

Potential of ASEAN Power Market Integration and Its Progress

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Nepal Power Investment Summit
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2018 Kathmanthu, January 27-29,



I. Context of ASEAN Energy Development

ASEAN Energy Resources

- Fossil energy is the main energy source consists mainly of natural gas, petroleum, hard coal and lignite
- Renewable energy is also boosting, in particular, for biomass, geothermal and hydropower resources as well as huge potentials of wind, solar and tidal energy
- Indonesia has the richest types and quality of renewable energy sources
- Thailand, the Philippines and Cambodia have relatively less energy resources
- Brunei and Singapore are in shortage of renewable energy resources

Fossil Energy



Source: ASEAN Center for Energy

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Renewable Energy



Source: ASEAN Center for Energy

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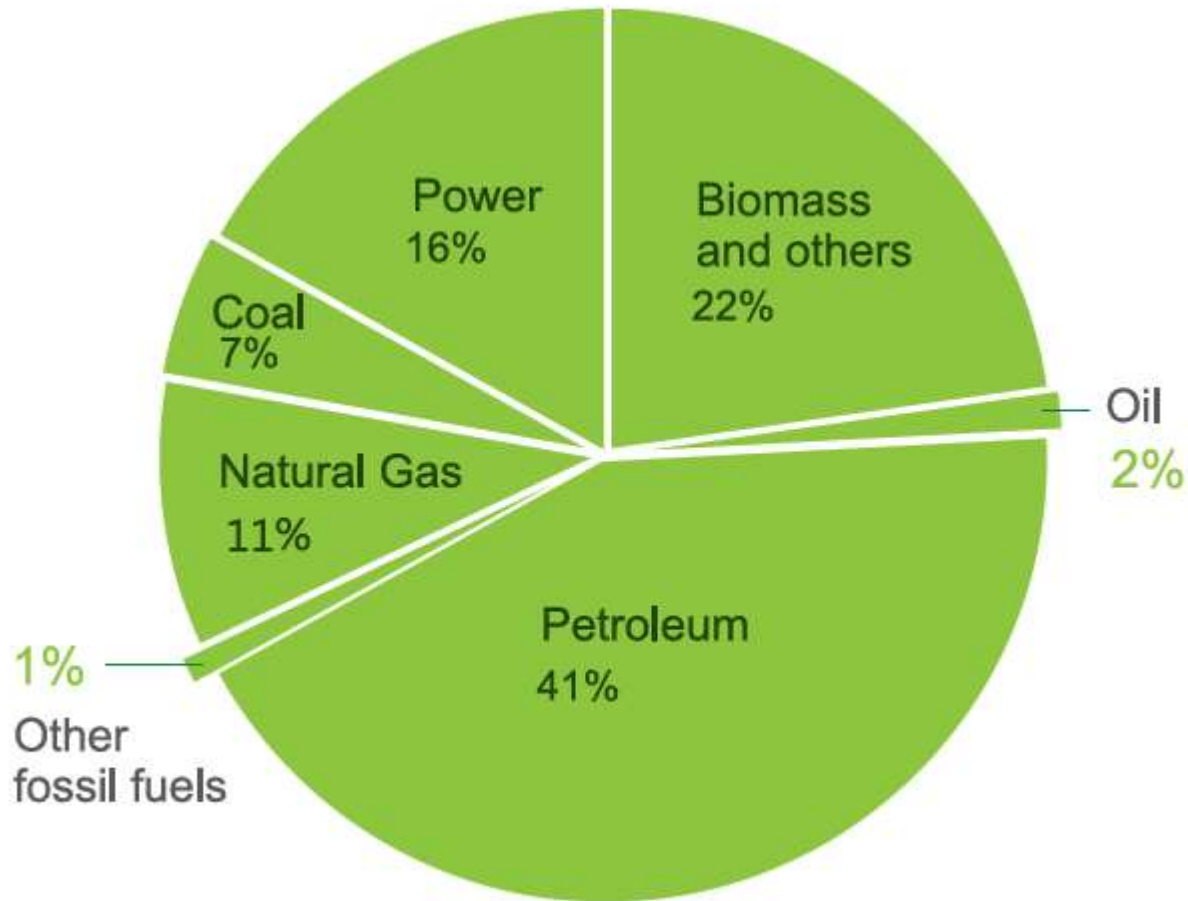
ASEAN Energy Market Profile

- Before the latest APAEC 2016-2025, security, accessibility, and, to a certain extent, affordability of energy supply are being prioritized over environmental sustainability, hence, fossil fuels, particularly coal and gas-fired turbines, dominate the fuel mix
- Efforts to use energy resources effectively are hampered by uneven distribution of their resources and different levels/rates of investment and economic development among ASEAN member countries
- Sufficient financial resources, enabling governance environments, and regional coordination are some of critical drivers for reliable, sustainable and affordable power systems

ASEAN Energy Consumption

- In 2016, ASEAN's energy consumption was 444 Mtoe in which petroleum is still the primary fuel (41%). Others are natural gas (11%), coal (7%), power (16%), biomass and others (22%)
- From 2012 to 2016, while ASEAN's energy consumption increased, the electricity power consumption had the biggest upsurge
- Among ASEAN countries, Indonesia and Thailand are biggest consumers (38.2% and 21.3% respectively). From 2012 to 2016, Vietnam had the biggest incremental quantity of energy consumption while the Philippines the fastest growth of 4.3% per annum.

