ASEAN Power Grid Interconnections Project Profiles

Prepared by:
ASEAN Centre for Energy (ACE) in collaboration with Heads of ASEAN Power Utilities/Authorities (HAPUA) Working Group 2

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Overview of the ASEAN Power Grid Interconnections Project Profile

Following the directive of the 41st ASEAN Ministers on Energy Meeting (AMEM) to expand multilateral power trading efforts, the ASEAN region aims for greater power grid interconnectivity within the region. As part of the Lao PDR Chairmanship Priority Economic Deliverable (PED) on Energy #8: "Enhance Monitoring for ASEAN Power Grid Interconnectors Project and Attract More Support from DPs/IOs", this APG Interconnection Project Profile is developed to a reference document to share relevant information on the APG interconnection projects to Development Partners and International Organisations, to enable support facilitation for APG infrastructure development in the future.

This APG Interconnection Project Profiles is developed by the ASEAN Centre for Energy (ACE) in close collaboration with the Heads of ASEAN Power Utilities/ Authorities (HAPUA) Working Group 2 (Transmission/ ASEAN Power Grid). The Project Profile is a high-level summary of the ASEAN Power Grid interconnection projects, which is identified through the ASEAN Interconnection Masterplan Study (AIMS) III Phase 1 and 2 (2020 – updated in 2022) and from the updated information collected through the 7th HAPUA Working Group 2 Meeting on 16 August 2024.

The ASEAN Interconnection Masterplan Study (AIMS) III released in 2020, identified eighteen (18) priority interconnection projects under APG which each will be explained in further detail under this document which includes information on each interconnector, namely the map of the interconnection, project overview, high-level technical specifications, and the potential renewable energy sites that could be utilised for cross-border power exchange via the interconnections. The lists of the 18 ASEAN Power Grid interconnection projects are shown in Table 1. This Project Profile only contain the existing or plan grid-to-grid interconnection in the ASEAN region.

It is expected that by publicly releasing this document, ASEAN stakeholders can monitor the status of each interconnector, promoting transparency in the development process of the ASEAN Power Grid. Moreover, it is expected that this document could provide an overview of APG development priorities for financial institutions, development partners, and international organisations interested in supporting the development of APG in various ways. Researchers and academia are also expected to benefit from conducting future research related to the APG.

Table 1 – List of Priorities Project under the ASEAN Power Grid as Identified under the ASEAN Interconnection Masterplan Study (AIMS) III

No	Connection	Interconnection Capacity (in MW)				
		Existing**	Ongoing (Up to 2024)**	Future**	Total**	AIMS III Projection (2040)*
1	Peninsular Malaysia – Singapore	525	525	TBC	1,050	1,050
2	Thailand – Peninsular Malaysia	380	-	TBC	380	1,043
3	Sarawak –Peninsular Malaysia	-	-	1,600	1,600	695
4	Peninsular Malaysia – Sumatera	-	-	600/ TBC	600	2,130
5	Batam – Singapore***	-	-	3,400	3,400	
6	Sarawak – West Kalimantan	230	-	-	230	777
7	Philippines – Sabah	-	-	500	500	196
8	Sarawak – Brunei – Sabah					
	• Sarawak – Brunei	-	TBC	TBC	TBC	TBC
	• Sarawak – Sabah	-	30 – 50	-	30 – 50	177
9	Thailand – Lao PDR	955	-	TBC	955	700
10	Lao PDR – Vietnam	-	-	TBC	TBC	625
11	Thailand – Myanmar	-	-	365	365	1,262
12	Vietnam – Cambodia	200	-	TBC	200	1,353
13	Lao PDR – Cambodia	300	-	TBC	300	625
14	Thailand – Cambodia	250	-	650	900	1,315
15	East Sabah – North Kalimantan	-	-	TBC	TBC	174
16	Singapore – Sumatera	-	-	TBC	TBC	1,133
17	Lao PDR – Myanmar	30	-	100 – 600	130 – 630	624
18	Internal Indonesia					
a	Kalimantan – Java	-	-	TBC	TBC	435
b	Sumatera – Java	-	-	2,600	2,600	10,000
TOTAL (MW)		**2,870**	**555 – 575**	**9,815-10,335**	**13,240-13,780**	**24,585**

**The AIMS III Projection data referred to the ASEAN RE Target Scenario projection of AIMS III Phase 1 and 2 (2020).*
***The data is based on the latest updates from HAPUA Working Group 2 (per 16 September 2024), which only includes grid-to-grid interconnection project.*
****Batam – Singapore was merged into Sumatera – Singapore Interconnection, based on AMS inputs.*

Disclaimer:

- *The list of interconnection projects is based on the country priorities and the result of assessments done in AIMS III Phase 1 and 2 (2020 – updated in 2022).*
- *The data on this project profile are subject to update (if there is update on AIMS or additional project nominations from the ASEAN Member States)*
- *The map of interconnections shown in this project profile is for illustrative purposes only, they don't reflect the exact substation locations.*
- *The potential renewable energy sites listed in the interconnection project sections are based on the RE resource assessment of AIMS III Phase 1 (2020), which identifies particularly vRE potential (solar and on-shore wind only) to be utilised in the region using APG. Other types of renewable energy generation is following of what stated in each country PDP.*

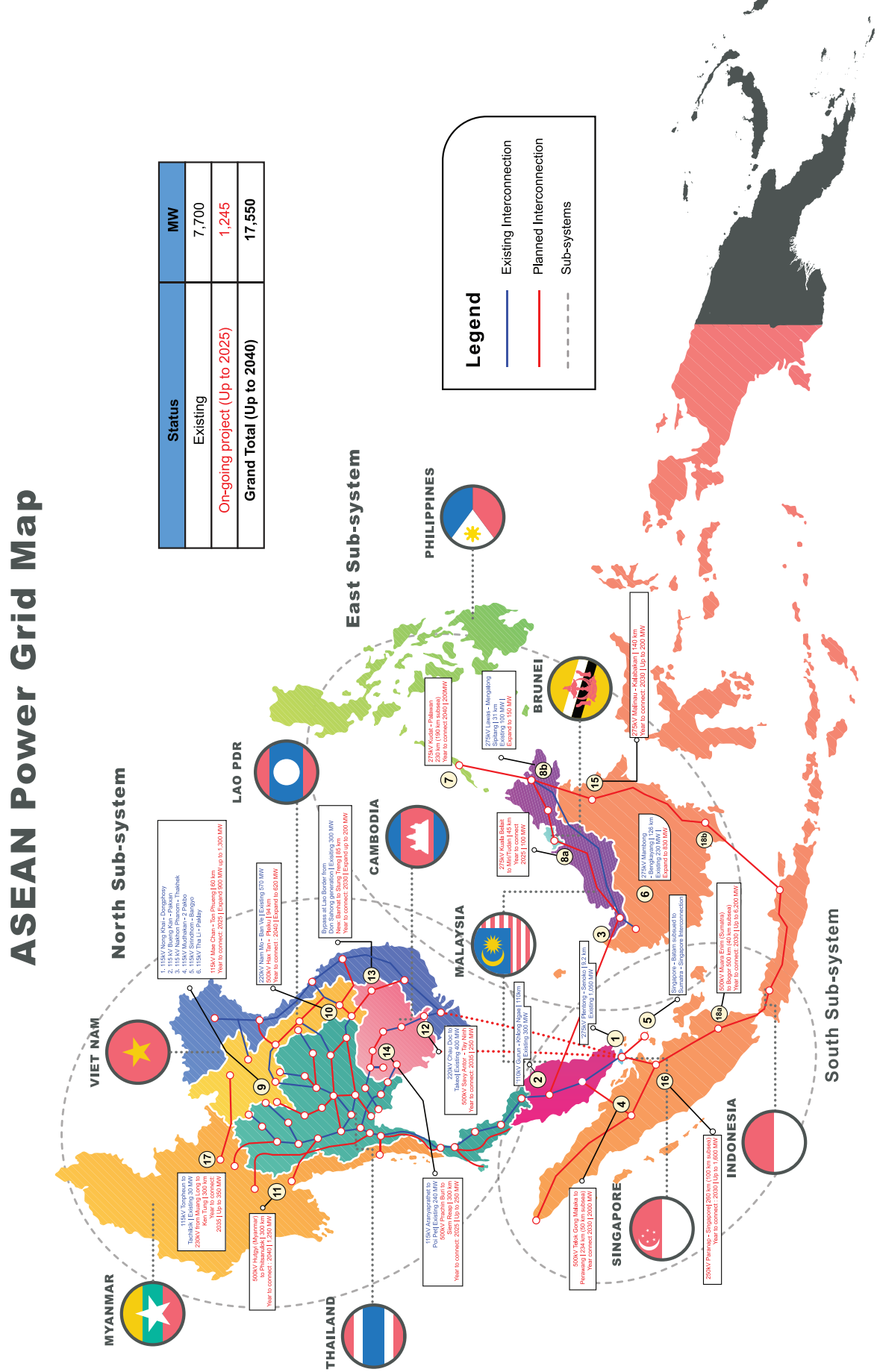


Figure 1 – Map of the Interconnections under the ASEAN Power Grid (APG) – to be updated.

**The total interconnection capacity shown in the map includes generation-to-grid/ gen-tie interconnection (5,914 MW out of 7,700 MW).*

Details of the APG Prioritised Interconnections

1. Peninsular Malaysia – Singapore

Type : **Existing & Planned**

Implementing agency : **Tenaga Nasional Berhad (TNB) & SP Group (Singapore Power)**

Reference studies : **AIMS III Phase 1 and 2 (2020 – updated in 2022)**

MAP OF THE INTERCONNECTION

PROJECT OVERVIEW

The Peninsular Malaysia – Singapore interconnection is a crucial grid-to-grid interconnection project in enabling over 266 GWh of electricity traded under the Lao PDR-Thailand-Malaysia-Singapore Power Integration Project (LTMS-PIP). Phase II of the power integration project is currently being discussed among the member countries with the possibility of increasing the power trading capacity. Therefore, the AIMS III studies underlined the need to expand the existing interconnection capacity to allow higher renewable energy exchange in Singapore, increasing its security of supply. Currently, no ongoing feasibility studies are being conducted to assess the need for transmission line capacity uprating.

