Energy Interconnection and Trade of ASEAN and China

Global Energy Interconnection Development and Cooperation Organization
（GEIDCO）

October 2020

1. What is Energy Interconnection

2. Status and Potential of EIT

3. Outlook of EIT

4. Conclusions

1.1 Global Trend

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Global sustainable development faces severe problems.

In June 2019, CO_2 concentration was *415* ppm. The average global temperature in 2018 is already about *1.1* ℃ higher than that before the industrial revolution.

PM2.5 in *64%* cities of the world's exceed the standard. *7* million people die from air pollution every year. *2* billion people short of water.

Coal reserves can be mined for only *130* years, and oil, gas for just *50* years. Soil conditions have deteriorated and forest cover has declined significantly.

730 million people below the international poverty line. Sub-Saharan's GDP per capita is *4%* of OECD's. *840* million people have no access to electricity. *3* billion people depend on firewood for energy.

1.2 What is Energy Interconnection

The Energy Interconnection will provide systematic solutions for addressing climate change and realizing sustainable development of world economy, society and environment.

Global Energy Interconnection is a platform for the application of advanced technologies such as smart grid, UHV power transmission, and clean energy, and promoting the large-scale development, deployment and utilization of clean energy globally.

Clean Replacement

Replace fossil fuels with clean energy such as hydropower, solar and wind energy.

Electricity Replacement

Replace coal, oil, gas and firewood with electricity generated from clean energy.

One Increase

Increase in the proportion of electric energy in final energy consumption by 1%.

One Restore

Fossil energy will be used as traditional industrial raw materials.

One Conversion

CO_2, water will be converted to fuels and raw materials such as hydrogen, methane through the electricity.

1.3 Research Findings

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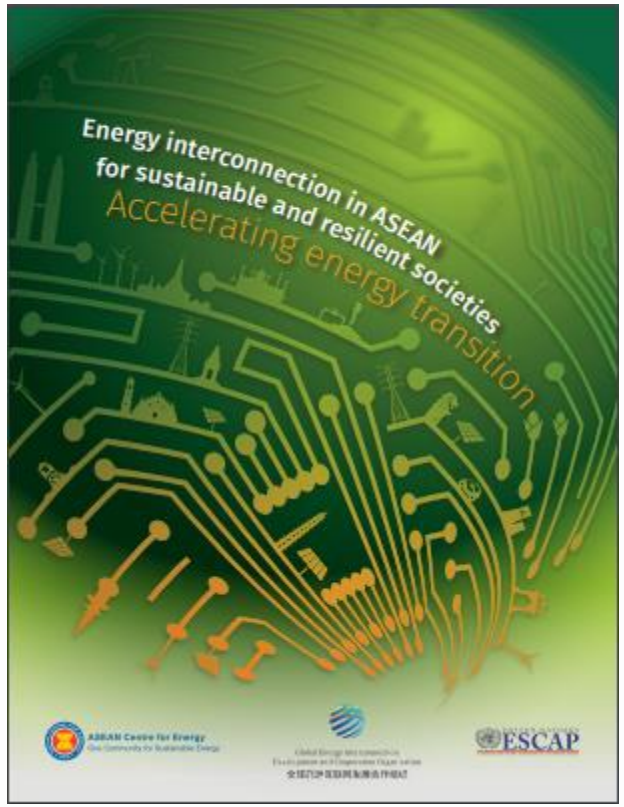
- Energy interconnection in ASEAN for sustainable and resilient societies: Accelerating energy transition
- Global Energy Interconnection Research Report Series