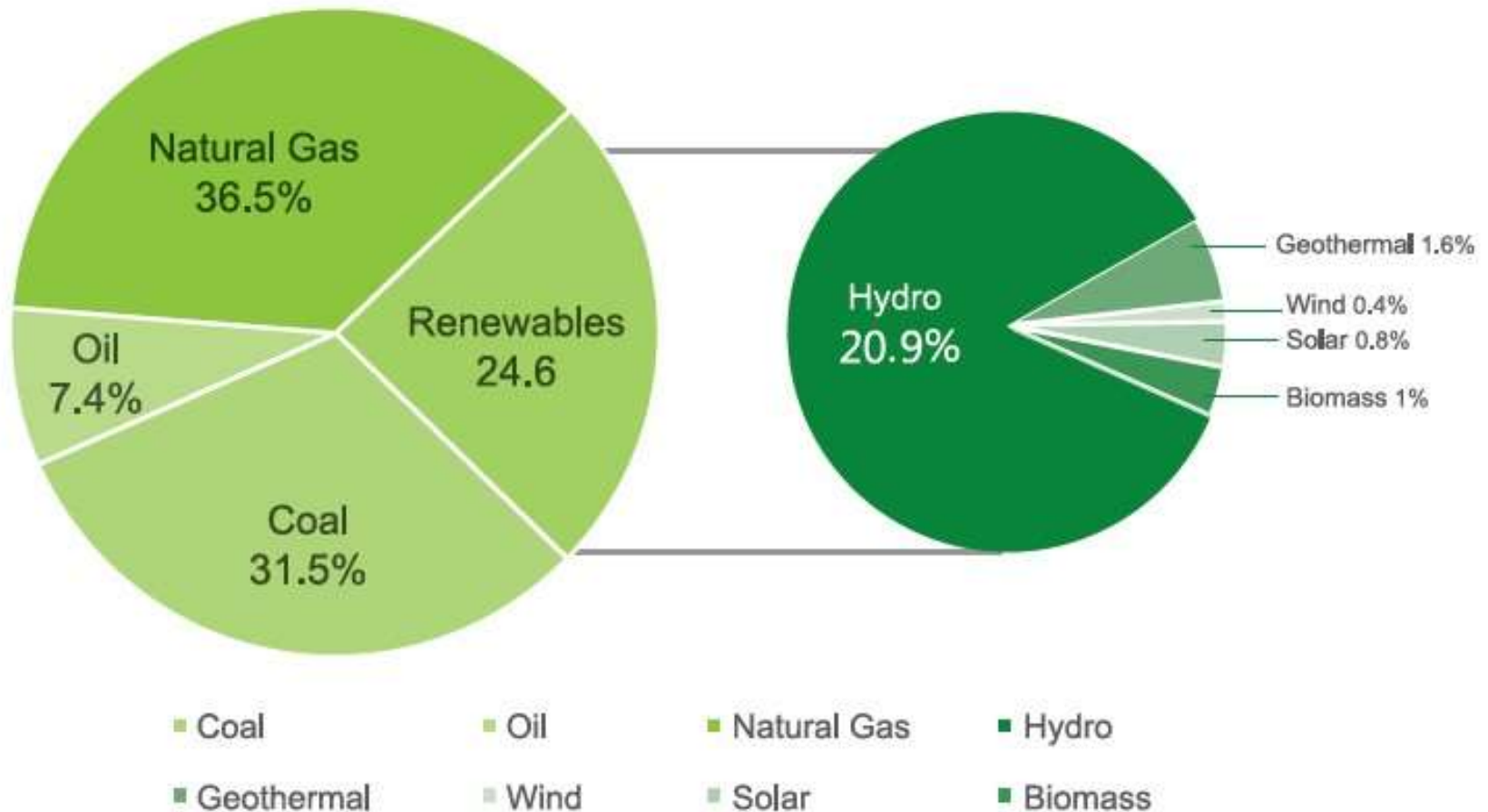
ASEAN Energy Consumption



ASEAN Power Sources

- In 2016, total installed power capacity amounted to 217 GW including 53.3 GW from renewable energy
- From 2012 to 2016, total installed power capacity increased by 49 GW with an average growth rate of 6.4% where installed capacity of coal-fired units climbed up to 22 GW with an annual average growth of 10.3% and its proportion went up to 31.5%, while installed capacity of gas-fired units only increased by 6.7 GW and its proportion drop from 43% in 2012 to 36.5% in 2016
- Installed renewable energy capacity increased rapidly from 35 GW in 2012 to 53 GW in 2016 with an average annual growth of 11.1% (85% from added hydropower)