TECHNICAL SPECIFICATIONS

- **Existing Interconnection**

Connecting substations	:	Plentong (MY) – Woodlands (SG)
Interconnection Arrangement	:	Energy Exchange
Voltage	:	230 kV
Transmission System Type	:	HVAC
Line Capacity	:	525 MW
Commercial Operating Date	:	1985

- **Planned Interconnection**

Connecting substations	:	Plentong (MY) – Woodlands (SG)
Interconnection Arrangement	:	Power Purchase from Malaysia to Singapore
Voltage	:	230 kV
Transmission System Type	:	HVDC
Line Capacity	:	525 MW
Commercial Operating Date	:	TBC

IDENTIFIED POTENTIAL RENEWABLE ENERGY SITES (AIMS III)

Potential Solar Sites

Province	Total Area (Acres)	Developable Area (Acres)	Approx. Capacity (MWDC)	Average GHI (kWh/ m2 /year)	Annual Average Net Energy (GWh)	Annual Average Net AC Capacity Factor (%)
Kangar Perlis	6,378	4,465	810	1,795	1,107.59	19.50%

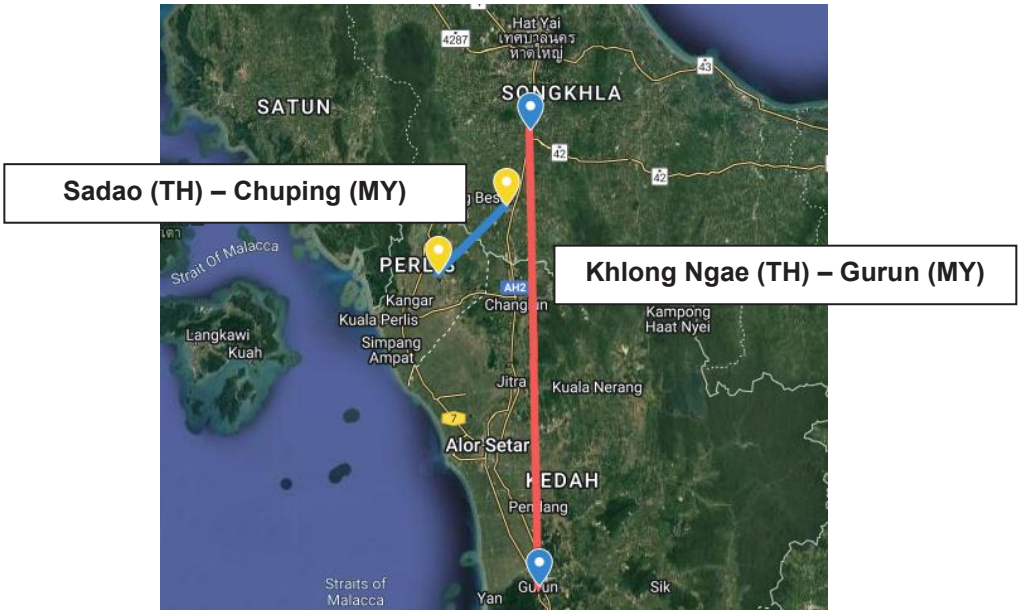
2. Thailand – Peninsular Malaysia

Type : **Existing & Planned**

Implementing agency : **Electricity Generation Authority of Thailand (EGAT) & Tenaga Nasional Berhad (TNB)**

Reference studies : **AIMS III Phase 1 and 2 (2020 – updated in 2022)**

MAP OF THE INTERCONNECTION



PROJECT OVERVIEW

The Thailand – Peninsular Malaysia interconnection has been established and has been in service since June 2002. A 300 MW capacity was constructed to connect Thailand and Peninsular Malaysia via a grid-to-grid 300 kV HVDC overhead transmission line. The existing interconnection spans around **110** km from a substation in Khlong Ngae, Thailand to Gurun East in Malaysia. The interconnection allows the energy exchange under the LTM-PIP Phase 1 and 2, as well as the LTMS-PIP which measures around 266 GWh as of June 2024.

The existing HVDC converter stations face obsolescence issues and the system is expected to expire in 2027. Therefore, EGAT and TNB have already done pre-feasibility studies on the interconnection line and are currently waiting for approval from both authorities. It is expected that the interconnection capacity will reach 1,043 MW by 2040, based on the ASEAN RE target scenario of AIMS III.

TECHNICAL SPECIFICATIONS

- **Existing Interconection**

  i. Sadao - Chuping

Connecting substations	:	Sadao (TH) – Chuping (MY)
Interconnection Agreement	:	Energy Exchange
Voltage	:	115/132 kV

Transmission System Type	:	HVAC
Line Capacity	:	80 MW
Commercial Operating Date	:	1980
Line Length	:	24.7 km
Line Type	:	477 MCM ACSR

ii. Khlong Ngae – Gurun

Connecting substations	:	Khlong Ngae (TH) – Gurun (MY)
Interconnection Agreement	:	Energy Exchange
Voltage	:	300 kV
Transmission System Type	:	HVDC
Line Capacity	:	300 MW
Commercial Operating Date	:	2002
Line Length	:	110 km
Line Type	:	954-54/7 KCMIL CARDINAL ACSR

- **Planned Interconection**

Connecting substations	:	Khlong Ngae (TH) – Gurun (MY)
Interconnection Agreement	:	Energy Exchange
Voltage	:	TBC
Additional Line Capacity	:	TBC
Commercial Operating Date	:	TBC
Line Length	:	TBC
Line Type	:	TBC

IDENTIFIED POTENTIAL RENEWABLE ENERGY SITES (AIMS III)

Potential Solar Sites

Province	Total Area (Acres)	Developable Area (Acres)	Approx. Capacity (MWDC)	Average GHI (kWh/ m2 /year)	Annual Average Net Energy (GWh)	Annual Average Net AC Capacity Factor (%)
Kangar, Perlis, Malaysia	6,378	4,465	810	1,795	1,107.59	19.50%
Tambon Tha Chai, Thailand	9,226	6,48	1,180	1,864	1,713.74	20.60%

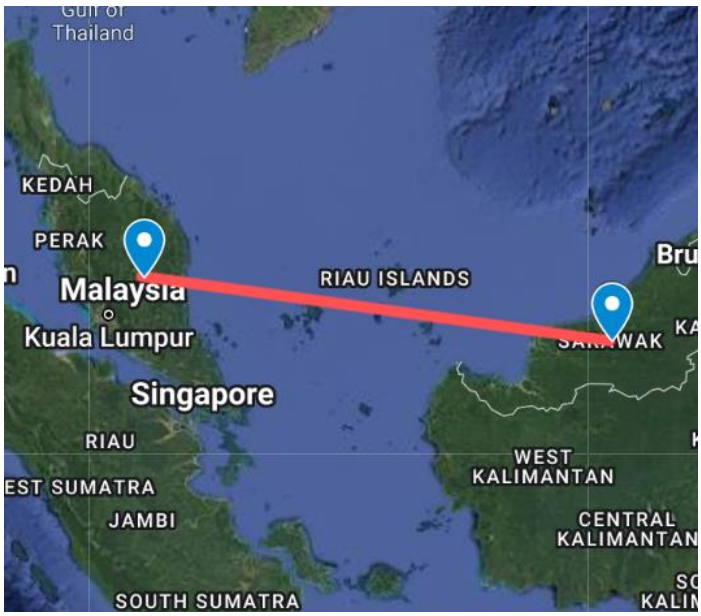
3. Peninsular Malaysia – Sarawak

Type : **Planned**

Implementing agency : **Tenaga Nasional Berhad (TNB) & Sarawak Energy Berhad (SEB)**

Reference studies : **AIMS III Phase 1 and 2 (2020 – updated in 2022)**

MAP OF THE INTERCONNECTION



PROJECT OVERVIEW

The Peninsular Malaysia – Sarawak interconnection was planned long before AIMS III, however no existing interconnection has been constructed. The interconnection plan is to connect Peninsular Malaysia and Sarawak through grid-to-grid HVDC subsea cables, with a planned line capacity of 2 x 800 MW (total of 1,600 MW).

TECHNICAL SPECIFICATIONS

Connecting substations	:	-
Interconnection Agreement	:	Power Purchase from Sarawak to Peninsular Malaysia
Voltage	:	500 kV
Transmission System Type	:	HVDC
Line Capacity	:	2 x 800 MW
Commercial Operating Date	:	TBC
Line Length	:	676 km
Line Type	:	-

IDENTIFIED POTENTIAL RENEWABLE ENERGY SITES (AIMS III)

Potential Solar Sites

Province	Total Area (Acres)	Developable Area (Acres)	Approx. Capacity (MWDC)	Average GHI (kWh/ m2 /year)	Annual Average Net Energy (GWh)	Annual Average Net AC Capacity Factor (%)
Kangar, Perlis, Malaysia	6,378	4,465	810	1,795	1,107.59	19.50%
Sri Aman, Sarawak, Malaysia	9,042	6,329	1,150	1,645	1,443.55	18.00%

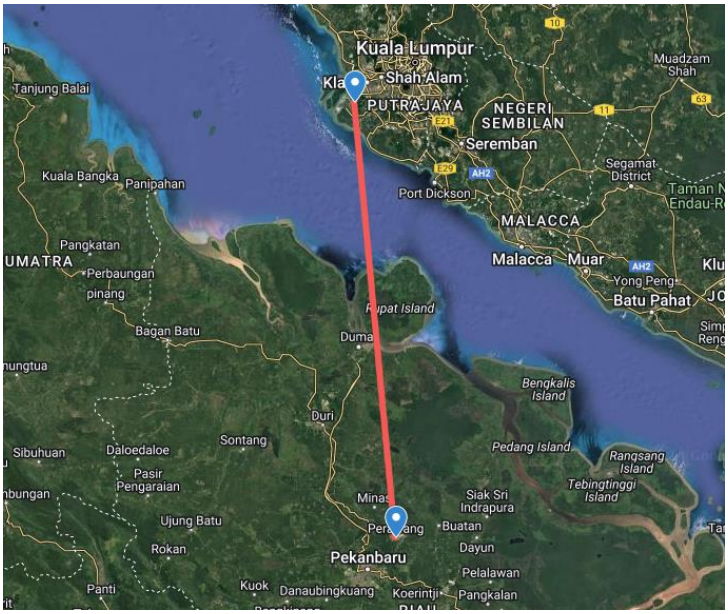
4. Peninsular Malaysia – Sumatera

Type : **Planned**

Implementing agency : **Tenaga Nasional Berhad (TNB) & PT Perusahaan Listrik Negara (Persero) (PLN)**

Reference Studies : **AIMS III Phase 1 and 2 (2020 – updated in 2022)**

MAP OF THE INTERCONNECTION



PROJECT OVERVIEW

The Peninsular Malaysia – Sumatera interconnection has not been constructed yet, although currently a feasibility study is being conducted to assess the technical, commercial, environmental, economic, and regulatory aspects of the interconnection under the grant from U.S. Trade and Development Agency (USTDA). The grid-to-grid interconnection will connect Sumatera through a 500 kV substation in Perawang to Telok Gong Malaka via HVDC overhead transmission lines (for the land transmission) and HVDC subsea cables (to cross the strait of Malaka).

TECHNICAL SPECIFICATIONS

Connecting substations	:	Telok Gong (MY) – Perawang (ID) (Melaka - Pekan Baru (Suggested by AIMS-II, Priority Project)
Interconnection Agreement	:	Energy Exchange (PP)
Voltage	:	500 kV (250 kV)
Transmission System Type	:	HVDC
Line Capacity	:	600 MW (TBC)
Commercial Operating Date	:	TBC
Line Length	:	234 km
Line Type	:	-

IDENTIFIED POTENTIAL RENEWABLE ENERGY SITES (AIMS III)

Potential Solar Sites

Province	Total Area (Acres)	Developable Area (Acres)	Approx. Capacity (MWDC)	Average GHI (kWh/ m2 /year)	Annual Average Net Energy (GWh)	Annual Average Net AC Capacity Factor (%)
Kangar, Perlis, Malaysia	6,378	4,465	810	1,795	1,107.59	19.50%
Lampung, Indonesia	34,248	23,974	4,360	1,681	5,519.25	18.00%

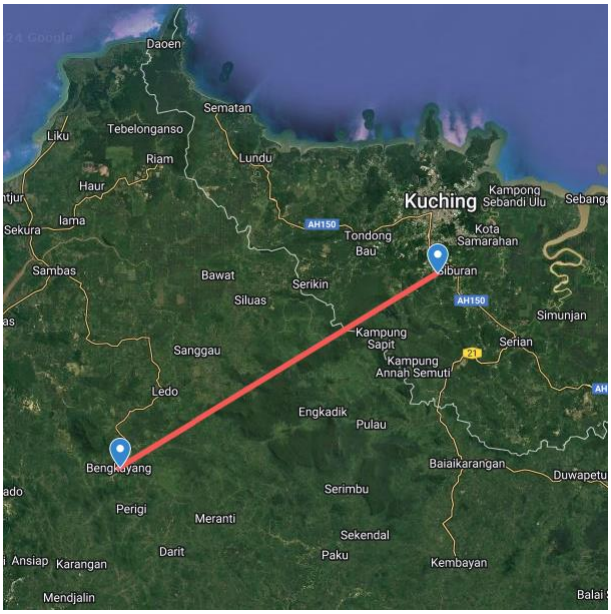
5. Sarawak – Kalimantan

Type : **Existing**

Implementing agency : **Sarawak Energy Berhad (SEB) & PT Perusahaan Listrik Negara (Persero) (PLN)**

Reference Studies : **AIMS III Phase 1 and 2 (2020 – updated in 2022); ADB (2013)**

MAP OF THE INTERCONNECTION



PROJECT OVERVIEW

The Sarawak and Kalimantan interconnection was first commercially operated on 31 December 2015, enabling electricity export of up to 230 MW from Sarawak to West Kalimantan. The power exchange was done under the Power Exchange Agreement (PEA) between SESCO (now Sarawak Energy) and PT PLN (Persero) via Mambong (MY) to Bengkayang (ID) using a 275 kV HVAC transmission system. Currently, there are no existing plans to upgrade the interconnection capacity, although the AIMS III study suggested that the interconnection capacity should be expanded to 830 MW in the future.

