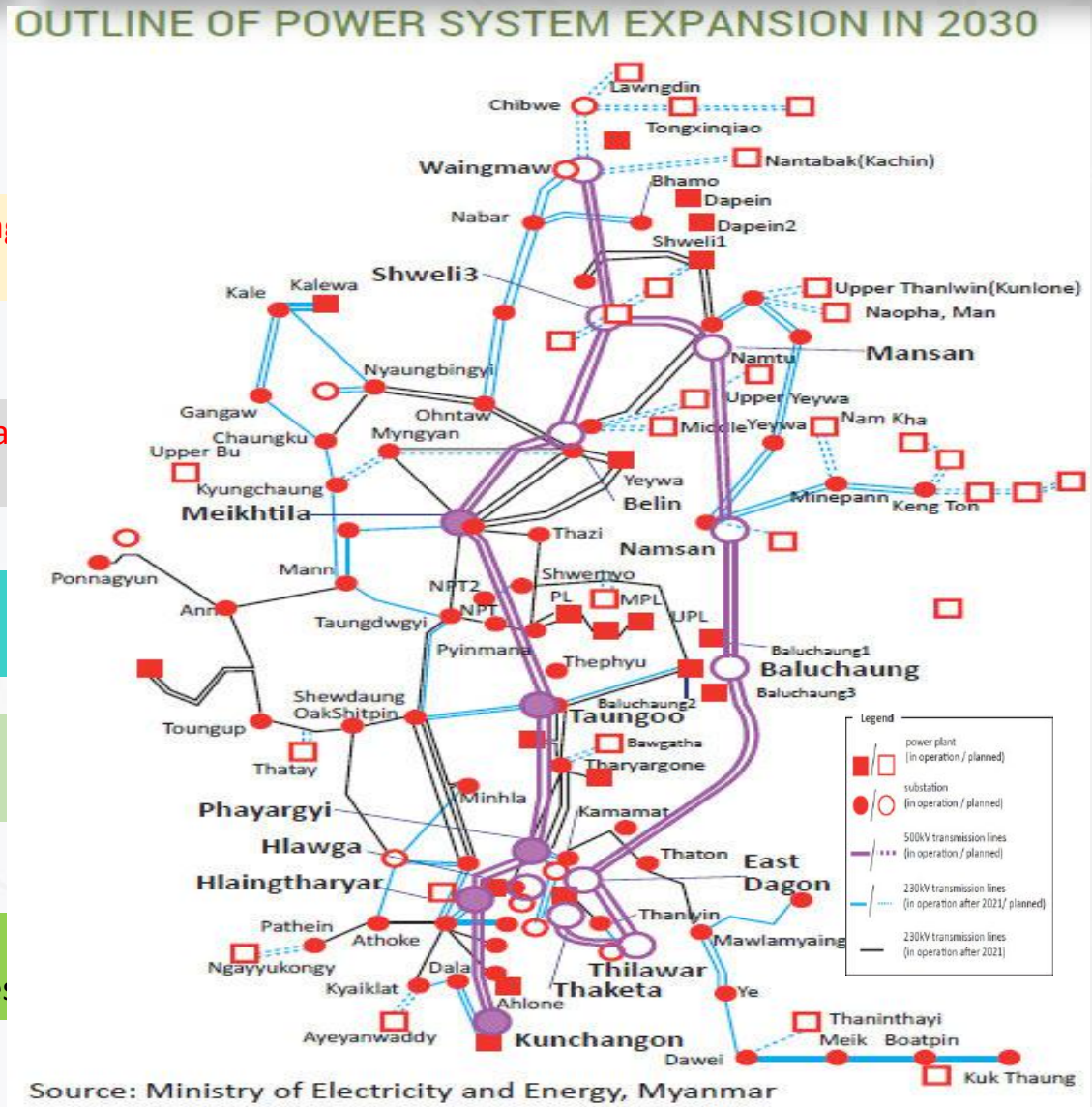
500 KV Power Transmission Plan In Myanmar



- ShweLi(3)- ThaPyaWa (Proposal Sta
  Double Circuit Line (250)miles
- 500kV ThaPyaWa – Taungoo(Contracted Sta
  Double Circuit Line (153.3)miles
- 500kV MongTon-Taungoo (Proposal Stage)
  Double Circuit Line (230)miles
- 500kV Taungoo-KamarNat(Proposal Stage)
  Double Circuit Line (117)miles
- 500kV KamarNat-MyaungTagar
  (Proposal Stage) Double Circuit Line (50)miles

Source: Presentation by Power Transmission Project Department (PTP),Myanmar Electric Power Enterprise (MEPE) Ministry of Electric Power(MOEP)