ASEAN Power Sources



II. Towards An ASEAN Power Market Integration



The launch of the 5th ASEAN Energy Outlook, Manila, 28 September 2017

ASEAN Power Systems' Operation

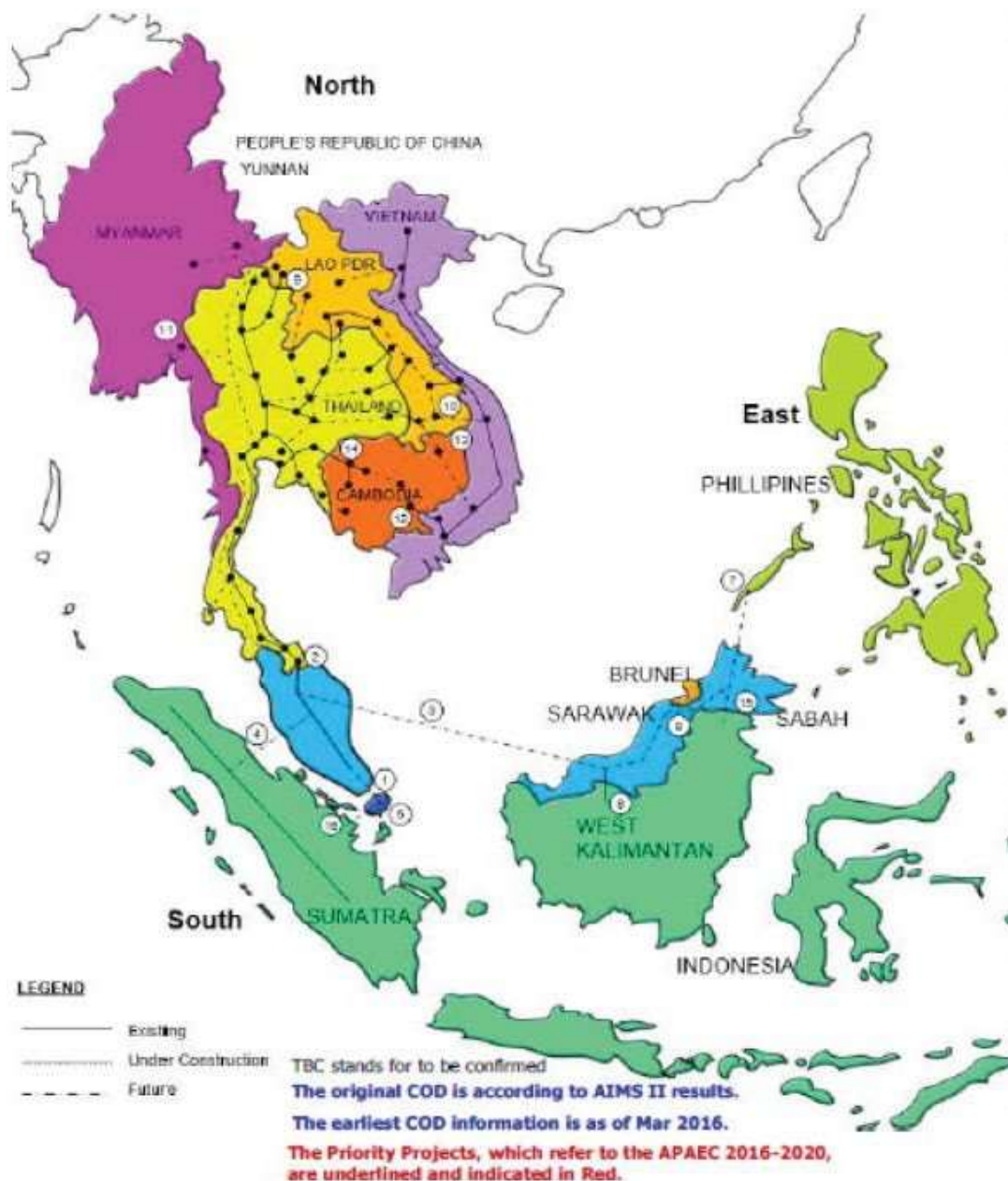
- Most ASEAN power system operates under a single-power market structure
- Competitive wholesale electricity markets exists only in Singapore and the Philippines
- Independent Power Producers(IPP) play a critical role in the single-buyer government budgets, financial burden due to investment and to promote competition which should result in greater power sector efficiencies and lower rates for consumers

ASEAN Potential to Improve Power Regulatory Framework

- Gains can be achieved if and only if appropriate regulatory environment is in place
- For ASEAN, and, in liberated markets, efficiency can only be obtained by having transparent regulatory framework, fair grid access and substantial number of market players
- Electricity prices for final consumers generally consist of costs of generation, network, retailing, taxes and levies as well as profit margins. Market and regulatory system need to ensure that all these components are fully covered to stimulate future investment

Establishment of ASEAN Power (RE) Market Integration

- ASEAN has good potential to further harness renewable energy (RE), especially, hydro, geothermal, biomass/biogas, wind and solar power
- Recognizing benefits of RE could provide, most ASEAN countries have set individual targets and support schemes which directly support the regional target
- Establishment of ASEAN Power Market Integration should offer better access to multi-technology and geographically RE
- Furthermore, ASEAN Power Market Integration may boost RE generation as variable sources which can be supported by flexible generation technologies
- In short-term, this can lead to much greater exploitation of ASEAN's hydroelectric resources, while significantly higher targets for modern renewable energy can be achieved only in the medium to long-run