TECHNICAL SPECIFICATIONS

Connecting substations	:	Mambong (Sarawak/MY) – Bengkayang (W. Kalimantan/ID)
Interconnection Agreement	:	Energy Exchange
Voltage	:	275 kV
Transmission System Type	:	HVAC
Line Capacity	:	230 MW
Commercial Operating Date	:	2015
Line Length	:	128.2 km
Line Type	:	Twin Drake (2 x 600 MVA) and Twin Zebra (2 x 600 MVA)

IDENTIFIED POTENTIAL RENEWABLE ENERGY SITES (AIMS III)

Potential Solar Sites

Province	Total Area (Acres)	Developable Area (Acres)	Approx. Capacity (MWDC)	Average GHI (kWh/ m2 /year)	Annual Average Net Energy (GWh)	Annual Average Net AC Capacity Factor (%)
Sri Aman, Sarawak, Malaysia	9,042	6,329	1,150	1,645	1,443.55	18.00%
Kalimantan Tengah, Indonesia	54,009	37,806	6,875	1,719	8,949.81	18.70%

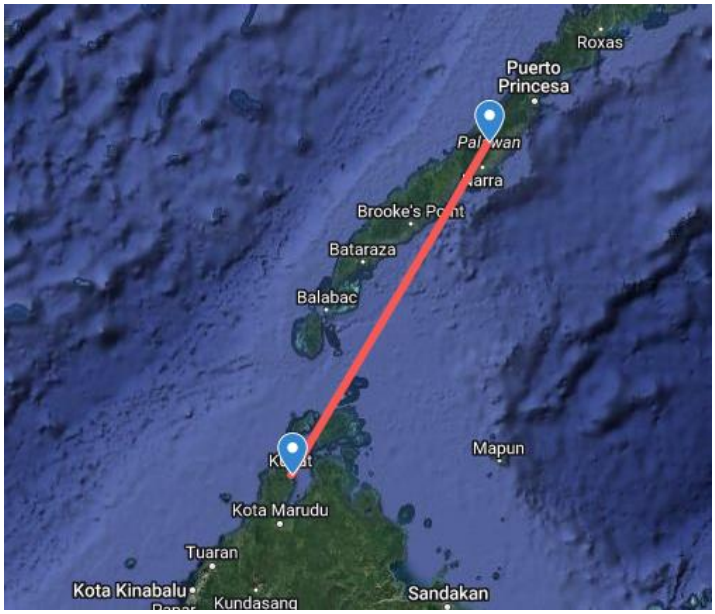
6. Philippines – Sabah

Type : **Planned**

Implementing agency : **Sabah Electricity Sdn Bhd (SESB) & National Transmission Corporation (TransCo)**

Reference studies : **AIMS III Phase 1 and 2 (2020 – updated in 2022); ADB (2014)**

MAP OF THE INTERCONNECTION



PROJECT OVERVIEW

The Philippines – Sabah interconnection would be one of the important grid-to-grid interconnections in the BIMP-PIP initiative, as it will extend the Kalimantan – Sabah interconnection therefore connecting Indonesia, Malaysia, and the Philippines. The planned interconnection will connect the Philippines and Malaysia through the Kudat substation in Sabah, Malaysia to Palawan in the Philippines, via a 275 kV HVDC subsea cable. Based on the ASEAN RE Target Scenario of AIMS III, the 230km interconnection is projected to have an installed capacity of 196 MW by 2040.

TECHNICAL SPECIFICATIONS

Connecting substations	:	Kudat (MY) – Palawan (PH)
Interconnection Agreement	:	Energy Exchange
Voltage	:	TBC
Transmission System Type	:	HVDC
Line Capacity	:	196 MW (TBC)
Commercial Operating Date	:	TBC
Line Length	:	TBC
Line Type	:	-

IDENTIFIED POTENTIAL RENEWABLE ENERGY SITES (AIMS III)

Potential Wind Sites

Province	No. of Turbines	Turbine Rated Capacity (MW)	Hub Height (m)	Plant Capacity (MW)	Average Wind Speed (m/s)	Gross Energy (GWh)	Plant Load Factor (%)
Tigbauan, Iloilo, Philippines	101	5.3	120.9	535.3	6.66	1,718.44	36.6%

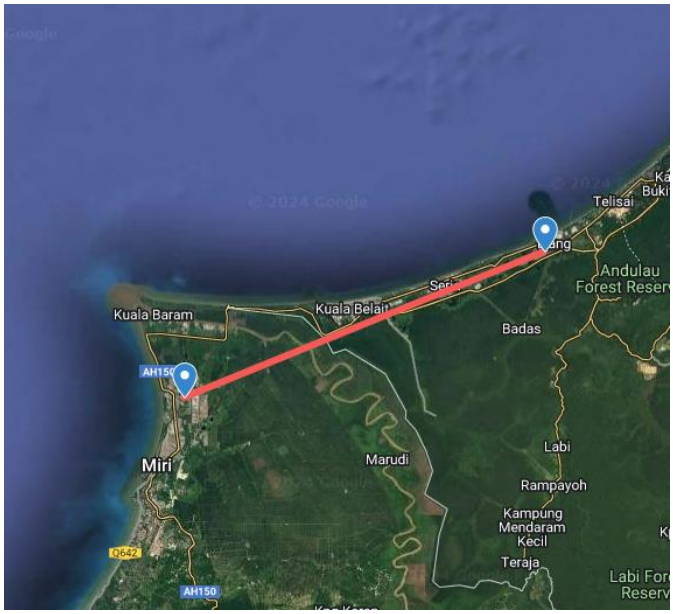
7. Sarawak – Brunei Darussalam

Type : **Planned**

Implementing agency : **Sarawak Energy Berhad (SEB) & Department of Electrical Services (DES)**

Reference Studies : **AIMS III Phase 1 and 2 (2020 – updated in 2022)**

MAP OF THE INTERCONNECTION



PROJECT OVERVIEW

There is no existing interconnection from Sarawak to Brunei Darussalam, although collaborative plans between Sarawak Energy and Brunei's Department of Energy to connect both countries are already in place. The Sarawak – Brunei Darussalam interconnection project is currently undergoing a feasibility study. Brunei Darussalam's Department of Energy and Sarawak Energy Berhad is in the process of establishing the Brunei – Sarawak Working Group committee for the feasibility study, as well as reviewing the draft Power Exchange Agreement (PEA). The grid-to-grid interconnection will connect Sarawak from the Tudan substation in Malaysia to Lumut in Brunei Darussalam through a 275 kV HVAC Overhead Transmission Line, with 45 km in length.

TECHNICAL SPECIFICATIONS

Connecting substations	:	Tudan (Sarawak/MY) – Lumut (BN)
Interconnection Agreement	:	Energy Exchange
Voltage	:	275 kV
Transmission System Type	:	HVAC
Line Capacity	:	TBC
Commercial Operating Date	:	2028
Line Length	:	61 - 74 km
Line Type	:	Twin Yew (2 x 600 MVA) and Twin Drake (2 x 600 MVA)

IDENTIFIED POTENTIAL RENEWABLE ENERGY SITES (AIMS III)

Potential Solar Sites

Province	Total Area (Acres)	Developable Area (Acres)	Approx. Capacity (MWDC)	Average GHI (kWh/ m2 /year)	Annual Average Net Energy (GWh)	Annual Average Net AC Capacity Factor (%)
Sri Aman, Sarawak, Malaysia	9,042	6,329	1,150	1,645	1,443.55	18.00%

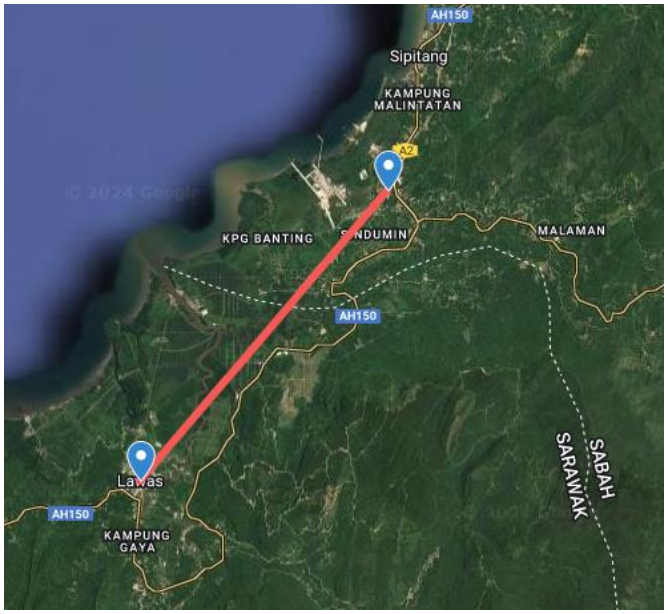
8. Sabah - Sarawak

Type : **Planned**

Implementing agency : **Sarawak Energy Berhad (SEB) & Sabah Electricity Sdn Bhd (SESB)**

Reference studies : **AIMS III Phase 1 and 2 (2020 – updated in 2022)**

MAP OF THE INTERCONNECTION



PROJECT OVERVIEW

There is ongoing progress to construct the interconnection between Sabah and Sarawak, with the project execution stage currently being conducted. In 2016, Sabah Energy Berhad and Sarawak Energy (previously named SESCO) did a feasibility study to assess the technical, commercial, and environmental aspects of the project. Later in 2021, a Power Exchange Agreement and Interconnection Agreement between both parties was signed to pave the way for electricity export of 30 MW from Sarawak to Sabah for a term of 15 years. The project was set to commercially operate by the end of 2023, however, due to several technical difficulties, the project was delayed until the end of 2024.