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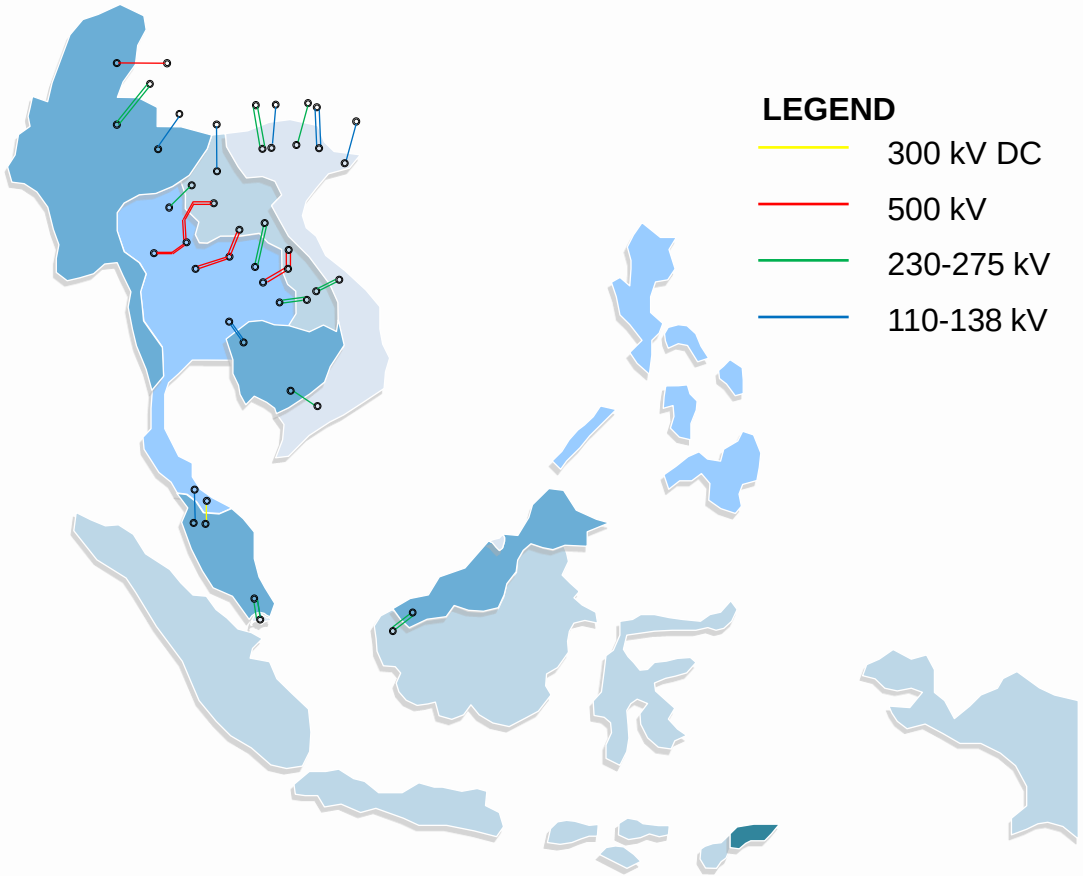
2.1 Current Status of Energy Interconnection and Trade

- Cross-border power trade is at a modest level.
- In 2016, the power trade reached a total amount of 5.2 GW, which is equivalent to 2.5 per cent of the total installed capacity 2015. In 2017, power trade increased to 5.5 GW, equivalent to approximately 2.7 per cent of total installed capacity.
- ASEAN has exchanged a cumulative 51.7 TWh electricity with Yunnan and Guangxi provinces in China by the end of 2017.
- Only 7 of the existing cross-border transmission lines are at the 500 kV level. The other transmission lines are 230 kV, 110 kV and below.



Current status of the energy interconnection in Southeast Asia

2.2 Drivers and Challenges

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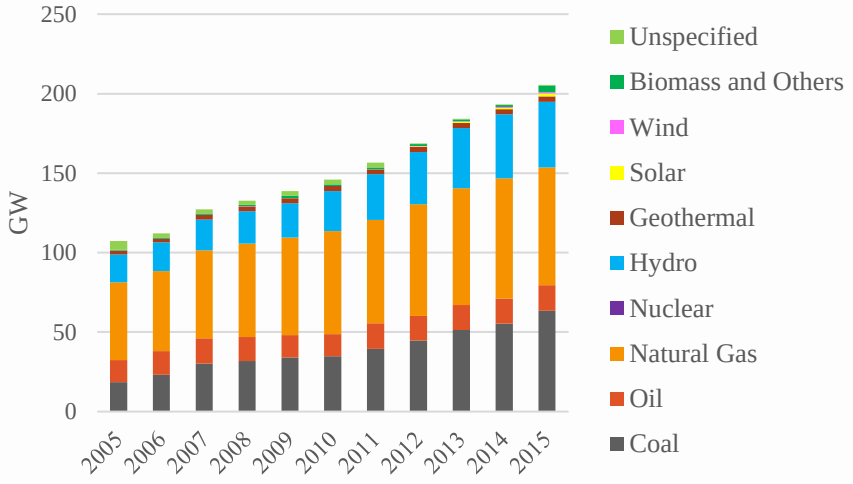
■ Drivers