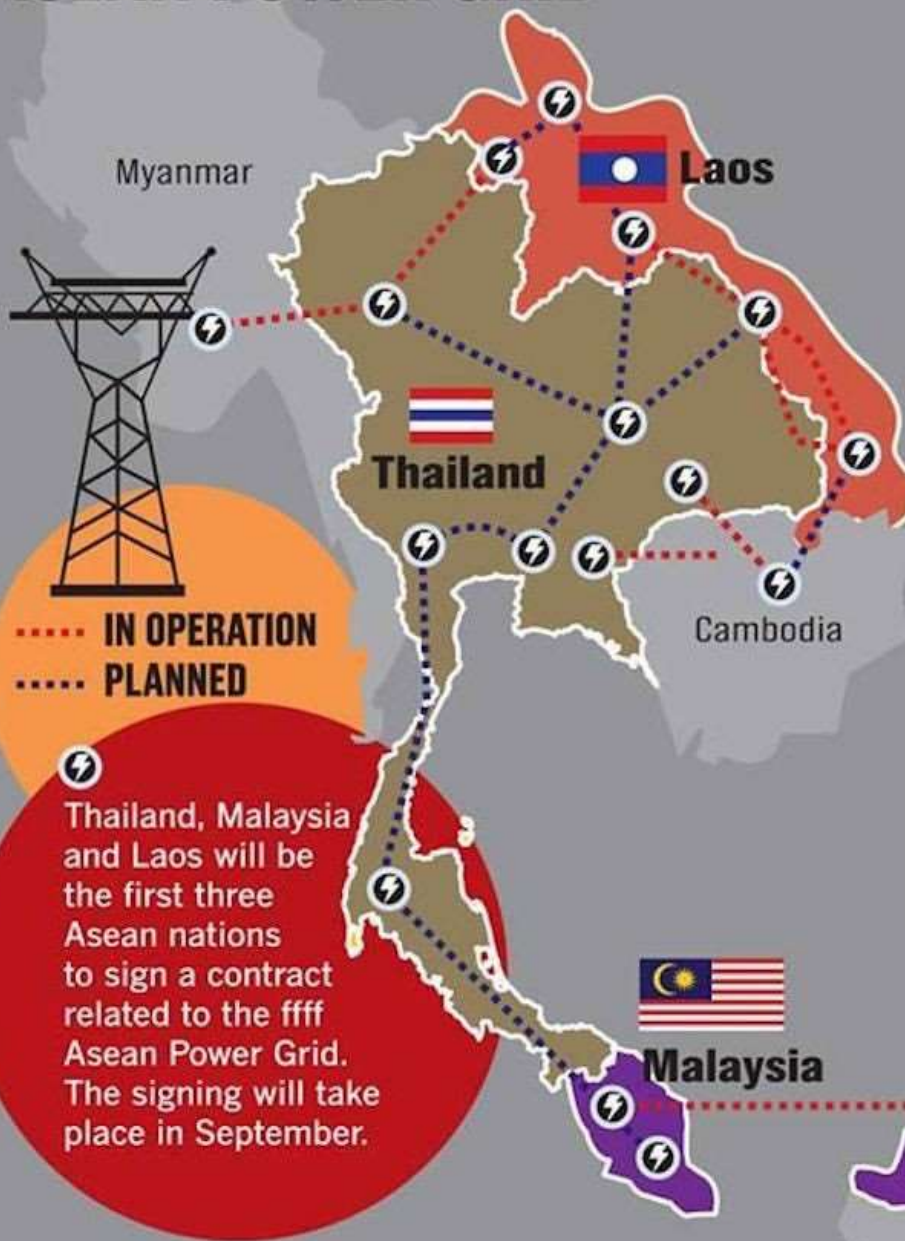


1)	P.Malaysia – Singapore	
	• Plentong – Woodlands	Existing
	• P.Malaysia – Singapore	post 2020
	(2 nd link Plentong – Woodlands)	
2)	Thailand – P.Malaysia	
	• Sadao – Bukit Keteri	Existing
	• Khlong Ngae – Gurun	Existing
	• Su Ngai Kokok – Rantau Panjang	TBC
	• Khlong Ngae – Gurun (2 nd Phase, 300MW)	TBC
3)	Sarawak – P. Malaysia	2025
4)	<u>P.Malaysia – Sumatra</u>	<u>2021</u>
5)	Batam – Singapore	post 2020
6)	Sarawak – West Kalimantan	Existing
7)	Philippines – Sabah	TBC
8)	Sarawak – Sabah – Brunei	2020
	• Sarawak – Sabah	2020
	• <u>Sarawak – Brunei</u>	<u>2019</u>
9)	Thailand – Lao PDR	
	• Nakhon Phanom 2 – Thakhek – Theun Hinboun	Existing
	• Ubon Ratchathani 2 – Houay Ho	Existing
	• Roi Et 2 – Nam Theun 2	Existing
	• Udon Thani 3 – Na Bong – Nam Ngum 2	Existing
	• Nakhon Phanom 2 – Thakhek – Then Hinboun (Exp.)	Existing
	• Mae Moh 3 – Nan – Hong Sa	Existing
	• Udon Thani 3 – Nabong (converted to 500KV)	2019
	• Ubon Ratchathani 3 – Pakse – Xe Pian Xe Namnoy	2019
	• Khon Kaen 4 – Loei 2 – Xayaburi	2019
	• Nakhon Phanom – Thakhek	2015
	• Thailand – Lao PDR (New)	2019-2023
10)	Lao PDR – Vietnam	2016 - 2020
	• Xekaman 3 – Tranmy	Existing
	• Xekaman 1 – Pleiku 2	2016
11)	Thailand – Myanmar	2018-2026
12)	Vietnam – Cambodia (New)	
	• Chau Doc – Takeo – Phnom Penh	Existing
	• Tay Ninh – Stung Treng	TBC
13)	<u>Lao PDR – Cambodia</u>	
	• Ban Hat – Kampong Sralao	Existing
	• Ban Hat – Stung Treng	post 2018
14)	Thailand – Cambodia (New)	post 2020
	• Aranyaprathet – Banteay Meanchey	Existing
	• Thailand – Cambodia	post 2020
15)	East Sabah – East Kalimantan	TBC
16)	Singapore – Sumatra	post 2020