TECHNICAL SPECIFICATIONS

Connecting substations	:	Lawas (Sarawak) – Mengalong (Sabah)
Interconnection Agreement	:	Power Purchase from Sarawak to Sabah
Voltage	:	275 kV
Transmission System Type	:	HVAC
Line Capacity	:	30 – 50 MW
Commercial Operating Date	:	TBC
Line Length	:	30 km
Line Type	:	Twin Drake (2 x 600 MVA) and Twin Bison (2 x 639 MVA)

IDENTIFIED POTENTIAL RENEWABLE ENERGY SITES (AIMS III)

Potential Solar Sites

Province	Total Area (Acres)	Developable Area (Acres)	Approx. Capacity (MWDC)	Average GHI (kWh/ m2 /year)	Annual Average Net Energy (GWh)	Annual Average Net AC Capacity Factor (%)
Sri Aman, Sarawak, Malaysia	9,042	6,329	1,150	1,645	1,443.55	18.00%

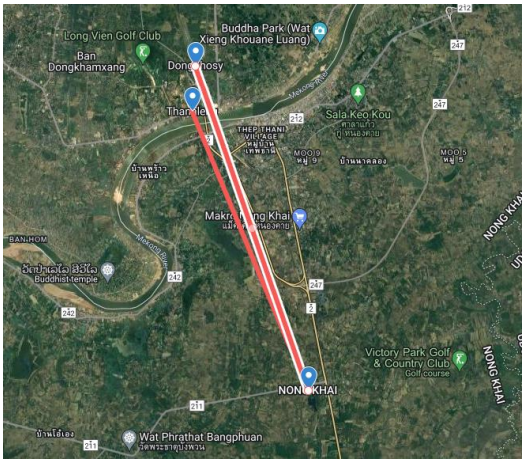
9. Thailand – Lao PDR

Type : **Existing & Planned**

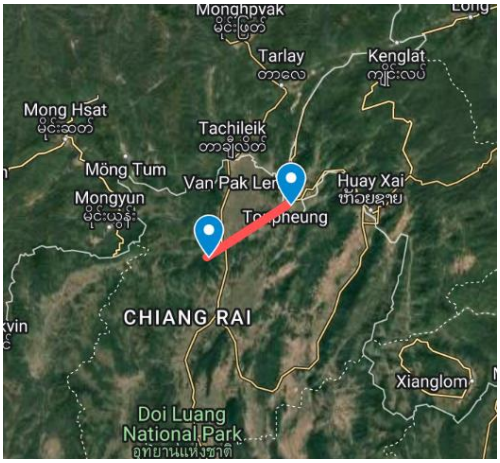
Implementing agency : **Electricity Generation Authority of Thailand (EGAT) & Electricite du Laos (EdL)**

Reference studies : **AIMS III Phase 1 and 2 (2020 – updated in 2022)**

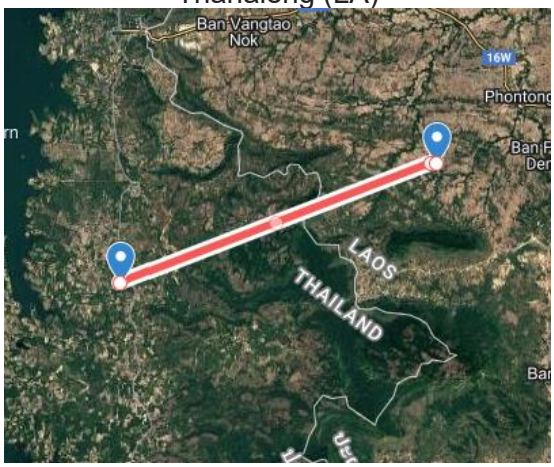
MAP OF THE INTERCONNECTION



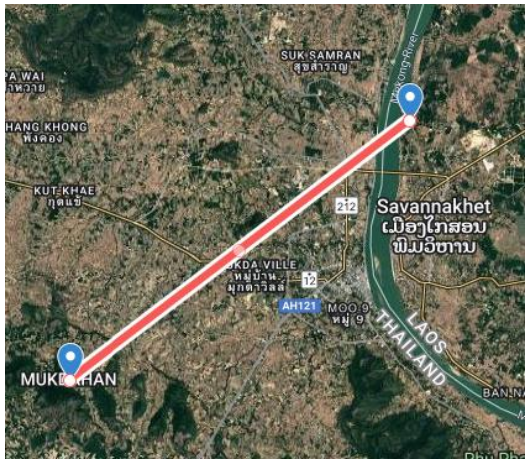
Nong Khai (TH) – Dongphosy (LA)/ Thanaleng (LA)



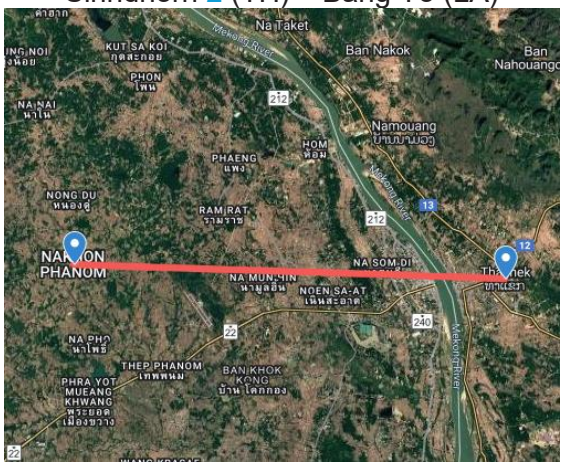
Mae Chan (TH) – Ton Pheung (LA)

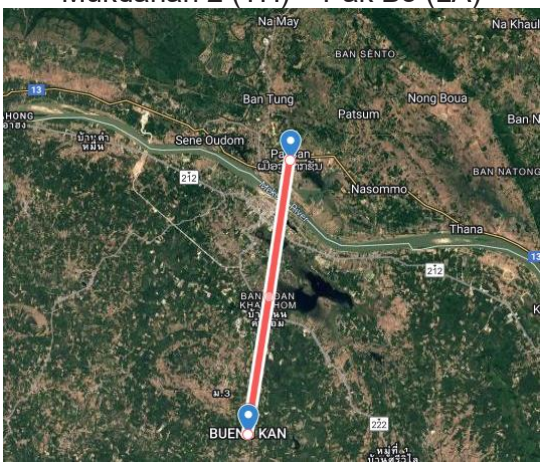


Sirindhorn 2 (TH) – Bang Yo (LA)

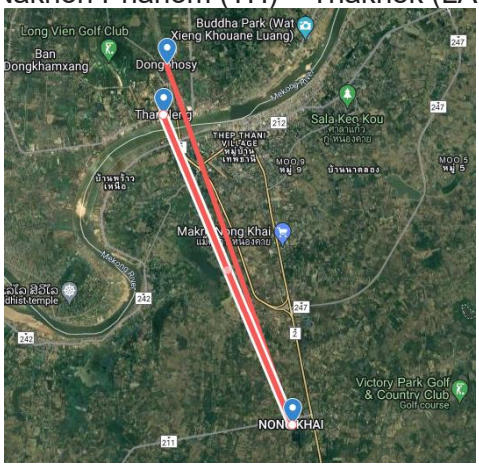


Mukdahan 2 (TH) – Pak Bo (LA)



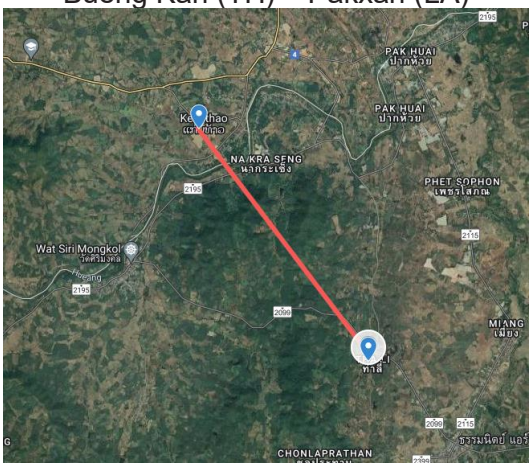


Nakhon Phanom (TH) – Thakhek (LA)



Nong Khai (TH) – Thanaleng (LA)

Bueng Kan (TH) – Pakxan (LA)



Tha Li (TH) – Ken Thao (LA)

PROJECT OVERVIEW

As of 2024, there are approximately 5,934.9 MW of existing generation-to-grid interconnections and 700 MW of grid-to-grid interconnections' maximim transfer capacity (N-1) between Thailand and Lao PDR, with some being a crucial part of the Lao PDR – Thailand – Malaysia – Singapore Power Integration Project (LTMS-PIP). There are six (6) existing cross-border interconnection projects between Thailand and Lao DPR, comprising of:

1. Nong Khai (TH) – Dongphosy (LA)
   Nong Khai (TH) – Thanaleng (LA)
2. Bueng Kan (TH) – Pakxan (LA)
3. Nakhon Phanom (TH) – Thakhek (LA)
4. Mudhakan 2 (TH) – Pakbo (LA)
5. Sirindhom 2 (TH) – Bangyo (LA)
6. Tha Li (TH) – Ken Thao (LA)

One (1) interconnection is planned to be constructed and listed under the priority interconnection of the APG, which is the Mae Chan (TH) – Ton Pheung (LA) interconnection. The interconnection will connect Thailand and Lao PDR through a grid-to-grid 115/230 kV HVAC overhead transmission line (to be constructed at 230 kV system, but initially energised at 115 kV).

Based on the latest Lao PDR's power development plan (PDP), there are plans to upgrade the existing Lao PDR-Thailand Interconnection projects, with the following details:

- 115 kV from Nong Khai (TH) – Dongphosy (LA) / Thanaleng (LA): Upgrading/reconductoring the 3-circuit conductor from 240 sqmm to 400 sqmm, with the targeted COD by 2027.
- 115 kV Bueng Kan (TH) – Pakxan (LA): Upgrading single circuit into a double circuit lines with new line route, as well as upgrading the voltage level from 115 kV to 230 kV. The project is targeted to commercially operate by 2030.
- 115 kV Mudhakan 2 (TH) – Pakbo (LA): Additional 1 new circuit with expected commercial operation date (COD) by 2027.

TECHNICAL SPECIFICATIONS

- **Existing Interconnections**

i. Tha Li – Ken Thao

Connecting substations	:	Tha Li (TH) – Ken Thao (LA)
Interconnection Agreement	:	Energy Exchange
Voltage	:	115 kV
Transmission System Type	:	HVAC
Line Capacity	:	100 MW
Commercial Operating Date	:	2020
Line Length	:	8.07 km
Line Type	:	477 MCM ACSR SC

ii. Nong Khai – Dongphosy

Connecting substations	:	Nong Khai (TH) – Dongphosy (LA)
Interconnection Agreement	:	Energy Exchange
Voltage	:	115 kV
Transmission System Type	:	HVAC
Line Capacity	:	100 MW
Commercial Operating Date	:	2007
Line Length	:	13.25 km
Line Type	:	477 MCM ACSR DC

Nong Khai – Thanalaeng

Connecting substations	:	Nong Khai (TH) – Thanalaeng (LA)
Interconnection Agreement	:	Energy Exchange
Voltage	:	115 kV
Transmission System Type	:	HVAC
Line Capacity	:	100 MW
Commercial Operating Date	:	1968
Line Length	:	9.53 km
Line Type	:	477 MCM ACSR SC

iii. Bueng Kan – Pakxan

Connecting substations	:	Bueng Kan (TH) – Pakxan (LA)
Interconnection Agreement	:	Energy Exchange
Voltage	:	115 kV
Transmission System Type	:	HVAC
Line Capacity	:	100 MW
Commercial Operating Date	:	2002
Line Length	:	9.91 km
Line Type	:	477 MCM ACSR SC

iv. Nakhon Phanom – Thakhek

Connecting substations	:	Nakhon Phanom (TH) – Thakhek (LA)
Interconnection Agreement	:	Energy Exchange
Voltage	:	115 kV

Transmission System Type	:	HVAC
Line Capacity	:	180 MW
Commercial Operating Date	:	2010
Line Length	:	9.93 km
Line Type	:	1272 MCM ACSR DC

v. Mukdahan 2 – Pak Bo

Connecting substations	:	Mukdahan 2 (TH) – Pak Bo (LA)
Interconnection Agreement	:	Energy Exchange
Voltage	:	115 kV
Transmission System Type	:	HVAC
Line Capacity	:	100 MW
Commercial Operating Date	:	1996
Line Length	:	7.22 km
Line Type	:	477 MCM ACSR SC

vi. Sirindhorn 2 – Bang Yo

Connecting substations	:	Sirindhorn 2 (TH) – Bang Yo (LA)
Interconnection Agreement	:	Energy Exchange
Voltage	:	115 kV
Transmission System Type	:	HVAC
Line Capacity	:	275 MW
Commercial Operating Date	:	2020
Line Length	:	52.19 km
Line Type	:	2 x 795 MCM ACSR DC

- **Planned Interconnections**

Connecting substations	:	Mae Chan (TH) – Ton Pheung (LA)
Interconnection Agreement	:	Energy Exchange
Voltage	:	115/230 kV
Transmission System Type	:	HVAC
Line Capacity	:	TBC
Commercial Operating Date	:	TBC
Line Length	:	TBC
Line Type	:	TBC