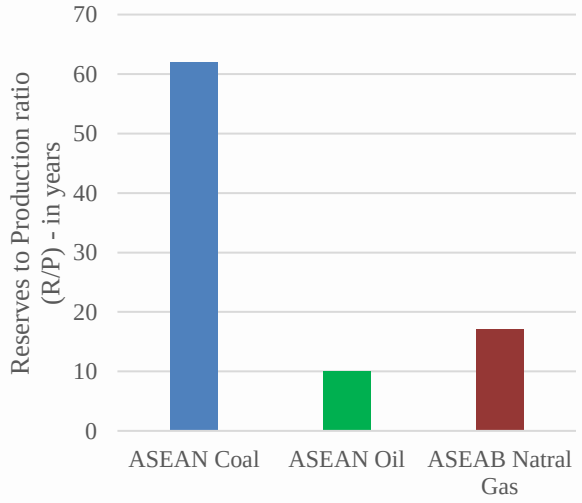
- ✓ Economy continues to grow rapidly
- ✓ Industrial Structure upgrade
- ✓ Abundant Clean Energy Resources

■ Challenges

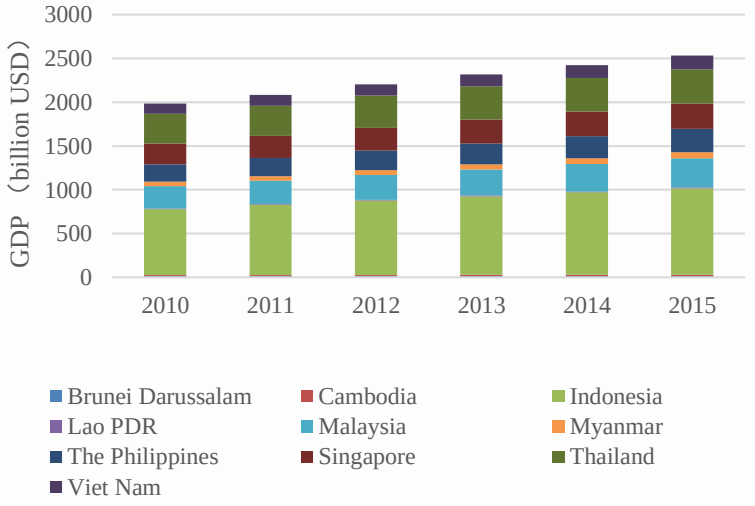
- ✓ Fossil fuels are running out
- ✓ Environment issues become increasingly sever
- ✓ Geographic and temporal mismatches



Trend of generating capacity in Southeast Asia



Ratio of reserves to production in Southeast Asia



GDP growing trend in 10 Southeast Asian Countries

2.3 Principle

■ Coordinate Development of Clean Energy & Power Grid

✓ Overall planning of power supplies shall be made to optimize generation allocation, promote intensive development of power supplies.

■ Coordinate Markets at Supply & Demand Sides

✓ Coordinate export scale and local electricity demand at the supply side and import scale and local generation at the demand side to ensure the electricity is transmittable and receivable.