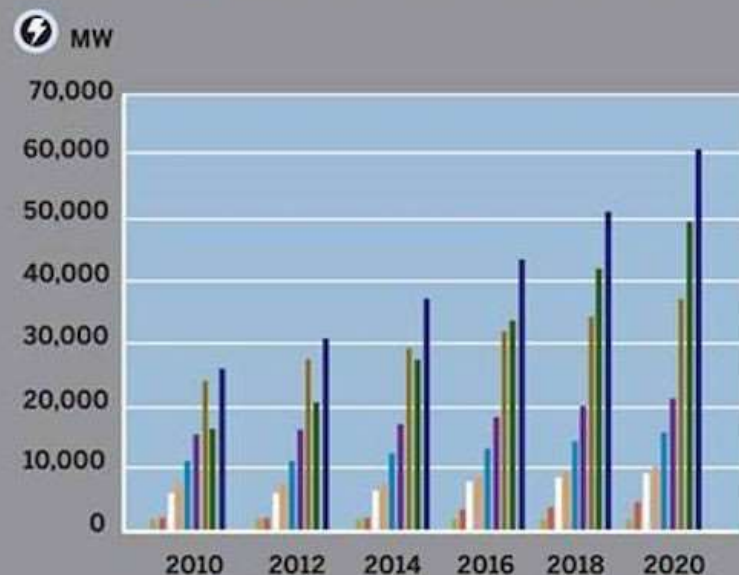
Advantages of ASEAN Power Market Integration

- Increase in security of supply and efficiency with larger service territories for pooling of generating resources, thus taking advantage of generation diversity. This diversity also has ability to aggregate demand
- In the ASEAN context, complete consolidation of power systems is impractical, not least because of geographical factors, but because complete consolidation would mean the establishment of a single market operator with authority that stretches across multiple jurisdictions, requiring changes in national law
- In this case, for ASEAN, coordination is a more preferable option for power market integration

ASEAN POWER GRID

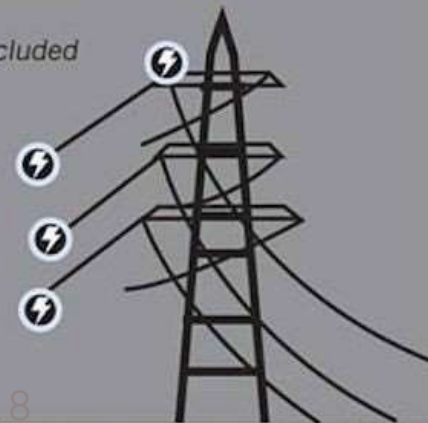


ASEAN'S ELECTRICITY DEMAND



■ Indonesia ■ Malaysia ■ Myanmar
 ■ Vietnam ■ Philippines ■ Laos
 ■ Thailand ■ Singapore ■ Brunei

*Figures for Cambodia not included



Regulatory Framework for ASEAN Power Market Integration

- Regulatory framework plays a critical role in a regional market
- Key responsibilities include establishing electricity security regulations, coordinated planning, allocating costs of transmission development, revising network codes and system monitoring
- It is also critical to define and designate operation and maintenance responsibilities of each regulator early on, to avoid overlap and misunderstanding of roles
- Matters pertaining to cross-border energy transfer must be managed in line with practice in the local electricity market

III. Latest Progress of ASEAN Power Market Integration

ASEAN Cross-border Power Development

- Growth and development result in increase of energy demand/supply beyond national capacity to handle it alone
- At present, several ASEAN countries have achieved bilateral power cooperation by building up several cross-border power transmission lines
- This includes power interconnection between Malaysia and Singapore, Malaysia and Indonesia, Thailand and Lao PDR, Thailand and Cambodia, Lao PDR and Vietnam
- Among the 16 ASEAN Power Grid interconnection projects defined in the APAEC, 8 cross-border electricity transmission projects have been built up with a capacity of 5,212 MW (with added capacity in 2015-16 over 1,723 MW)

ASEAN Cross-border Power Situation



State of ASEAN Power Supply/Demand

- In general, power development is becoming cleaner, there is an increase in the proportion of renewable energy in total power generation
 - Hydropower concentrated in Indonesia, Lao PDR and Vietnam
 - Wind energy in Indonesia, Thailand and Vietnam
 - Solar energy in Indonesia and Thailand
 - Geothermal and biomass power in Indonesia, Malaysia, the Philippines and Thailand
- Fossil energy power generation for installed capacity will rise, but the proportion will fall