Power System Expansion-2030



Source: Ministry of Electricity and Energy, Myanmar

Myanmar : Power Supply Strategies

(1) Sole investment of Ministry

(2) Build, Own and transfer (B.O.T) by local entrepreneur

(3) Joint Venture/Build, Own and Transfer (JV/B.O.T) by foreign investor

Resources	Development Stage	Projects	Installed (MW)
Hydropower	Existing Power Plant	25	3151
	Implementation	6	1522.4
	JVA	4	12700
	MOA	19	16970
	MOU	12	8583
	Planning/Proposal	4	783.1
	Sub-total	**70**	**43709.5**
Steam/Gas-fired	Existing Power Plant	14	714.9
	Implementation	12	1255.35
	JVA	-	-
	MOA	2	703
	MOU	4	1899
	Planning/Proposal	1	106
	Sub-total	**33**	**4678.25**
Coal-fired	Existing Power Plant	2	128
	Implementation	-	-
	JVA	-	-
	MOA	-	-
	MOU	12	10090
	Planning/Proposal	10	8710
	Sub-total	**24**	**18928**
Others	(Wind) MOU	25	4032
	(Solar) MOU	4	530
	(Geothermal) MOU	5	200
	Sub-total	**34**	**4762**
Total		**161**	**72077.75**

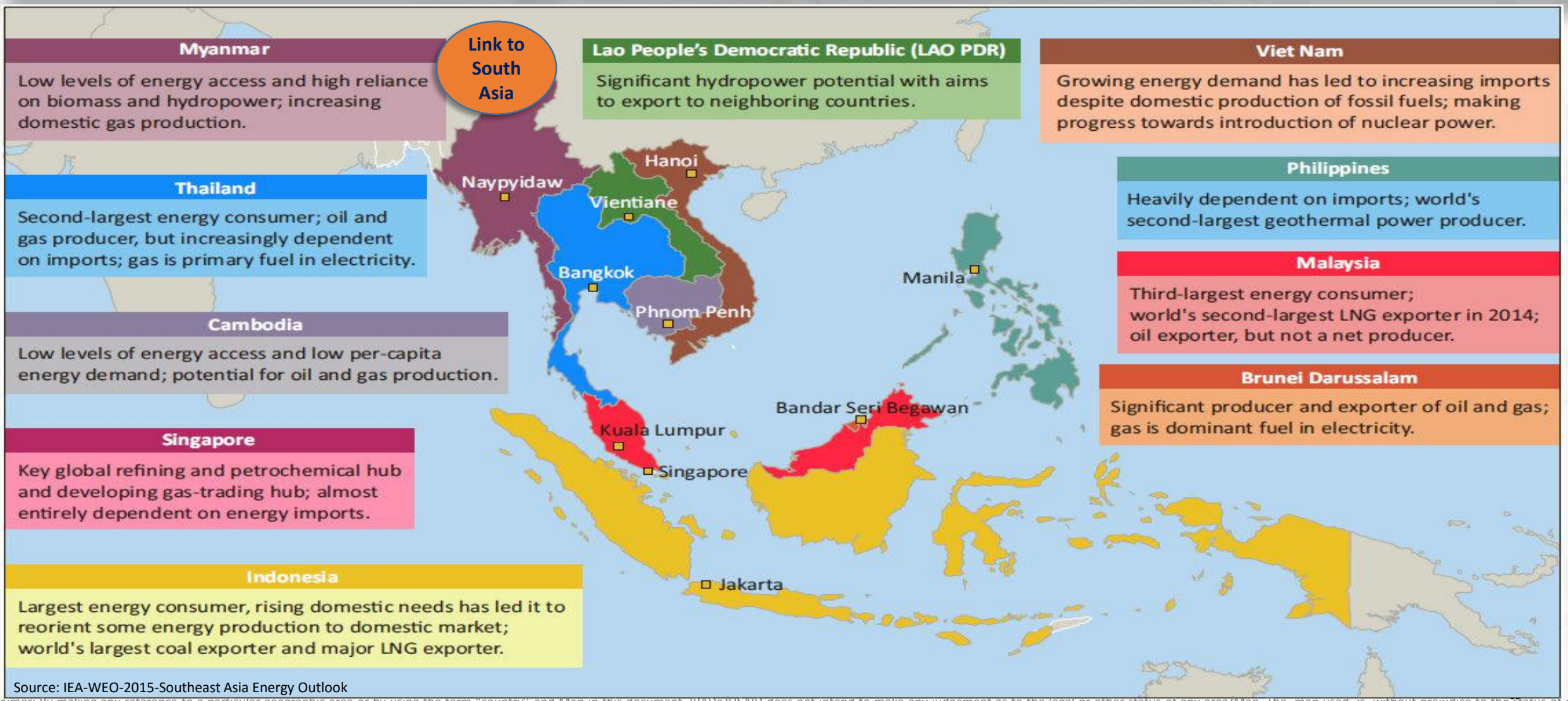
Source: https://www.hydropower.org/sites/default/files/publications-docs/U-Maw-Thar-Htwe-Myanmar-assessing-demand-and-opportunities-Asia-World-Hydropower-Congress.pdf