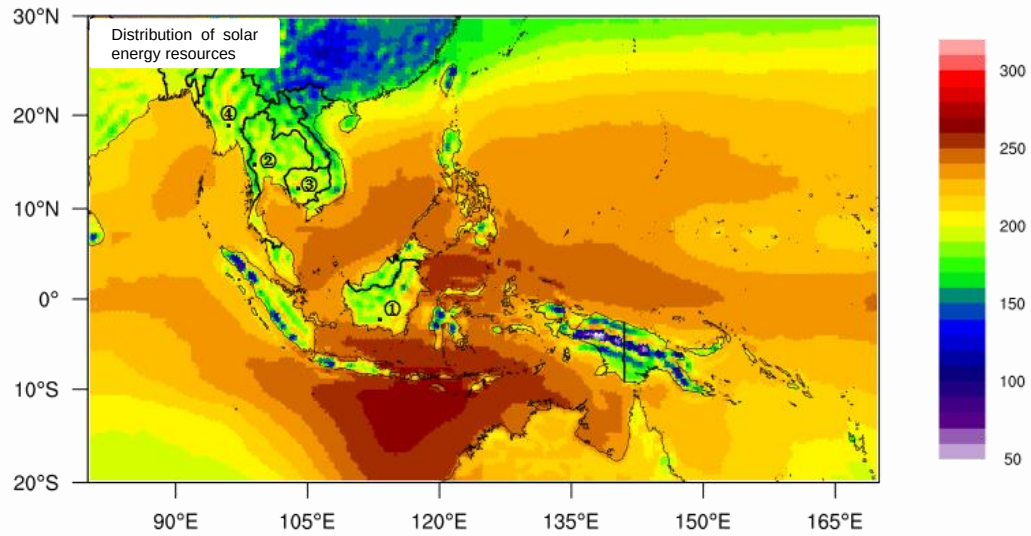
■ Coordinate Regional & Cross-regional Interconnection

✓ It is advised to accelerate the construction and development of regional power grid, establish power grid interconnection among ASEAN, China and South Asia to meet the needs of electricity complementation and expand the scope of clean energy consumption.

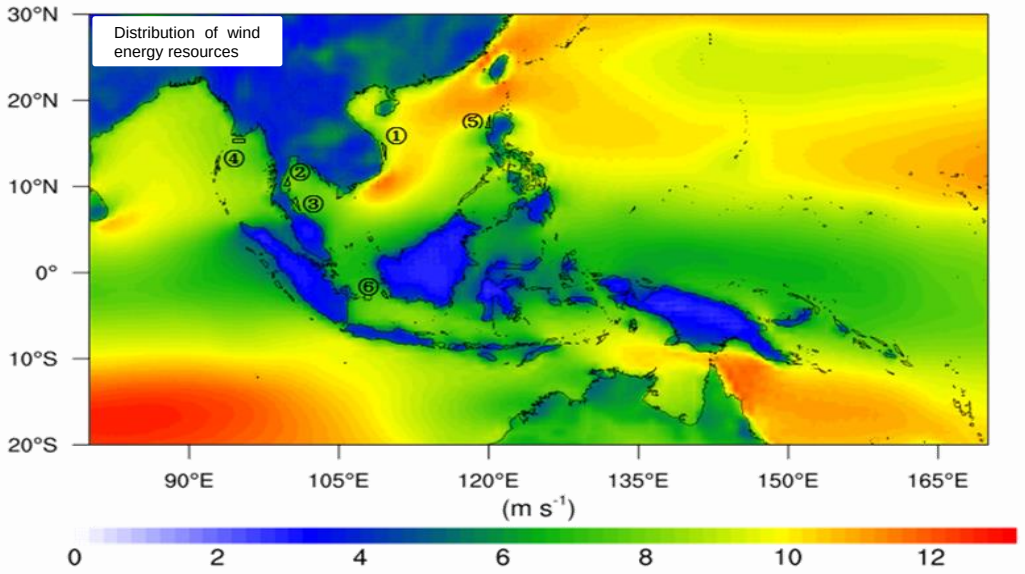
2.4 Layout & Development of Clean Energy

- **Abundant Clean Energy.** The solar irradiation intensity is 200~250 W/m^2. The average wind speed in coastal areas of Myanmar, Thailand, Viet Nam and the Philippines can reach 8~11 m/s. Hydro energy resource is mainly distributed in Irrawaddy, Salween, Mekong, and Kalimantan.
- **Coordination of centralized and distributed development.**