State of ASEAN Power Supply/Demand (2)

- Supply/Demand balance as follows
 - Indonesia has relatively more surplus electricity, thus is qualified for export
 - The Philippines and Thailand have certain shortage, thus need support from neighboring countries
 - Cambodia, Malaysia and Vietnam are basically balanced
 - Lao PDR and Myanmar relatively abundant hydropower resources, thus can export
 - Brunei and Singapore, limited option, import renewable from others

Supply and Demand Balance



ASEAN Energy Blueprint

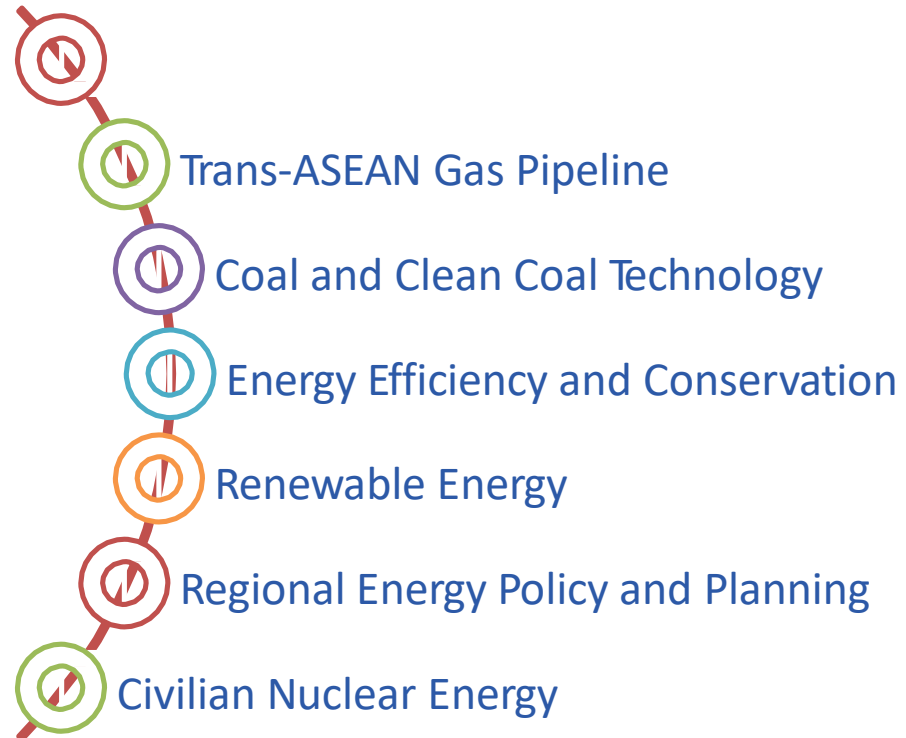
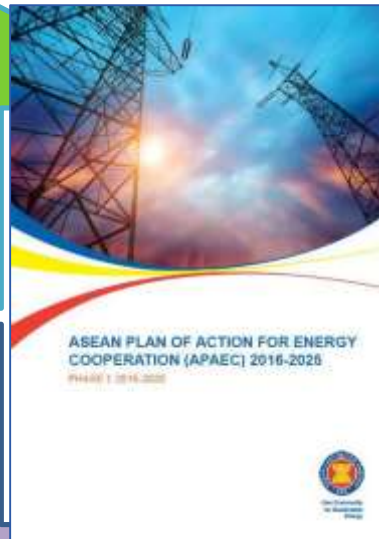
ASEAN Plan of Action for Energy Cooperation (APAEC) 2016-2025

→ “Enhancing Energy Connectivity and Market Integration in ASEAN to Achieve Energy Security, Accessibility, Affordability and Sustainability for All”.

ASEAN Po

Increase RE to
23% by 2025
in TPES.

Reduce EI by
20% in 2020
30% in 2025
based on 2005
level.



34th ASEAN Ministers on Energy Meeting

- Signed MOU to engage and implement the first phase of the “Lao PDR – Thailand-Malaysia-Singapore (LTMS) Power Integration Project (PIP)” by January 2018
- Optimize use of resources and promote economic cooperation on multilateral power interconnection and trading in the region (ASEAN Energy Development Report 2017)
- Enable power trade from Lao PDR to Singapore via existing interconnection of Thailand’s and Malaysia’s grids, which will be considered the first multilateral power trade in ASEAN and pave the way for other power integration projects in ASEAN to follow up
- LTMS-PIP will take into account each country’s national development plan as well as associated law and regulations in order to streamline regional coordination (Bambang Hermawanto, 2015)