USAID FROM THE AMERICAN PEOPLE

SARI/EI

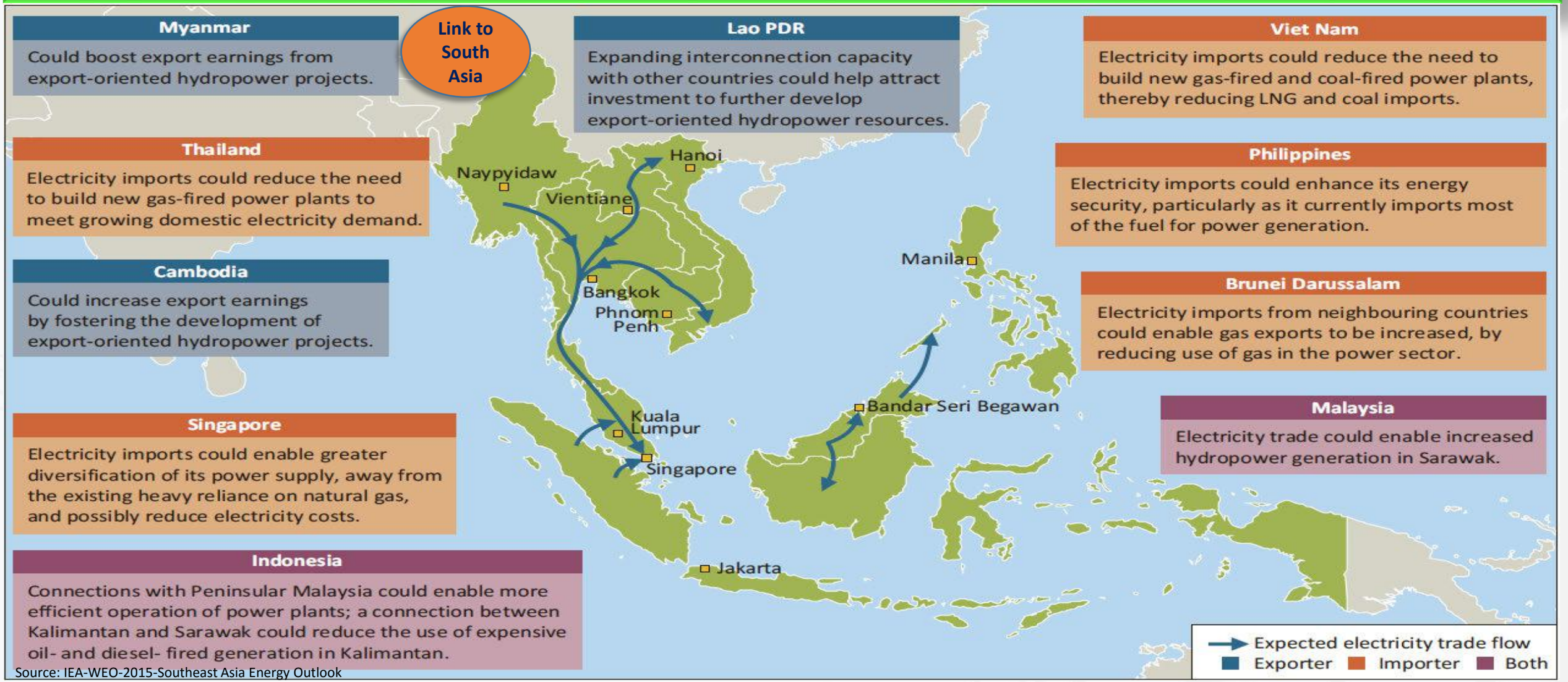
IRADe Integrated Research and Action for Development

Energy Overview of South East Asia



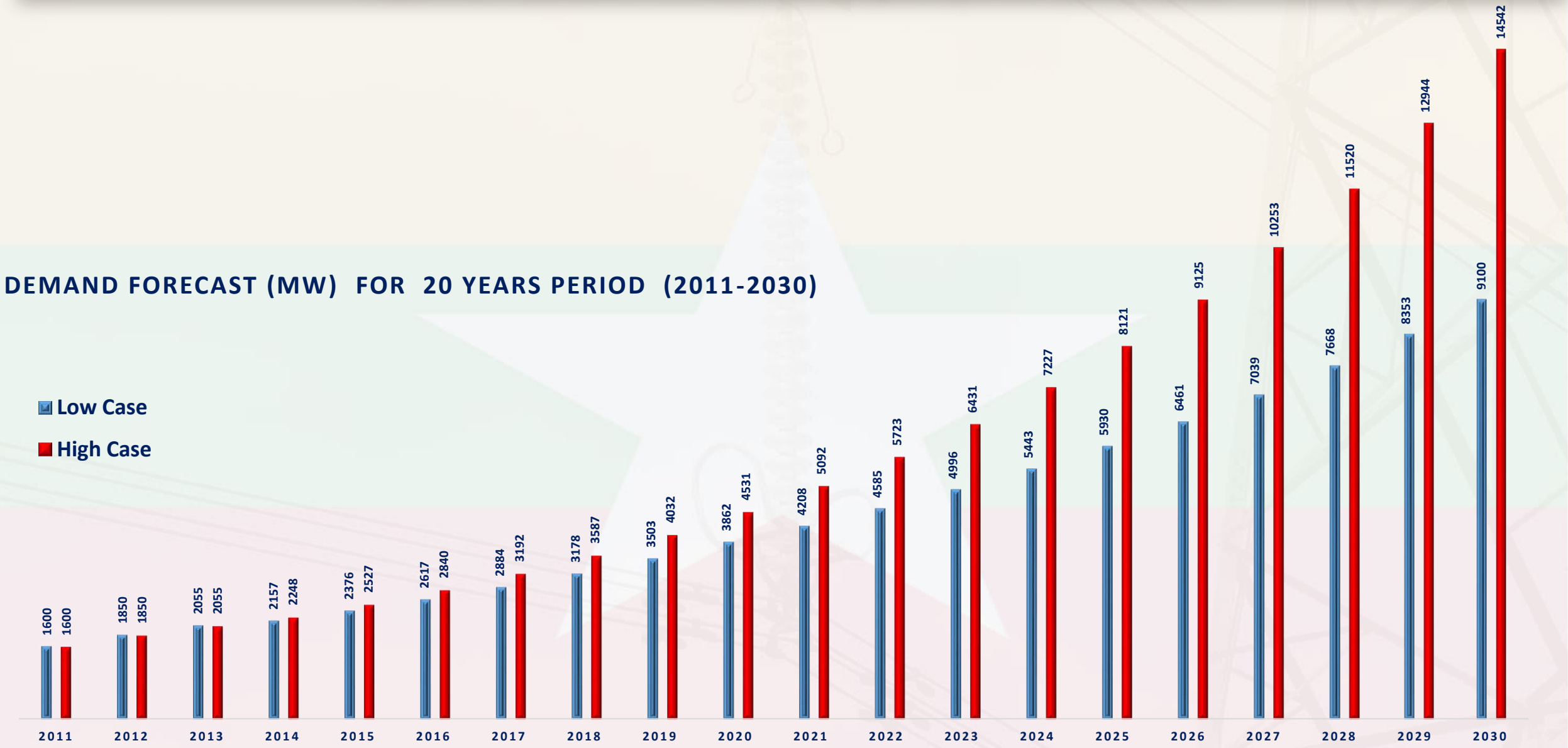
Source: IEA-WEO-2015-Southeast Asia Energy Outlook