Diagram of clean energy bases distribution in Southeast Asia



Solar irradiation distribution in Southeast Asia（W/m²）



Wind speed distribution in Southeast Asia

2.5 Scenarios of EIT

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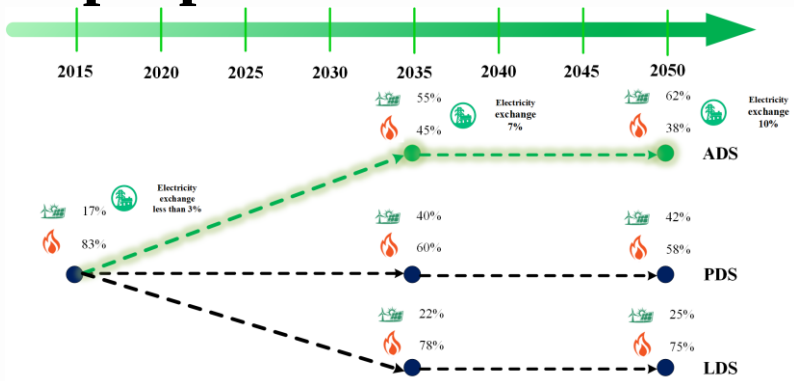
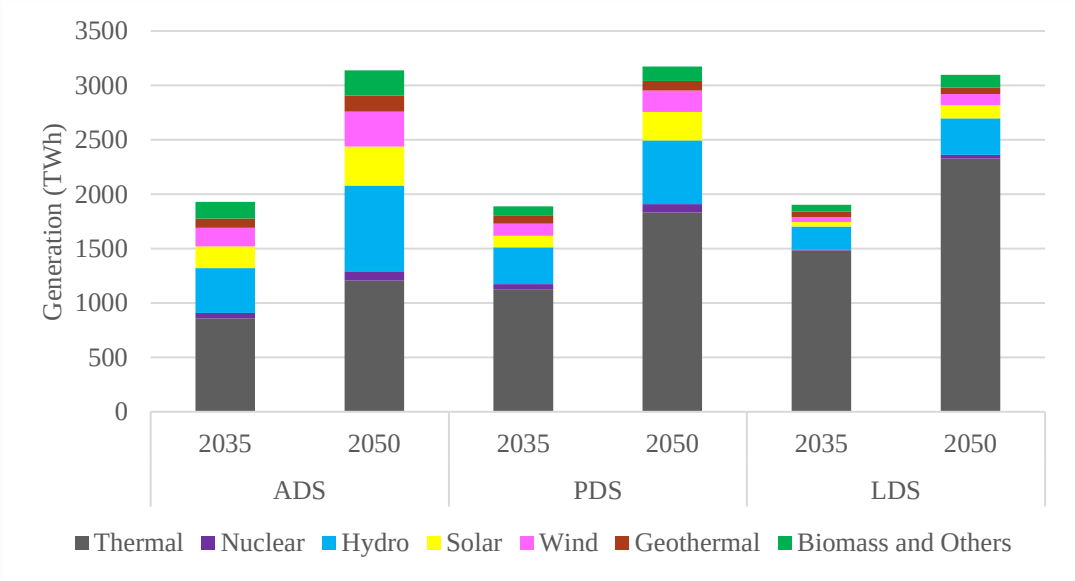
■ Three clean energy development scenarios are proposed