IDENTIFIED POTENTIAL RENEWABLE ENERGY SITES (AIMS III)

Identified Solar Sites

Province	Total Area (Acres)	Developable Area (Acres)	Approx. Capacity (MWDC)	Average GHI (kWh/ m2 /year)	Annual Average Net Energy (GWh)	Annual Average Net AC Capacity Factor (%)
Chang Wat Roi Et, Thailand	7,692	5,384	980	1,907	1,445.63	21.10%
Chang Wat Nakhon Ratchasima, Thailand	11,157	7,810	1,420	1,848	2,032.57	19.80%
Tambon Wang Nam, Thailand	8,881	6,217	1,130	1,893	1,644.11	21.10%
Tambon Tha Chai, Thailand	9,226	6,458	1,180	1,864	1,713.74	20.60%
Savannakhet, Lao PDR	24,657	12,284	2,230	1,796	3,140.76	19.90%
Champasak, Lao PDR	10,066	7,046	1,280	1,805	1,803.32	19.90%

Identified Wind Sites

Province	No. of Turbines	Turbine Rated Capacity (MW)	Hub Height (m)	Plant Capacity (MW)	Average Wind Speed (m/s)	Gross Energy (GWh)	Plant Load Factor (%)
Huai Bong, Thailand	125	5.3	120.9	662.5	6.12	1,831.06	31.5%
Khona Sai, Thailand	48	5.3	120.9	254.4	5.79	620.17	27.8%
Prachuap, Thailand	47	5.3	120.9	249.1	6.18	694.39	31.8%
Savannakhet, Lao PDR	288	2.7	130.0	777.6	5.70	2,288.39	33.6%

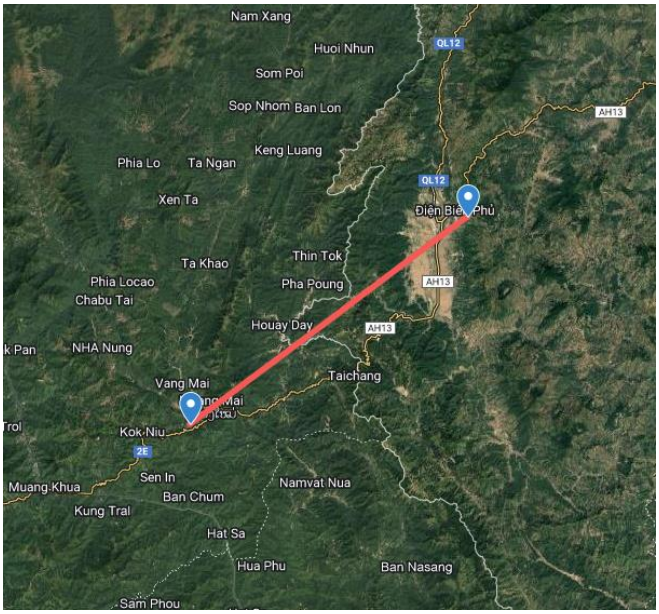
10. Lao PDR – Vietnam

Type : **Planned**

Implementing agency : **Electricite du Laos (EdL) & Electricity Viet Nam (EVN)**

Reference studies : **AIMS III Phase 1 and 2 (2020 – updated in 2022)**

MAP OF THE INTERCONNECTION



PROJECT OVERVIEW

The Vietnam and Lao PDR interconnection is planned to be constructed in a grid-to-grid arrangement, allowing power purchase from Lao DPR to Vietnam. Although no further studies have been conducted, the interconnection is set to be energised at 220 kV connecting Nam Ou and Dien Bien using HVAC overhead transmission lines.

TECHNICAL SPECIFICATIONS

Connecting substations	:	Nam Ou (LA) – Dien Bien (VN)
Interconnection Agreement	:	Power Purchase from Lao PDR to Vietnam
Voltage	:	220 kV
Transmission System Type	:	HVAC
Line Capacity	:	TBC
Commercial Operating Date	:	TBC
Line Length	:	TBC
Line Type	:	-

IDENTIFIED POTENTIAL RENEWABLE ENERGY SITES (AIMS III)

Identified Solar Sites

Province	Total Area (Acres)	Developable Area (Acres)	Approx. Capacity (MWDC)	Average GHI (kWh/ m2 /year)	Annual Average Net Energy (GWh)	Annual Average Net AC Capacity Factor (%)
Savannakhet, Lao PDR	24,657	12,284	2,230	1,796	3,140.76	19.90%
Champasak, Lao PDR	10,066	7,046	1,280	1,805	1,803.32	19.90%
An Giang, Vietnam	964	675	125	1,806	171.79	19.00%
Tacy Ninh, Vietnam	3,838	2,687	490	1,931	717.19	20.10%
Banh Thuan, Vietnam	7,509	5,256	960	1,885	1,381.57	19.80%
Aa K La K, Vietnam	31,962	22,373	4,070	1,868	5,857.65	19.80%

Identified Wind Sites

Province	No. of Turbines	Turbine Rated Capacity (MW)	Hub Height (m)	Plant Capacity (MW)	Average Wind Speed (m/s)	Gross Energy (GWh)	Plant Load Factor (%)
Savannakhet, Lao PDR	288	2.7	130.0	777.6	5.70	2,288.39	33.60%
Bac Lieu, Vietnam	110	5.3	120.9	583	6.84	1,968.15	38.50%
Bin Dhin, Vietnam	105	5.3	120.9	556.5	7.36	2,037.35	41.80%
Bin Thuan, Vietnam	171	5.3	120.9	906.3	7.07	3,164.47	39.80%
Gia Lai, Vietnam	113	5.3	120.9	598.9	6.15	1,597.33	30.40%
Phan Rang, Vietnam	58	5.3	120.9	307.4	7.28	1,133.23	42.10%
Quang Binh, Vietnam	101	5.3	120.9	535.3	6.53	1,630.74	34.75%
Phu Yen, Vietnam	47	5.3	120.9	249.1	7.14	879.64	40.30%

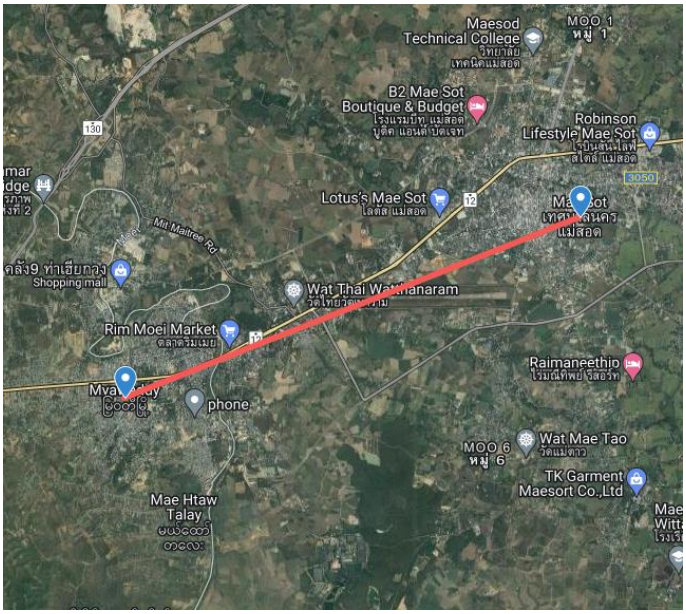
11. Thailand – Myanmar

Type : **Planned**

Implementing agency : **Electricity Generation Authority of Thailand (EGAT) & Ministry of Electric Power (MoEP) Myanmar**

Reference studies : **AIMS III Phase 1 and 2 (2020 – updated in 2022)**

MAP OF THE INTERCONNECTION



PROJECT OVERVIEW

Based on the latest updates from HAPUA Working Group 2, there is a plan to interconnect Thailand and Myanmar using the Mae Sot (TH) – Myawaddy (MM) grid-to-grid interconnection. The substations will be connected via 230 kV HVAC overhead transmission line with maximum capacity of 365 MW, allowing energy exchange between both countries. EGAT has developed an in-house preliminary technical study on the feasibility of the interconnection projects. However, further detailed studies are needed to confirm whether this interconnection project is feasible both technically and economically.

TECHNICAL SPECIFICATIONS

- **Planned Interconnection**

Connecting substations	:	Mae Sot (TH) – Myawaddy (MM)
Interconnection Agreement	:	Energy Exchange
Voltage	:	230 kV
Transmission System Type	:	HVAC
Line Capacity	:	365 MW
Commercial Operating Date	:	TBC
Line Length	:	31 km
Line Type	:	1272 MCM ACSR DC

IDENTIFIED POTENTIAL RENEWABLE ENERGY SITES (AIMS III)

Identified Solar Sites

Province	Total Area (Acres)	Developable Area (Acres)	Approx. Capacity (MWDC)	Average GHI (kWh/ m2 /year)	Annual Average Net Energy (GWh)	Annual Average Net AC Capacity Factor (%)
Chang Wat Roi Et, Thailand	7,692	5,384	980	1,907	1,445.63	21.10%
Chang Wat Nakhon Ratchasima, Thailand	11,157	7,810	1,420	1,848	2,032.57	19.80%
Tambon Wang Nam, Thailand	8,881	6,217	1,130	1,893	1,644.11	21.10%
Tambon Tha Chai, Thailand	9,226	6,458	1,180	1,864	1,713.74	20.60%
Naypyidaw UT, Myanmar	3,784	2,649	480	1,906	737.32	21.00%
Bago Region, Myanmar	12,565	8,796	1,600	1,839	2,327.43	20.20%
Sagaing Region, Myanmar	3,895	2,727	500	1,801	728.39	20.70%
Ayeyarwady, Myanmar	7,334	5,135	1,020	1,823	1,464.92	20.40%

Identified Wind Sites

Province	No. of Turbines	Turbine Rated Capacity (MW)	Hub Height (m)	Plant Capacity (MW)	Average Wind Speed (m/s)	Gross Energy (GWh)	Plant Load Factor (%)
Huai Bong, Thailand	125	5.3	120.9	662.5	6.12	1,831.06	31.50%
Khona Sai, Thailand	48	5.3	120.9	254.4	5.79	620.17	27.80%
Prachuap, Thailand	47	5.3	120.9	249.1	6.18	694.39	31.80%
Ayeyarwady, Myanmar	123	2.7	130	332.1	5.83	989.08	34.00%

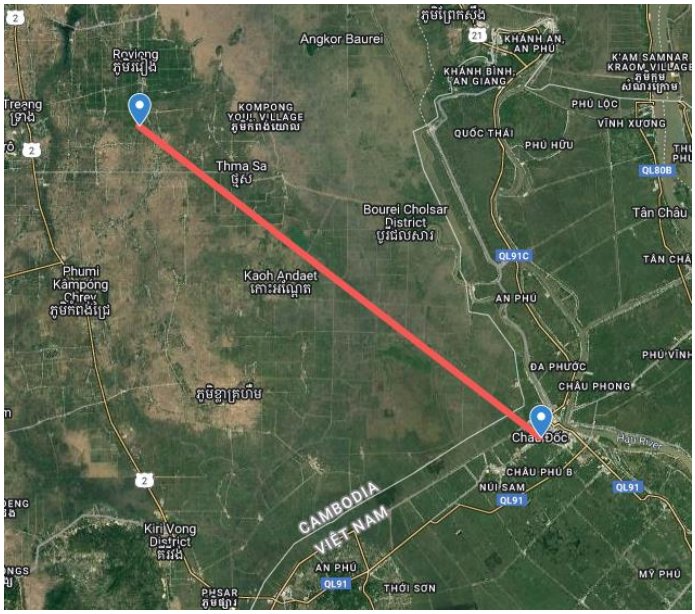
12. Vietnam – Cambodia

Type : **Planned**

Implementing agency : **Electricity Viet Nam (EVN) & Electricite du Cambodge (EdC)**

Reference studies : **AIMS III Phase 1 and 2 (2020 – updated in 2022)**

MAP OF THE INTERCONNECTION



PROJECT OVERVIEW

Vietnam and Cambodia have a 200 MW grid-to-grid interconnection which was established in 2009, connecting a substation in Chau Doc, Vietnam to Takeo in Cambodia. The interconnection utilise 220 kV HVAC Overhead transmission and approximately 26.5 km of lines in length, with over 10,000 GWh of bulk electricity transmitted to Cambodia after 10 years of operation[1].