35th ASEAN Ministers on Energy Meeting

- ASEAN energy outlook and support to APAEC implementation
 - Launched 5th ASEAN Energy Outlook (AEO5) noting that primary energy demand in ASEAN is expected to grow big as much as 2.3 times by 2040 (Business-as-Usual (BAU) scenario)
 - Substantial energy saving to be achieved through implementation of EE and RE initiatives
 - Robust policies and investments are still needed to transform the energy landscape of ASEAN
- Initiating multilateral electricity trade in ASEAN Power Grid
 - Signing of the Energy Purchase and Wheeling Agreement (EPWA) among Lao PDR, Thailand and Malaysia (LTM) (up to 100 MW)
 - Examine feasibility of expanding bilateral trade to multilateral electricity trade in the AEC, through APG
 - Power sector to contribute significantly its goal of 23% of RE with ASEAN Energy Mix by 2025

ASEAN Power Grid Integration

- HAPUA has established APG institutions to accelerate multilateral electricity trading, namely (ASEAN Energy Report 2017)
 - APG Generation Transmission Planning (AGTP)
 - APG Transmission System Operator (ATSO)
 - With roles and structure of ASEAN Energy Regulatory Network (AERN) and ASEAN Power Grid Consultative Committee (APGCC)
 - Pilot project aims to study multilateral electricity trade of up to 100 MW from Lao PDR to Singapore

Conclusion (1)

- Energy demand will considerably increase, in line with the expected economic and population growth
- Fossil fuels remain to be main sources, but national, regional to global efforts slow its growth while more RE sources are penetrating
- Efforts to integrate energy market in ASEAN is gaining momentum to reflect new trends of efficiency, affordability, accessibility and sustainability, beyond the security per se

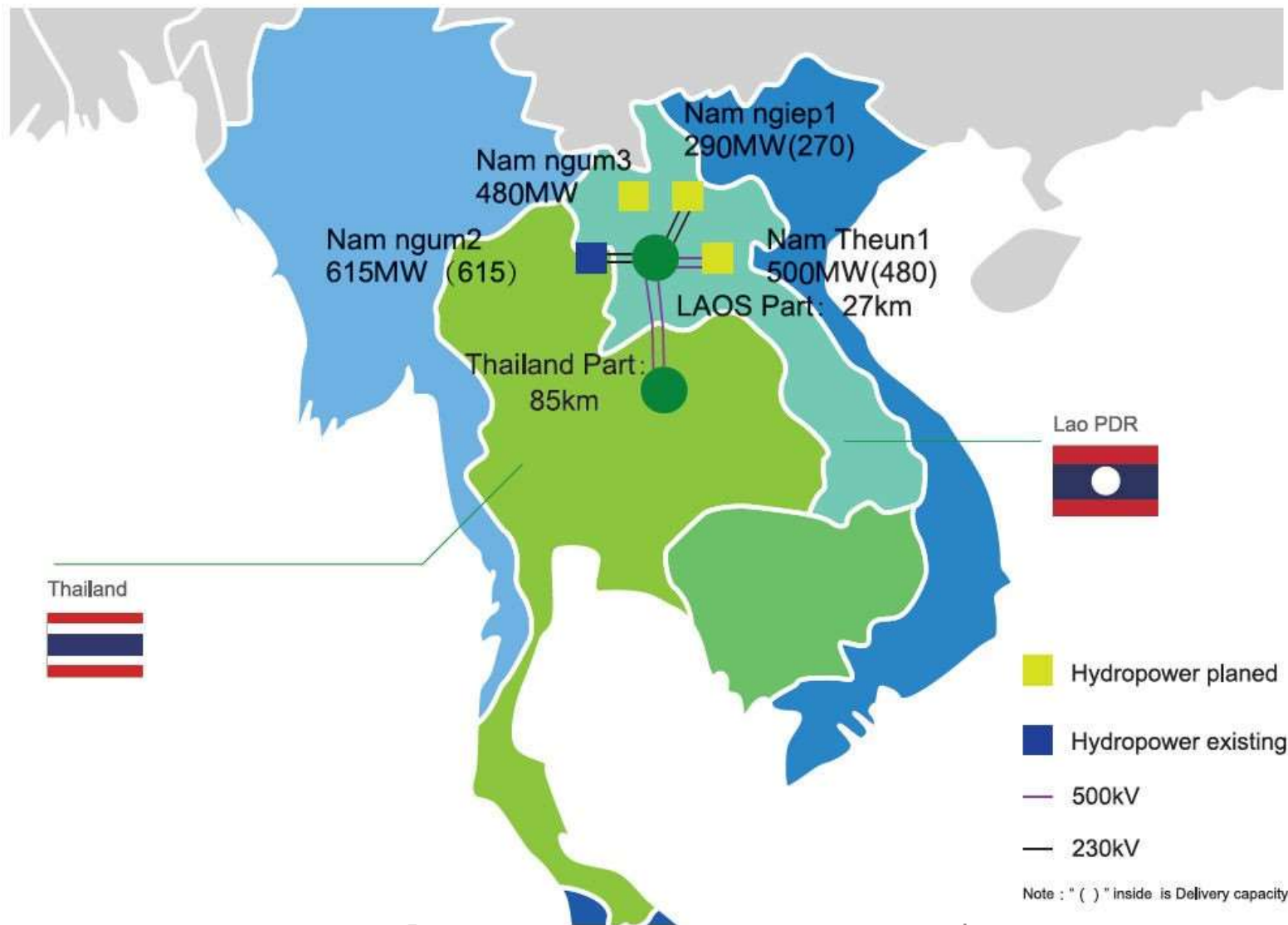


Conclusion (2)