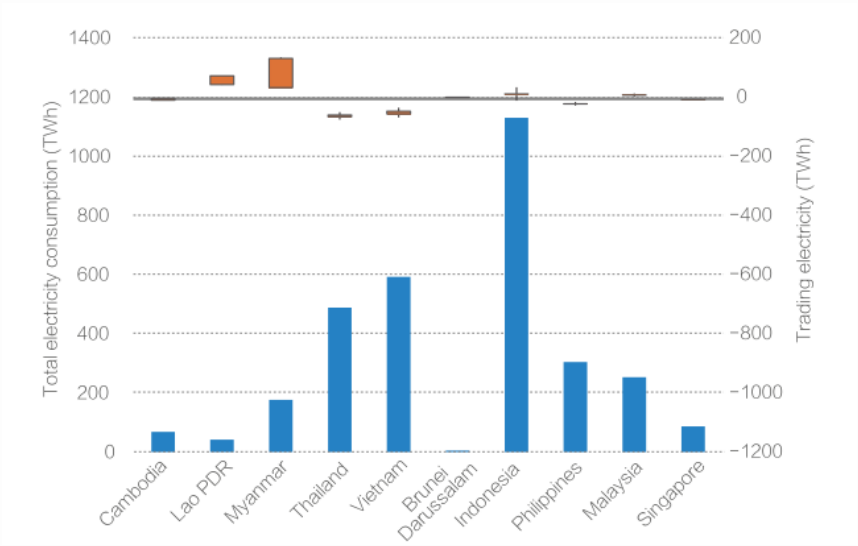
- ✓ Accelerated Development Scenario (ADS)
- ✓ Progressive Development Scenario (PDS)
- ✓ Low-speed Development Scenario (LDS)



Roadmap of Southeast Asia Energy Interconnection development



Generation mix in different scenarios



Balance in 2050

2.6 Potential of Energy Interconnection and Trade

- **Across the region**, Southeast Asia, together with China and South Asia, will achieve multi-energy complementation and solve the seasonal variation of power supplies.
- **Within ASEAN**, the power is transmitted from north to south in **CLMTV**. In the **BIMPS**, the power is transmitted from center to rim.

✓ **In 2035, countries will preliminarily build a regional power grid in Southeast Asia through bilateral and multilateral interconnection.**

✓ **In 2050, the ASEAN power grid will become the hub connecting China and South Asia.**

Diagram of regional electricity exchange

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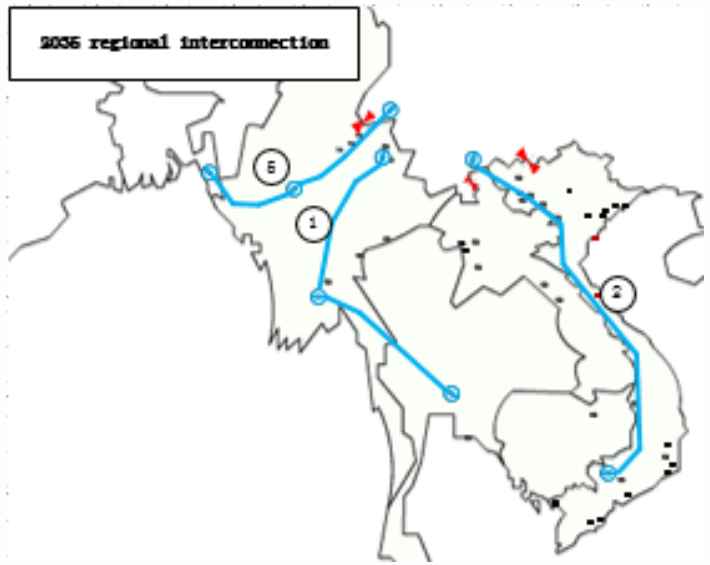
3.1 Interconnection Scheme

■ In 2035

✓ **Within ASEAN: In CLMTV**, a 500 kV synchronous AC grid could be built covering Myanmar, Lao PDR, Viet Nam and Thailand. **BIMPS** will form three synchronous power grids,.

✓ **Across the region: To the north**, Southeast Asia connects with Yunnan, China with 3 back-to-back DC projects. By constructing Yunnan-Ho Chi Minh DC transmission project, the electricity demand in the south Viet Nam will be met. **To the west**, it connects with South Asia by a China-Myanmar-Bangladesh DC transmission project.