Potential implications and benefits of enhanced power grid interconnections South East Asia



Source: IEA-WEO-2015-Southeast Asia Energy Outlook

Myanmar: Demand Forecast for 20 years period (2011-2030)



Source: MoEP

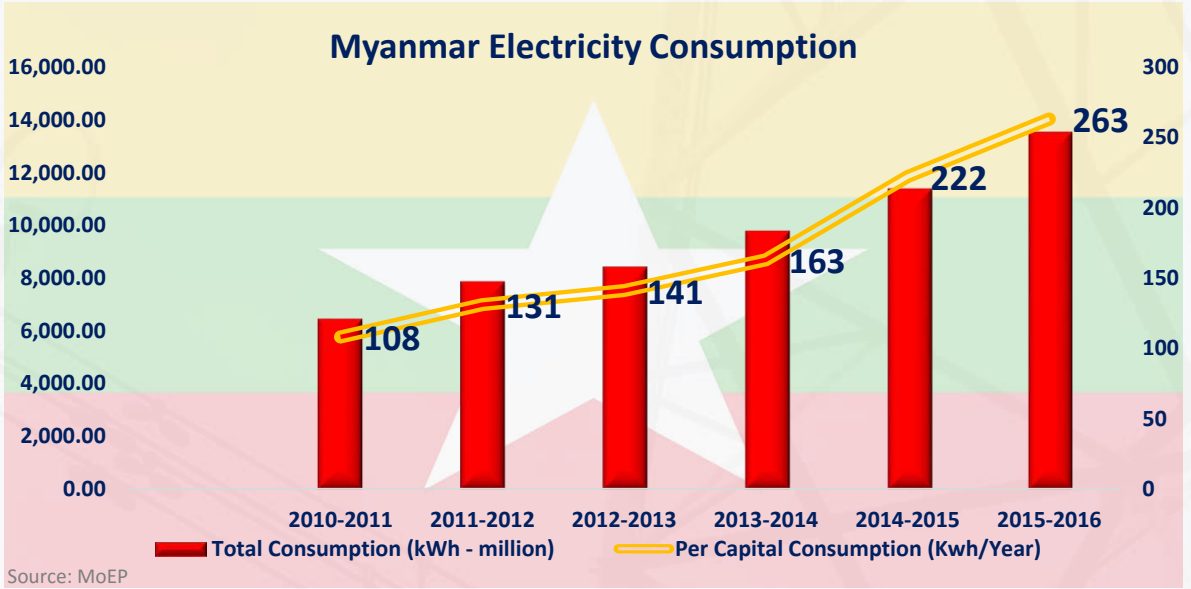
Myanmar: Electricity Tariff and Subsidies

Block Rate Tariff		Average Selling Price	Cost of Generation, Transmission & Distribution		Average Cost of Overall	Subsidies
Residential		71.10	Hydro Power Station		93.67	22.57
up to 100kWh	35		MOEE	18.51		
from 101kWh to 200kWh	40		Privates	52.84		
from 201kWh and above	50		Natural Gas Power Station			
Industrial & Commercial			MOEE	161.09		
up to 500kWh	75		Privates	142.27		
501kWh to 10,000kWh	100		Coal Fired Power Station			
10,001kWh to 50,000kWh	125		Privates	105.54		
50,001kWh to 200,000kWh	150		Transmission	3.00		
200,001kWh to 300,000kWh	125		Distribution	5.18		
300,001kWh and above	100					