There are plans to establish more interconnections from Vietnam to Cambodia, noting the high variable renewable energy capacity in Vietnam. Although no further information is available on the additional interconnection capacity, the agreement is projected to be in the form of power purchase agreements to export electricity from Vietnam to Cambodia via 230 kV transmission line.

TECHNICAL SPECIFICATIONS

Connecting substations	:	Chau Doc (VN) – Takeo (KH)
Interconnection Agreement	:	Power Purchase from Vietnam to Cambodia
Voltage	:	220 kV
Transmission System Type	:	HVAC
Line Capacity	:	200 MW
Commercial Operating Date	:	2009

[1] Chau Doc - Ta Keo 220kV transmission line: 10 years with 10 billion kWh (evn.com.vn)

Line Length : 26.5 km
Line Type : 450 ACSR

IDENTIFIED POTENTIAL RENEWABLE ENERGY SITES (AIMS III)

Identified Solar Sites

Province	Total Area (Acres)	Developable Area (Acres)	Approx. Capacity (MWDC)	Average GHI (kWh/ m2 /year)	Annual Average Net Energy (GWh)	Annual Average Net AC Capacity Factor (%)
An Giang, Vietnam	964	675	125	1,806	171.79	19.00%
Tacy Ninh, Vietnam	3,838	2,687	490	1,931	717.19	20.10%
Banh Thuan, Vietnam	7,509	5,256	960	1,885	1,381.57	19.80%
Aa K La K, Vietnam	31,962	22,373	4,070	1,868	5,857.65	19.80%
Kampong Thom, Cambodia	52,908	26,454	4,800	1,927	7,062.04	20.90%
Battambang, Cambodia	15,978	11,185	2,035	1,852	2,880.41	20.00%
Kampong Cham, Cambodia	10,232	7,163	1,432	1,926	2,110.85	21.10%
Oddar Meanchey, Cambodia	14,848	10,394	1,890	1,891	2,735.16	20.50%

Identified Wind Sites

Province	No. of Turbines	Turbine Rated Capacity (MW)	Hub Height (m)	Plant Capacity (MW)	Average Wind Speed (m/s)	Gross Energy (GWh)	Plant Load Factor (%)
Bac Lieu, Vietnam	110	5.3	120.9	583	6.84	1,968.15	38.50%
Bin Dhin, Vietnam	105	5.3	120.9	556.5	7.36	2,037.35	41.80%
Bin Thuan, Vietnam	171	5.3	120.9	906.3	7.07	3,164.47	39.80%
Gia Lai, Vietnam	113	5.3	120.9	598.9	6.15	1,597.33	30.40%
Phan Rang, Vietnam	58	5.3	120.9	307.4	7.28	1,133.23	42.10%
Quang Binh, Vietnam	101	5.3	120.9	535.3	6.53	1,630.74	34.75%
Phu Yen, Vietnam	47	5.3	120.9	249.1	7.14	879.64	40.30%
Angkoi, Cambodia	38	2.7	130	102.6	6.00	312.83	34.80%

Province	No. of Turbines	Turbine Rated Capacity (MW)	Hub Height (m)	Plant Capacity (MW)	Average Wind Speed (m/s)	Gross Energy (GWh)	Plant Load Factor (%)
Kampot, Cambodia	60	2.7	130	162	6.00	495.59	34.90%
Mondil Kir South, Cambodia	147	2.7	130	396.9	6.93	1,493.91	42.90%

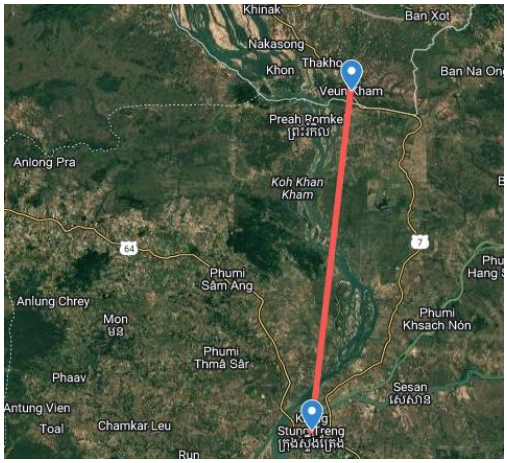
13. Lao PDR – Cambodia

Type : **Planned**

Implementing agency : **Electricite du Laos (EdL) & Electricite du Cambodge (EdC)**

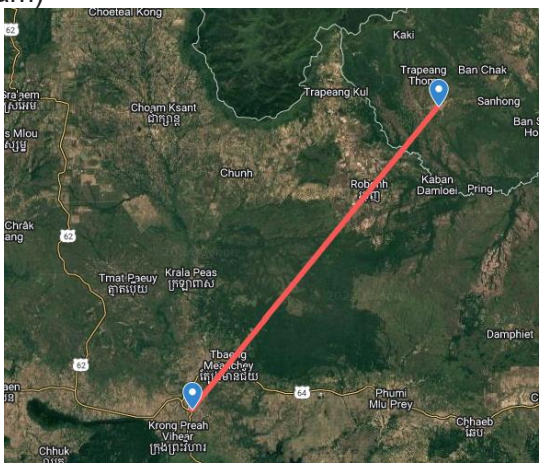
Reference studies : **AIMS III Phase 1 and 2 (2020 – updated in 2022)**

MAP OF THE INTERCONNECTION



Ban Hat – Stung Treng (via Veunkham)[2]

Ban Hat – Kampong Sralau



Ban Hat – Preah Vihear

PROJECT OVERVIEW

Currently, Lao PDR has an existing generation-to-grid cross-border interconnection from the Don Sahong hydropower dam to neighboring countries, Thailand and Cambodia. Besides generation-to-grid, Lao PDR possess one existing grid-to-grid interconnection from Ban Hat to Strung Treng allowing power export from Lao PDR to Cambodia at a maximum capacity of 300 MW via HVAC overhead transmission line. The grid-to-grid interconnection was established in 2019 and uses 230 kV transmission line with potential to be upgraded to 500 kV to allow higher power transfer between the countries.

[2] Laos - Greater Mekong Subregion Power Trade Projects : resettlement plan : Ban Hat-Veunkham-Stung Treng 115kv Tranmission Line Project (worldbank.org)

The interconnection between Lao PDR and Cambodia is planned to be expanded, with the interconnection between Ban Hat in Lao DPR and Stung Treng in Cambodia via 115 kV HVAC Overhead Transmission Line is being constructed with expected COD of 2026. Through power purchase agreement, the Ban Hat – Kampong Sralao interconnection allows hydro power export from Lao PDR to Cambodia. In the future, Lao PDR also aimed to establish the Ban Hat – Preah Vihear interconnection via 500 kV HVAC transmission line to further enable power export to Cambodia.

TECHNICAL SPECIFICATIONS

- **Existing Interconnection**

Connecting substations	:	Ban Hat (LA) – Strung Treng (KH)
Interconnection Agreement	:	Power Purchase from Lao PDR to Cambodia
Voltage	:	230/500 kV
Transmission System Type	:	HVAC
Line Capacity	:	300 MW
Commercial Operating Date	:	2019
Line Length	:	-
Line Type	:	-

- **Planned Interconnection**

i. Ban Hat – Kampong Sralao

Connecting substations	:	Ban Hat (LA) – Kampong Sralao (KH)
Interconnection Agreement	:	Power Purchase from Lao PDR to Cambodia
Voltage	:	115 kV
Transmission System Type	:	HVAC
Line Capacity	:	-
Commercial Operating Date	:	2026
Line Length	:	-
Line Type	:	-

ii. Ban Hat – Preah Vihear

Connecting substations	:	Ban Hat (LA) – Preah Vihear (KH)
Interconnection Agreement	:	Power Purchase from Lao PDR to Cambodia
Voltage	:	500 kV
Transmission System Type	:	HVAC
Line Capacity	:	-
Commercial Operating Date	:	TBC
Line Length	:	TBC
Line Type	:	TBC

IDENTIFIED POTENTIAL RENEWABLE ENERGY SITES (AIMS III)

Identified Solar Sites

Province	Total Area (Acres)	Developable Area (Acres)	Approx. Capacity (MWDC)	Average GHI (kWh/ m2 /year)	Annual Average Net Energy (GWh)	Annual Average Net AC Capacity Factor (%)
Savannakhet, Lao PDR	24,657	12,284	2,230	1,796	3,140.76	19.90%
Champasak, Lao PDR	10,066	7,046	1,280	1,805	1,803.32	19.90%
Kampong Thom, Cambodia	52,908	26,454	4,800	1,927	7,062.04	20.90%
Battambang, Cambodia	15,978	11,185	2,035	1,852	2,880.41	20.00%
Kampong Cham, Cambodia	10,232	7,163	1,432	1,926	2,110.85	21.10%
Oddar Meanchey, Cambodia	14,848	10,394	1,890	1,891	2,735.16	20.50%

Identified Wind Sites

Province	No. of Turbines	Turbine Rated Capacity (MW)	Hub Height (m)	Plant Capacity (MW)	Average Wind Speed (m/s)	Gross Energy (GWh)	Plant Load Factor (%)
Savannakhet, Lao PDR	288	2.7	130.0	777.6	5.70	2,288.39	33.60%
Angkoi, Cambodia	38	2.7	130	102.6	6.00	312.83	34.80%
Kampot, Cambodia	60	2.7	130	162	6.00	495.59	34.90%
Mondil Kir South, Cambodia	147	2.7	130	396.9	6.93	1,493.91	42.90%

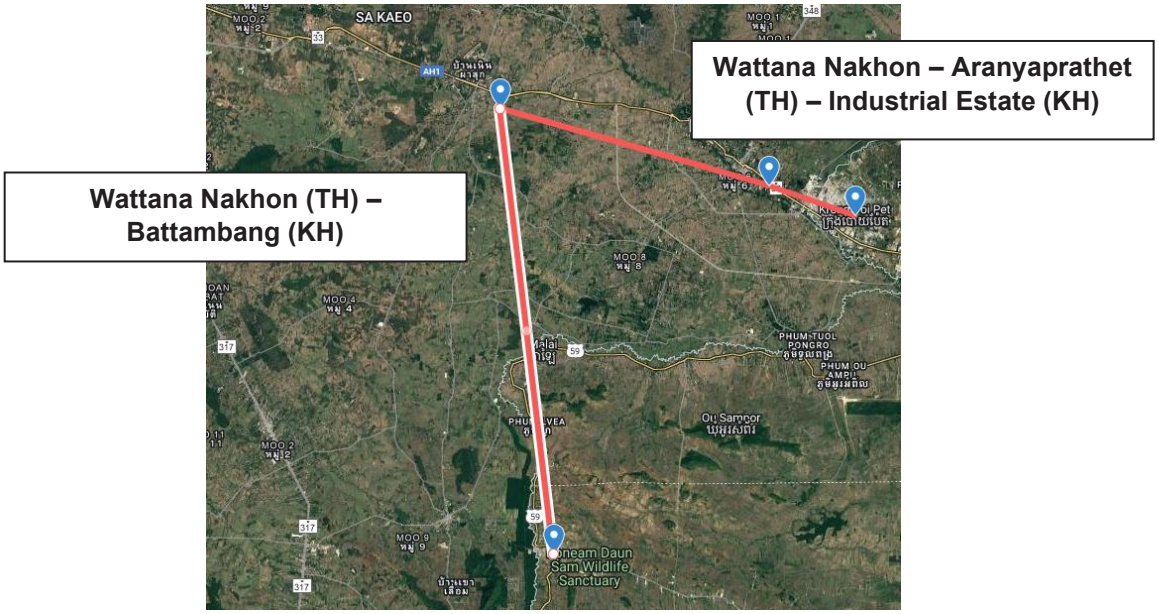
14. Thailand - Cambodia

Type : **Existing & Planned**

Implementing agency : **Electricity Generation Authority of Thailand (EGAT) & Electricite du Cambodge (EdC)**

Reference studies : **AIMS III Phase 1 and 2 (2020 – updated in 2022)**

MAP OF THE INTERCONNECTION



PROJECT OVERVIEW

As of 2023, Thailand shared one (1) existing grid-to-grid cross-border interconnection with Cambodia, which is the Wattana Nakhon (TH) – Aranyaprathet (TH) – Poi Pet Industrial Estate (KH) 115 kV overhead transmission line. The interconnection was developed under a power purchase agreement between the utilities, to export power from Thailand to Cambodia, with a maximum transmission capacity of 250 MW.