2035 regional interconnection

3.1 Interconnection Scheme

- **In 2050, across the region**

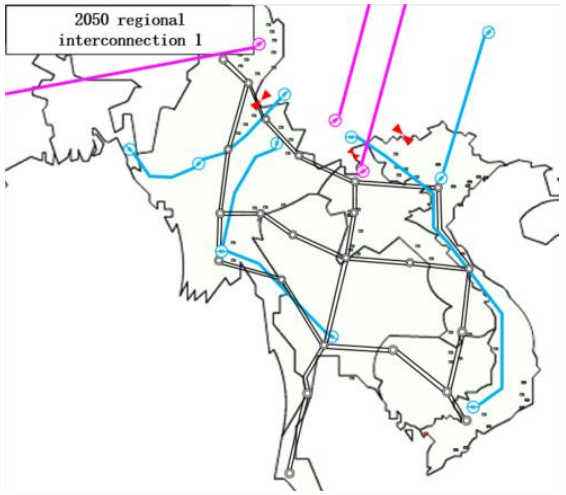
✓ **Southeast Asia-China**: build a Zhengzhou, China-Phongsali, Lao PDR ±800 kV UHVDC transmission project and a Liupanshui, China-Hanoi, Viet Nam ±660 kV HVDC transmission project to exchange power with China.

✓ **Southeast Asia-South Asia**: a Myanmar-India ±800 kV UHVDC transmission line is proposed to send electricity to load centers in central and eastern India.

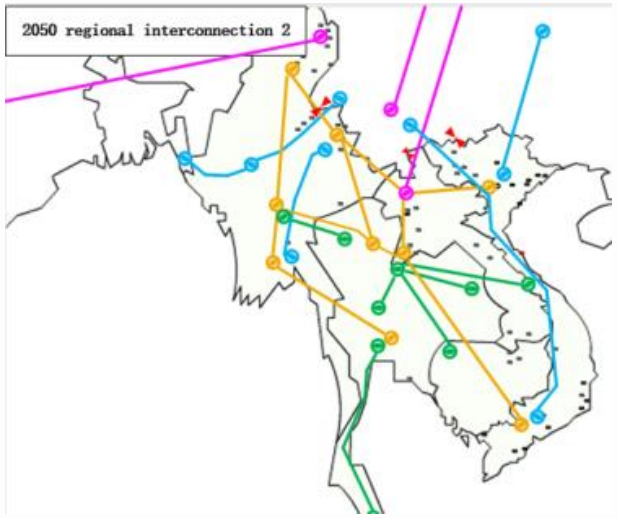
- **In 2050, within ASEAN**

✓ **CLMTV, Option 1：** could construct a 1000 kV UHV backbone grid with three horizontal and three vertical corridors. **Option 2：** a ±800 kV flexible DC backbone grid with the structure of two loops could be formed in Myanmar, Lao PDR and Thailand.

✓ **BIMPS** maintain three synchronous power grids. On Kalimantan island, a 500 kV grid could be built, with the construction of 6 transmission projects sending clean energy to the surrounding load centers.



2050 regional interconnection 1



2050 regional interconnection 2

3.2 Recommended Pilot Projects

- **China-Myanmar-Bangladesh Interconnection Project:** ±660 kV three-terminal DC with a capacity of 4 GW,
- **China-Viet Nam Interconnection Project:** ±660 kV DC with a capacity of 4 GW.

CMB Interconnection Project

China-Viet Nam Interconnection Project

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Energy and electricity cooperation is the core for the regional cooperation and clean development of this area. The key of cooperation is to establish the **energy interconnection**. In specific, the first emphasize should be laid on replacing the traditional **energy development mode** relying on fossil fuel and local balance by a new mode focusing on clean energy and wide-area optimal allocation. Other important contents to ensure the **energy security** and **sustainable development** in the area include the construction of large-scale **clean energy bases**, the establishment of a **strong interconnected grid**, and the **clean development and transition** in the countries.

The region is of great value and prospect, and its implementation is necessary for the region. To achieve that, the **consensus** must be reached among the stakeholders and their efforts must be concentrated on enhancing the **policy-making coordination** and improving the **mechanism for bilateral and multilateral cooperation**. To be specific, a **regional electricity market** should be built, **innovations** should be made in investing and financing aspects, and the **pilot projects** of clean energy utilization and grid interconnection should be implemented in the near future.

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Make joint efforts for innovative development, and create a beautiful future together