Remarks; Above calculation is base upon the Revenue and Expenditure Budget Estimation for fiscal year 2016-2017.
Source: MoEP

Myanmar: Growth of Electricity Consumption and Electrification

No.	Year	Total Consumption (kWh - million)	Electrified Household		Per Capital Consumption (kWh / yr)
			No of Household (Million)	Percentage	
1	2010-2011	6,467.30	2.22	25%	108
2	2011-2012	7,876.72	2.42	26%	131
3	2012-2013	8.441.04	2.63	28%	141
4	2013-2014	9,795.09	2.91	31%	163
5	2014-2015	11,406.76	3.26	29%	222
6	2015-2016	13,550.267	3.70	34%	263



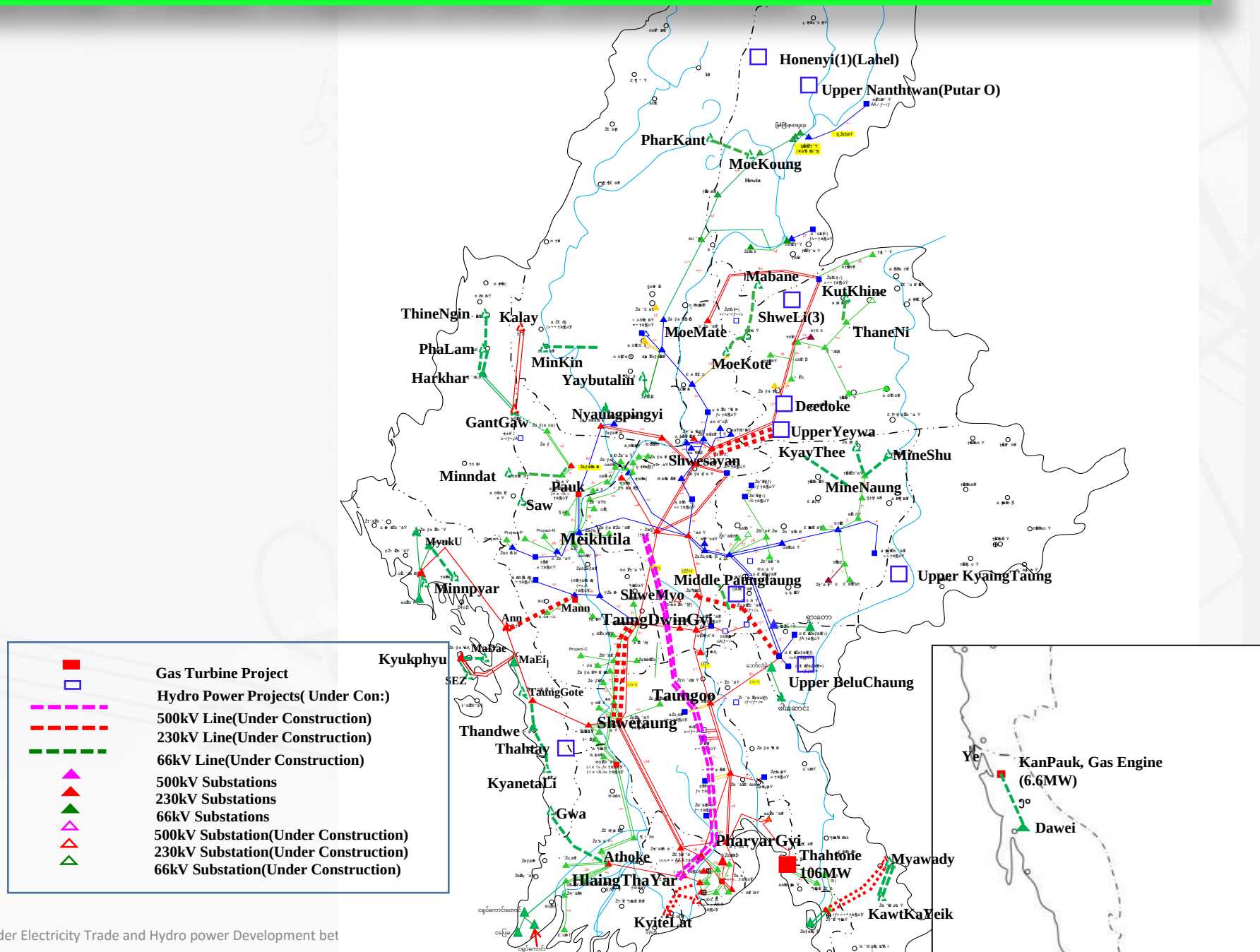
Source: MoEP

Myanmar: Power Projects Under Construction

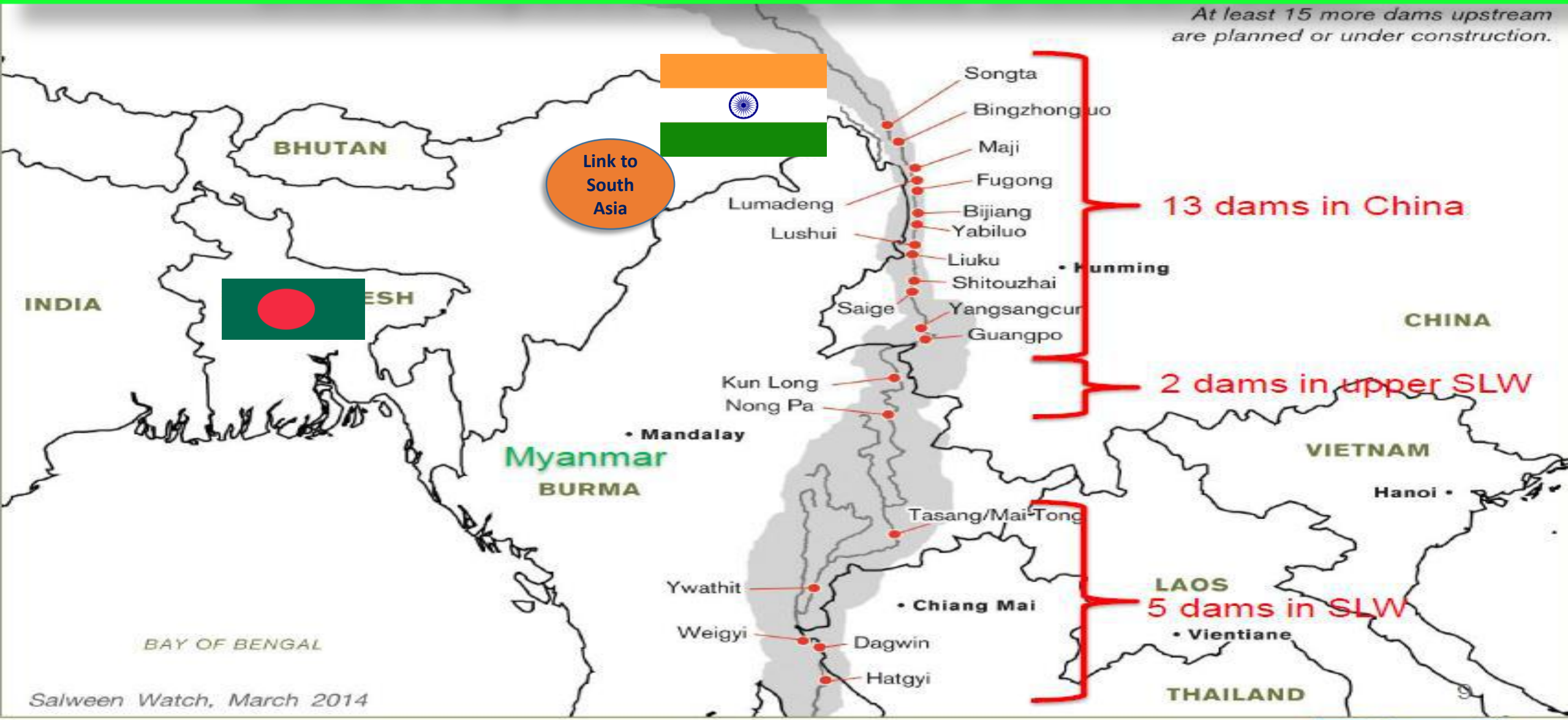
Sr.	Project	MW
1	Honenyi (Hydro)	6
2	Upper Nanhtwan (Hydro)	3.2
3	Shweli (3) (Hydro)	1050
4	Deedoke (Hydro)	66
5	Upper Yweywa (Hydro)	280
6	Middle Paunglaung (Hydro)	100
7	Upper Kyaingtaung (Hydro)	51
8	Upper Beluchaung (Hydro)	30.4
9	Thahtay (Hydro)	111
10	Thahtone (Gas)	106