- APAEC (2016-2025) strategies are broad and flexible enough to meet the ever changing regional energy environments and to support the goal of the AEC Blueprint 2025
- The 35th AMEM endorsed the inaugural ASEAN Energy Cooperation Report (AECR) 2017 that also included the ASEAN Power Grid (APG) Integration, in particular, the MOU to engage and implement the first phase of LTMS Power Integration Project (PIP), moving towards a multilateral power trading arrangement
- A fully consolidated regional market may not be achievable in the near future, however, there is room to work closely together to set common long-term goals, with mid-term target to be harmonized of grid codes and reliability standards
- An independent regional regulator (for instance, APGCC and HAPUA) should be established and given a mandate to look after common benefits and interests of the ASEAN member countries

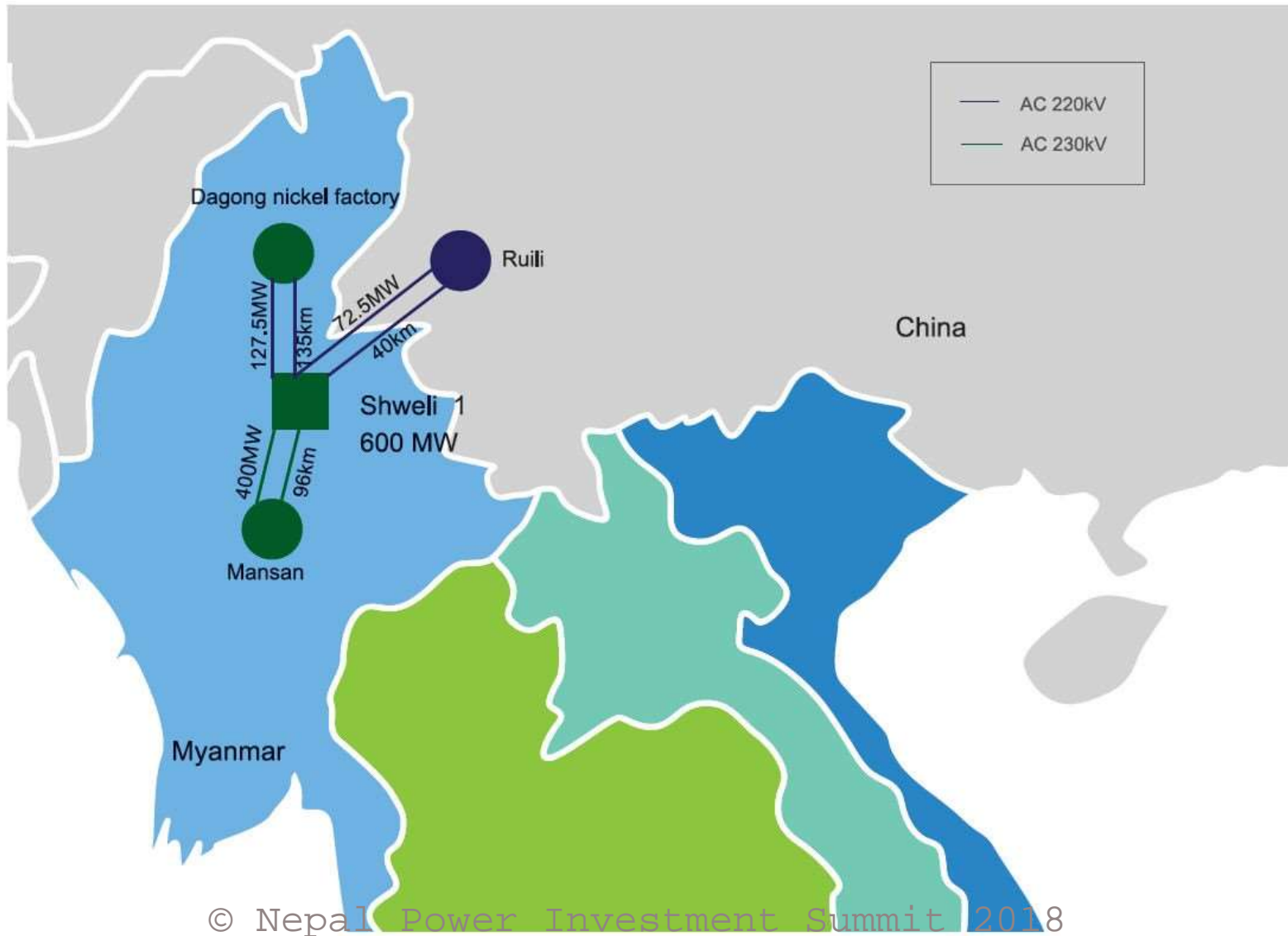
Appendix

Nabong-UdonThani 3,500 kV Grid Connection Project



Shweli River Cascade I

Hydropower Station



Power Grid Integration Projects in Lao PDR, Thailand, Malaysia and Singapore



Lao PDR, Thailand and China Power Integration Project



Sources:

- ACE(2017), The 5th ASEAN Energy Outlook 2015 – 2040
- ACE(2017), ASEAN Energy Cooperation Report 2017
- ACE and CREEI (2017), ASEAN Power Cooperation Report