Given the high renewable potential and overall generation capacity of Thailand, the interconnection between Thailand and Cambodia is planned to be enhanced, through connection between Wattana Nakhon 2 (TH) and Battambang 2 (KH). The interconnection will span about 112 km in length, utilising 230/500 kV (initially energize at 230 kV) overhead transmission line, with the line capacity of 650 MW.

TECHNICAL SPECIFICATIONS

- **Existing Interconnection**

Connecting substations	:	Watthana Nakhon (TH) – Aranyaprathet (TH) Aranyaprathet (TH) – Industrial Estate (KH)
Interconnection Agreement	:	Power Purchase from Thailand to Cambodia
Voltage	:	115 kV
Transmission System Type	:	HVAC
Line Capacity	:	250 MW

Commercial Operating Date	:	2007
Line Length	:	27.85 km + 20.4 km
Line Type	:	795 MCM ACSR SC

- **Planned Interconnection**

Connecting substations	:	Watthana Nakhon 2 (TH) - Battambang 2 (KH)
Interconnection Agreement	:	Power Purchase from Thailand to Cambodia
Voltage	:	230/500 kV (initially energize at 230 kV)
Transmission System Type	:	HVAC
Line Capacity	:	650 MW
Commercial Operating Date	:	TBC
Line Length	:	112 km
Line Type	:	4 x 1272 MCM ACSR DC

2. IDENTIFIED POTENTIAL RENEWABLE ENERGY SITES (AIMS III)

Identified Solar Sites

Province	Total Area (Acres)	Developable Area (Acres)	Approx. Capacity (MWDC)	Average GHI (kWh/ m2 /year)	Annual Average Net Energy (GWh)	Annual Average Net AC Capacity Factor (%)
Chang Wat Roi Et, Thailand	7,692	5,384	980	1,907	1,445.63	21.10%
Chang Wat Nakhon Ratchasima, Thailand	11,157	7,810	1,420	1,848	2,032.57	19.80%
Tambon Wang Nam, Thailand	8,881	6,217	1,130	1,893	1,644.11	21.10%
Tambon Tha Chai, Thailand	9,226	6,458	1,180	1,864	1,713.74	20.60%
Kampong Thom, Cambodia	52,908	26,454	4,800	1,927	7,062.04	20.90%
Battambang, Cambodia	15,978	11,185	2,035	1,852	2,880.41	20.00%
Kampong Cham, Cambodia	10,232	7,163	1,432	1,926	2,110.85	21.10%
Oddar Meanchey, Cambodia	14,848	10,394	1,890	1,891	2,735.16	20.50%

Identified Wind Sites

Province	No. of Turbines	Turbine Rated Capacity (MW)	Hub Height (m)	Plant Capacity (MW)	Average Wind Speed (m/s)	Gross Energy (GWh)	Plant Load Factor (%)
Huai Bong, Thailand	125	5.3	120.9	662.5	6.12	1,831.06	31.50%
Khona Sai, Thailand	48	5.3	120.9	254.4	5.79	620.17	27.80%
Prachuap, Thailand	47	5.3	120.9	249.1	6.18	694.39	31.80%
Angkoi, Cambodia	38	2.7	130	102.6	6.00	312.83	34.80%
Kampot, Cambodia	60	2.7	130	162	6.00	495.59	34.90%
Mondil Kir South, Cambodia	147	2.7	130	396.9	6.93	1,493.91	42.90%

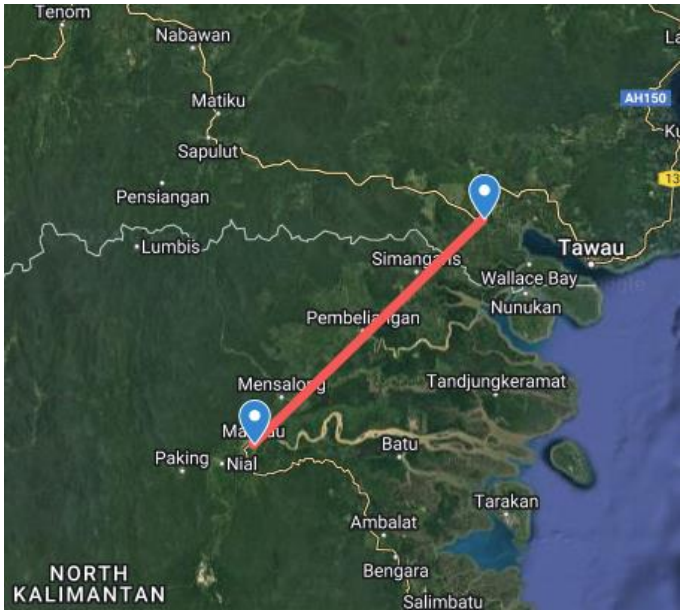
15. Sabah - Kalimantan

Type : **Planned**

Implementing agency : **Sabah Electricity Sdn Bhd (SESB) & PT Perusahaan Listrik Negara (Persero) (PLN)**

Reference studies : **AIMS III Phase 1 and 2 (2020 – updated in 2022)**

MAP OF THE INTERCONNECTION



PROJECT OVERVIEW

There are no existing interconnection between Kalimantan and Sabah. However, the proposed interconnection is currently undergoing a feasibility study with the support from USTDA. The interconnection will connect Indonesia and Malaysia through overhead lines, expanding the cross-border power trading within the Eastern subregion. The Sabah – Kalimantan interconnection will be located in the eastern part of Borneo Island, while the Sarawak – Kalimantan is located in the western part. The lines will be one of the important lines to support the establishment of multilateral power trade under the BIMP-PIP initiative.

The project is currently undergoing feasibility study, with support from the U.S. Trade and Development Agency (USTDA), to study the technical, commercial, environmental, economic, and regulatory aspects of the interconnection. The interconnection of Kalimantan and Sabah will be connected through the Sebatik/ Nunukan substation in Indonesia and Kalabakan substation in Malaysia.

TECHNICAL SPECIFICATIONS

Connecting substations	:	Sebatik/ Nunukan (ID) – Kalumpang/ Kalabakan (MY)
Interconnection Agreement	:	Energy Exchange
Voltage	:	TBC
Transmission System Type	:	HVAC
Line Capacity	:	TBC

Commercial Operating Date	:	2029
Line Length	:	TBC
Line Type	:	TBC

IDENTIFIED POTENTIAL RENEWABLE ENERGY SITES (AIMS III)

Identified Solar Sites

Province	Total Area (Acres)	Developable Area (Acres)	Approx. Capacity (MWDC)	Average GHI (kWh/ m2 /year)	Annual Average Net Energy (GWh)	Annual Average Net AC Capacity Factor (%)
South Kalimantan	19,762	11,857	2,150	1,728	2,790.31	18.70%
East Kalimantan	21,118	14,783	2,700	1,662	3,400.72	17.80%
Central Kalimantan	54,009	37,806	6,875	1,719	8,949.81	18.70%

16. Sumatera – Singapore

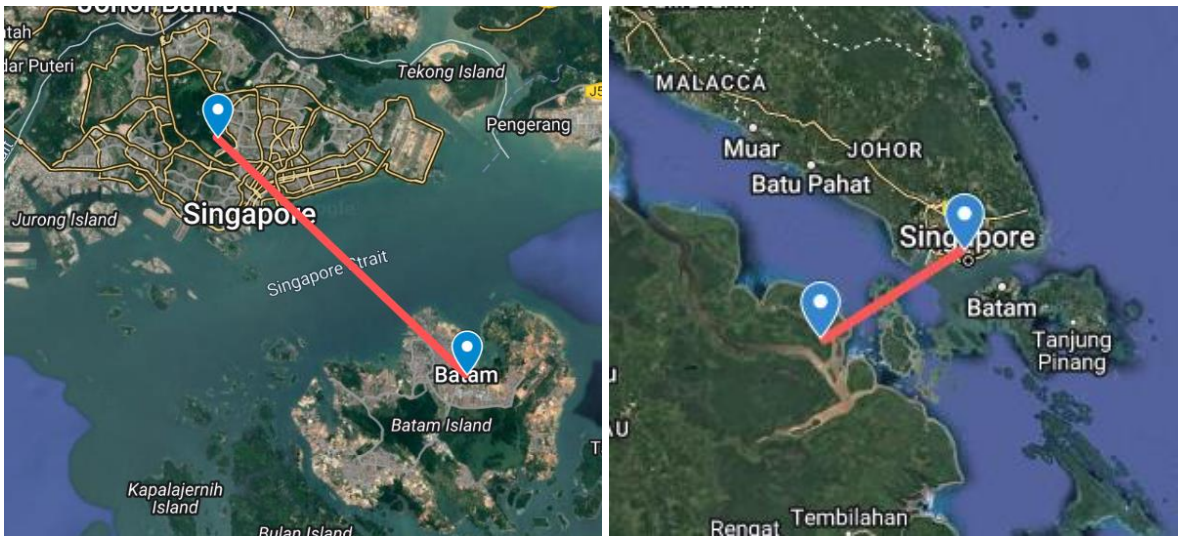
**The Batam – Singapore Interconnection is compiled into one APG interconnection project under the Sumatera – Singapore Interconnection.*

Type : **Planned**

Implementing agency : **PT Perusahaan Listrik Negara (Persero) (PLN) & SP Group (Singapore Power)**

Reference studies : **AIMS III Phase 1 and 2 (2020 – updated in 2022)**

MAP OF THE INTERCONNECTION



PROJECT OVERVIEW

Plans to connect the Sumatera Island and Singapore has been long planned under the first AIMS, in which the SIJORI (Singapore-Johor-Riau) initiative was mentioned. However, as of 2023, there is no existing interconnection between Sumatera and Singapore.

As of September 2024, Singapore's Energy Market Authority has granted approvals to seven projects seeking to import a total of 3.4 GW of low-carbon electricity from Riau Archipelago and the Riau Province.

The interconnection between Singapore and Sumatera will be connected from a 250 kV substation in Paranap, Sumatera, Indonesia. The line will have an installed capacity of up to 1,600 MW by 2030 using a subsea HVDC transmission cable, with a length of 100km. The interconnection capacity is sufficient to support the ASEAN region in achieving the RE share target by 2025 according to AIMS III.