(A)	500 kV	1	146
(B)	230 kV	6	452.423
(C)	66 kV	17	509

Source: MOEP Presentation



China: Proposed DAMS in the SALWEEN Basin



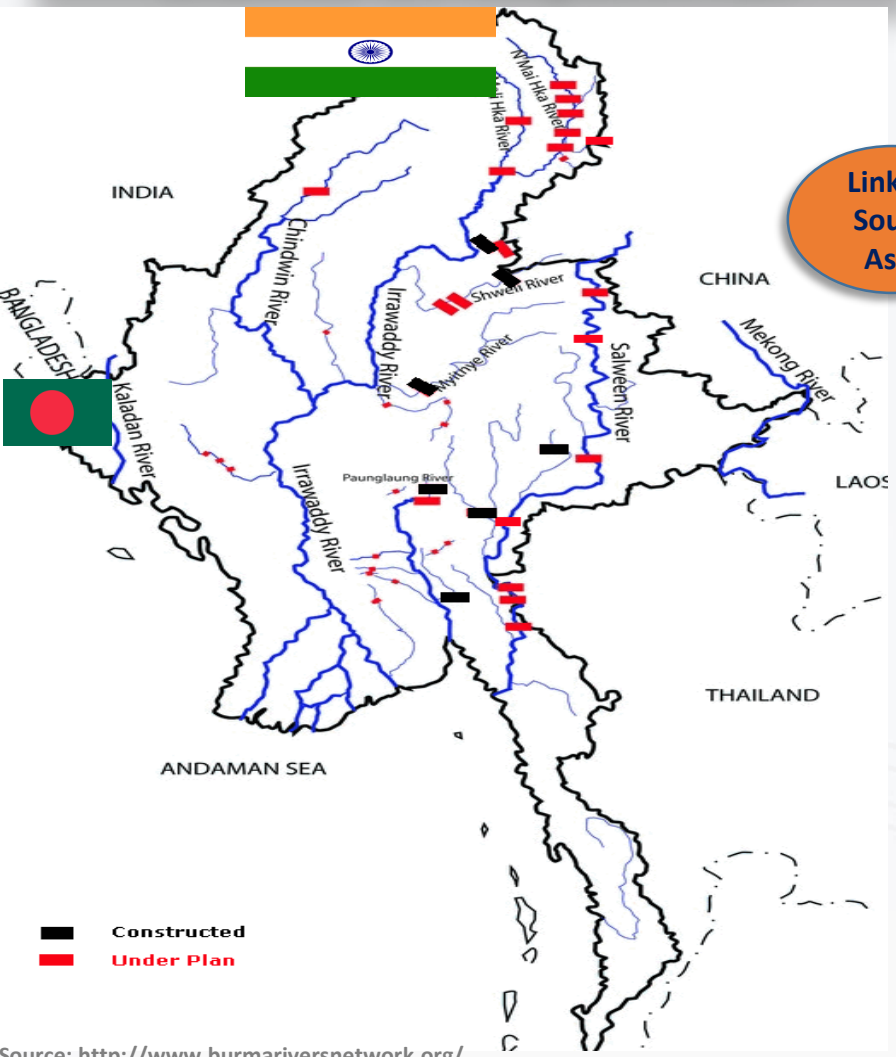
Disclaimer: By making any reference to a particular geographic area or by using the term "country'' and Map in this document, IRADe/USAID does not intend to make any judgement as to the legal or other status of any area/Map. The map used is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries, and to the name of any territory, city or area.

USAID FROM THE AMERICAN PEOPLE

SARI/EI

Integrated Research and Action for Development

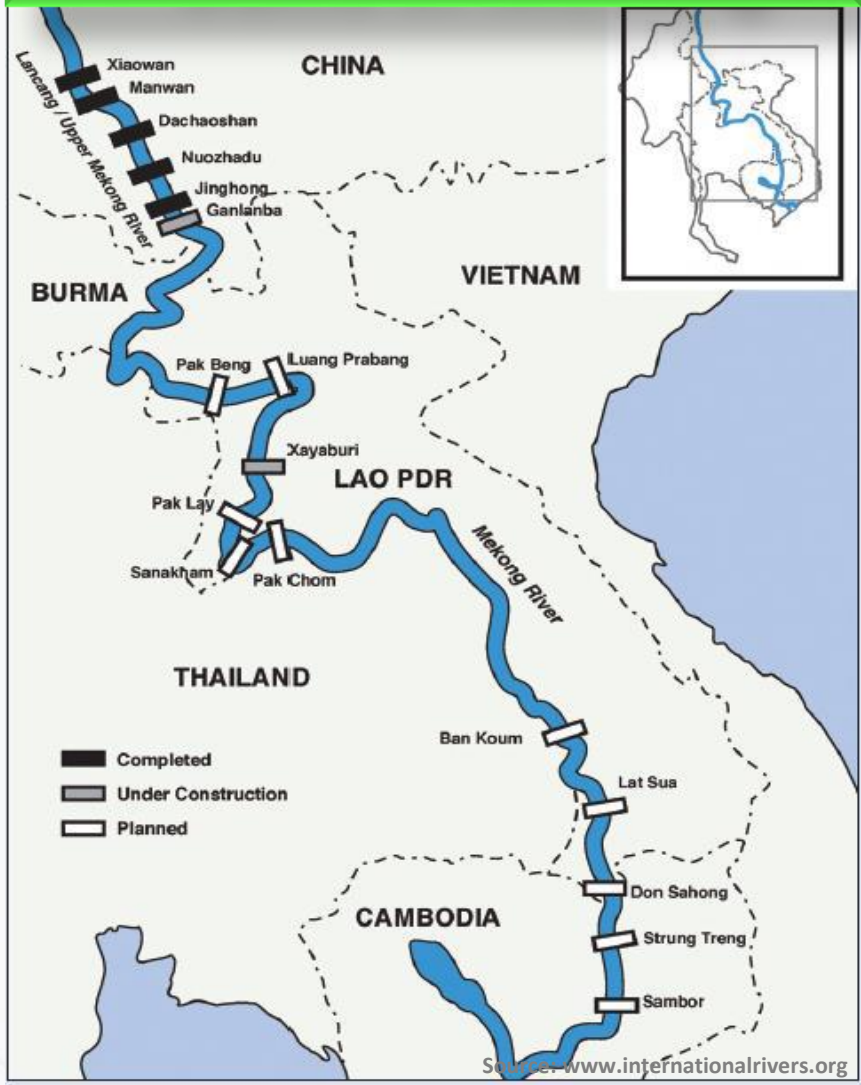
Dams in Myanmar



Source: http://www.burmariversnetwork.org/

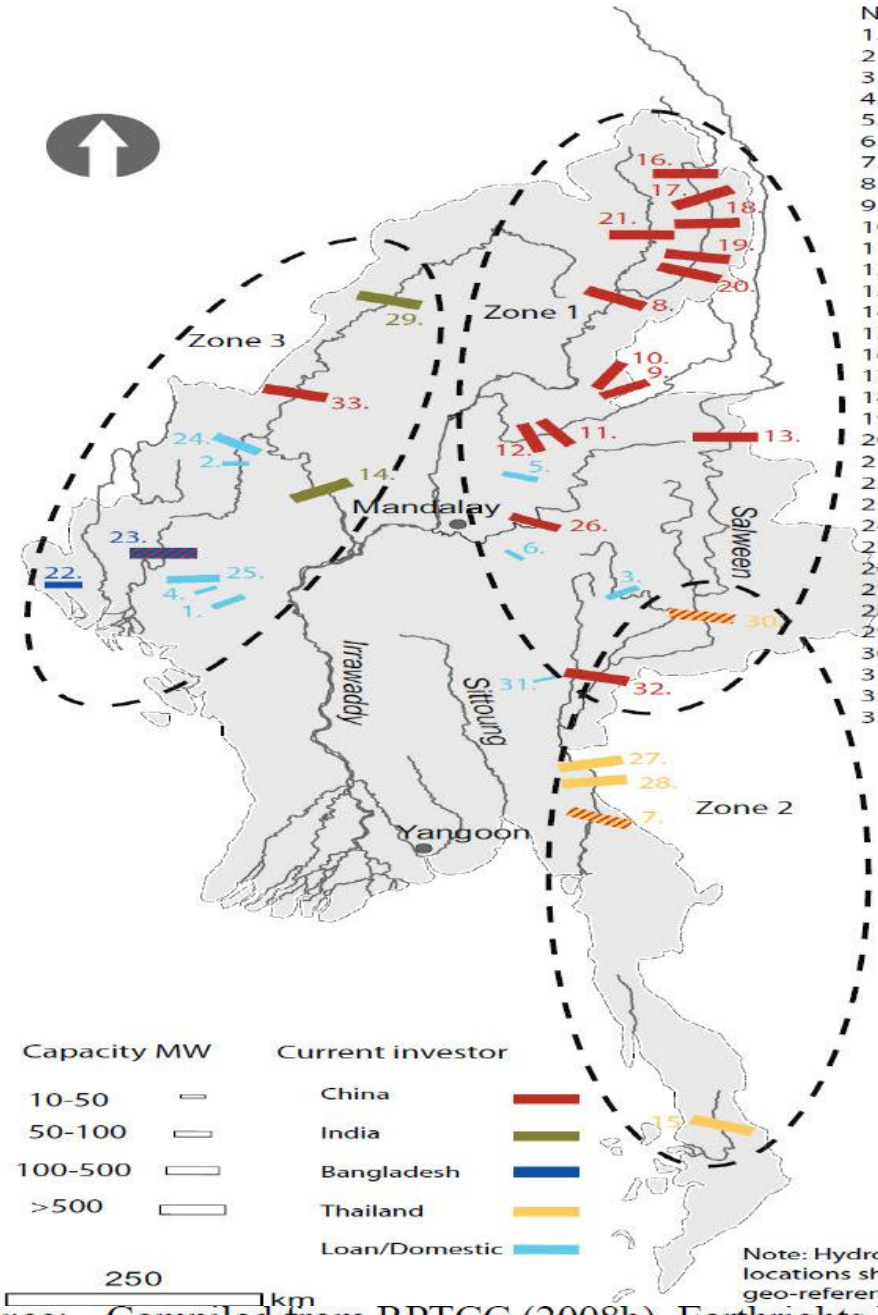
Mekong River

Dams in Mekong



Source: www.internationalrivers.org

Myanmar: Hydro Power Development in Zone wise (under various stage of planning and implementation)



Name	(MW)
1. Kyeeon Kyeewa	74
2. Myithar	40
3. Upper Kengtaung	52.5
4. Buywa Lower	42
5. Upper Sedawgyi	60
6. Myogyi	24
7. Hutgyi	1360
8. Myitsone	4100
9. Tapein (1)	240
10. Tapein (2)	168
11. Shweli (2)	460
12. Shweli (3)	360
13. Upper Thanlwin	1400
14. Shwe Sar Yay	660
15. Tanintharyi	600
16. Yenan	1200
17. Khaung Lan Phu	2700
18. Phi Zaw	2000
19. Wu Sauk	1800
20. Chibwe	2800
21. Laik Zar	1900
22. Sai Din	76.5
23. Laymro	500
24. Manipur	380
25. Upper Buywa	150
26. Upper Yeywa	140
27. Weigyi	4540
28. Dagwyi	792
29. Tamanthi	1200
30. Tasang	7110
31. Baluchaung 3	48
32. Ywathit	800
33. Mawlaik	515

Zone-1: Across China Border
Zone-2-AcrossThailand Border
Zone-3-India and Bangladesh Border

Note: Hydropower zones and dam locations shown on the map are not geo-referenced

Source: Compiled from RPTCC (2008b), Earthrights International (2008), Magee and Kelley (2009), Salween Watch (2010), Brown et al. (2008), Irrigation Department (2011)

-Hydropower development in Myanmar and its implications on regional energy cooperation