TECHNICAL SPECIFICATIONS

Connecting substations	:	Paranap (ID) – Singapore
Interconnection Arrangement	:	Power Purchase from Indonesia to Singapore
Length of transmission line	:	260 km (~100 km subsea)
Transmission technology	:	HVDC Overhead Transmission Line and Subsea Cable
Voltage level	:	250 kV

Existing interconnection capacity	:	-
Planned interconnection capacity	:	1,600 MW (by 2030)
Conductor type	:	Subsea 2500 sqmm XLPE
Expected trade volume	:	

IDENTIFIED POTENTIAL RENEWABLE ENERGY SITES (AIMS III)

Identified Solar Sites

Province	Total Area (Acres)	Developable Area (Acres)	Approx. Capacity (MWDC)	Average GHI (kWh/ m2 /year)	Annual Average Net Energy (GWh)	Annual Average Net AC Capacity Factor (%)
Lampung	34,248	23,974	4,360	1,681	5,519.25	18.00%

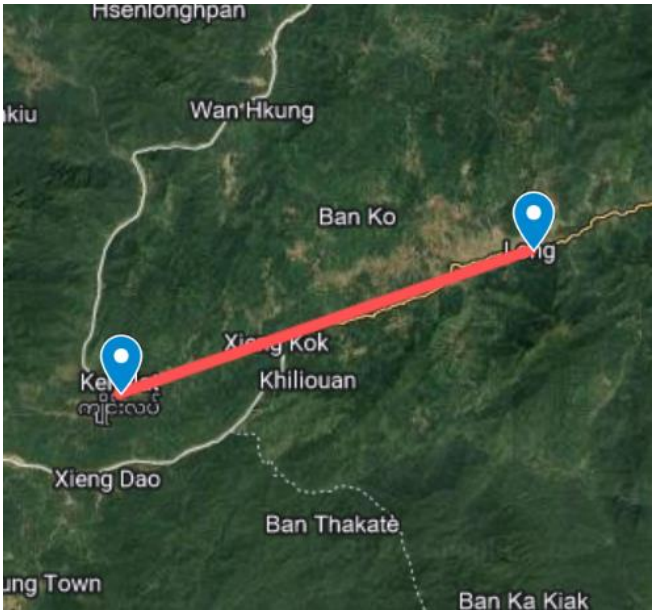
17. Lao PDR – Myanmar

Type : **Existing & Planned**

Implementing agency : **Electricite du Laos (EdL) & Ministry of Electric Power (MoEP) Myanmar**

Reference studies : **AIMS III Phase 1 and 2 (2020 – updated in 2022)**

MAP OF THE INTERCONNECTION



PROJECT OVERVIEW

Lao PDR and Myanmar have an established cross-border interconnection, which is the 115 kV Muang Long – Shan State grid-to-grid interconnection with an installed capacity of 30 MW. The interconnection was established to export power from Lao PDR to Myanmar using a HVAC overhead transmission line, which has been commercially operated since 2022.

Based on the Lao PDR's latest Power Development Plan (PDP), Lao PDR is planning to construct a 230 kV transmission line from Muang Long to Shan State (Myanmar), which is targeted to be operated commercially by 2027. The interconnection capacity is set to be upgraded periodically, from 100 MW, 300 MW, to 600 MW in the future, allowing higher hydropower transfer from Lao PDR to Myanmar.

TECHNICAL SPECIFICATIONS

- **Existing Interconnection**

Connecting substations	:	Muang Long (LA) – Shan State (MM)
Interconnection Agreement	:	Power Purchase from Lao PDR to Myanmar
Voltage	:	115 kV
Transmission System Type	:	HVAC
Line Capacity	:	30 MW
Commercial Operating Date	:	2022
Line Length	:	-

Line Type : -

- **Planned Interconnection**

Connecting substations : Muang Long (LA) – Shan State (MM)
Interconnection Agreement : Power Purchase from Lao PDR to Myanmar
Voltage : 230 kV
Transmission System Type : HVAC
Line Capacity : 100 MW – 300 MW – 600 MW
Commercial Operating Date : 2027
Line Length : TBC
Line Type : TBC

IDENTIFIED POTENTIAL RENEWABLE ENERGY SITES (AIMS III)

Identified Solar Sites

Province	Total Area (Acres)	Developable Area (Acres)	Approx. Capacity (MWDC)	Average GHI (kWh/ m2 /year)	Annual Average Net Energy (GWh)	Annual Average Net AC Capacity Factor (%)
Savannakhet, Lao PDR	24,657	12,284	2,230	1,796	3,140.76	19.90%
Champasak, Lao PDR	10,066	7,046	1,280	1,805	1,803.32	19.90%
Naypyidaw UT, Myanmar	3,784	2,649	480	1,906	737.32	21.00%
Bago Region, Myanmar	12,565	8,796	1,600	1,839	2,327.43	20.20%
Sagaing Region, Myanmar	3,895	2,727	500	1,801	728.39	20.70%
Ayeyarwady, Myanmar	7,334	5,135	1,020	1,823	1,464.92	20.40%

Identified Wind Sites

Province	No. of Turbines	Turbine Rated Capacity (MW)	Hub Height (m)	Plant Capacity (MW)	Average Wind Speed (m/s)	Gross Energy (GWh)	Plant Load Factor (%)
Savannakhet, Lao PDR	288	2.7	130.0	777.6	5.70	2,288.39	33.60%
Ayeyarwady, Myanmar	123	2.7	130	332.1	5.83	989.08	34.00%

18. Internal Indonesia

a. Java – Kalimantan

Type : **Planned**

Implementing agency : **PT Perusahaan Listrik Negara (Persero) (PLN)**

Reference studies : **AIMS III Phase 1 and 2 (2020 – updated in 2022)**

MAP OF THE INTERCONNECTION

PROJECT OVERVIEW

The planned interconnection between Java Island and Kalimantan is an initiative conveyed by the Indonesian utility, PLN, which is meant to connect the Southern subregion and Eastern subregion of the ASEAN Power Grid, in order to enhance grid resilience through grid-to-grid interconnection. Java Island's high electricity demand could be supported by the generation from Kalimantan or imported energy from Sabah/Sarawak (Malaysia).

TECHNICAL SPECIFICATIONS

Connecting substations	:	TBC
Interconnection Agreement	:	Grid-to-Grid
Voltage	:	TBC
Transmission System Type	:	TBC
Line Capacity	:	TBC
Commercial Operating Date	:	TBC
Line Length	:	TBC
Line Type	:	TBC

IDENTIFIED POTENTIAL RENEWABLE ENERGY SITES (AIMS III)

Identified Solar Sites

Province	Total Area (Acres)	Developable Area (Acres)	Approx. Capacity (MWDC)	Average GHI (kWh/ m2 /year)	Annual Average Net Energy (GWh)	Annual Average Net AC Capacity Factor (%)
South Kalimantan	19,762	11,857	2,150	1,728	2,790.31	18.70%
East Kalimantan	21,118	14,783	2,700	1,662	3,400.72	17.80%
Central Kalimantan	54,009	37,806	6,875	1,719	8,949.81	18.70%

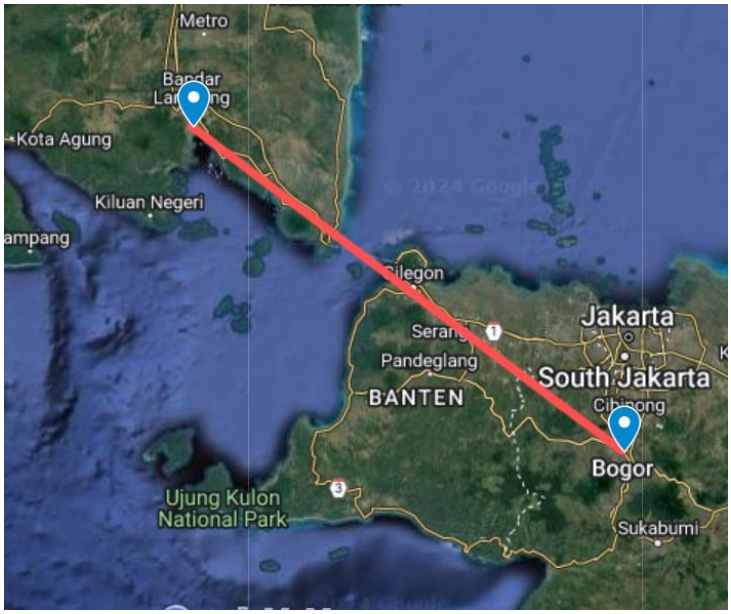
b. Sumatera – Java

Type : **Planned**

Implementing agency : **PT Perusahaan Listrik Negara (Persero) (PLN)**

Reference studies : **AIMS III Phase 1 and 2 (2020 – updated in 2022)**

MAP OF THE INTERCONNECTION



PROJECT OVERVIEW

Java Island possess a huge growing electricity demand in the future. Therefore, an interconnection between Sumatera and Java is proposed to provide electricity supply from Sumatera, which is enriched with coal, gas, and renewable energy power plants. There are several pre-feasibility studies and technical feasibility studies on the Sumatera – Java interconnection. However, the establishment of the physical infrastructure has yet to be done due to financial and technical challenges.

A plan under the APG is established to connect the Sumatera and Java Island through a 500 kV HVDC transmission system, utilising subsea cable to pass the strait. The interconnection will connect through a substation in Muara Enim and Bogor, West Java. It is expected to have an installed line capacity of 2,600 MW by 2031.

TECHNICAL SPECIFICATIONS

Connecting substations	:	TBC
Interconnection Agreement	:	Grid-to-Grid
Voltage	:	500 kV
Transmission System Type	:	HVDC
Line Capacity	:	2,600 MW
Commercial Operating Date	:	2031
Line Length	:	TBC
Line Type	:	TBC

IDENTIFIED POTENTIAL RENEWABLE ENERGY SITES (AIMS III)

Identified Solar Sites

Province	Total Area (Acres)	Developable Area (Acres)	Approx. Capacity (MWDC)	Average GHI (kWh/ m2 /year)	Annual Average Net Energy (GWh)	Annual Average Net AC Capacity Factor (%)
Lampung	34,248	23,974	4,360	1,681	5,519.25	18.00%

Other Interconnection Projects/Initiatives

The following section lists the proposed interconnection projects by the ASEAN Member States under the ASEAN Power Grid (APG) initiative, which are not covered in the ASEAN Interconnection Masterplan Study (AIMS) III.

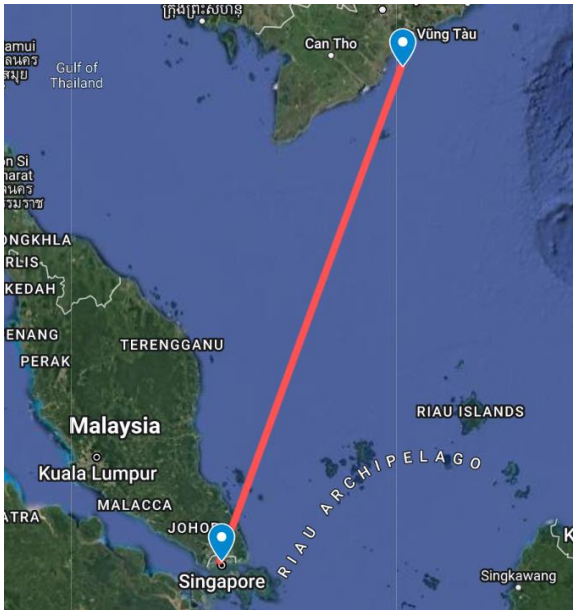
1. Singapore – Vietnam

Type : **Planned**

Implementing agency : **Energy Market Authority (EMA)/ Ministry of Trade and Industry (MTI) Singapore & Ministry of Industry and Trade (MoIT) Vietnam**

Reference studies :

MAP OF THE INTERCONNECTION



PROJECT OVERVIEW

In October 2023, Energy Market Authority (EMA) of Singapore gave conditional approval to Sembcorp Utilities (SCU), in partnership with Vietnam's Petrovietnam Technical Services Corporation (PTSC) to import 1.2 GW of low-carbon energy from Vietnam, primarily wind power to achieve the nation's target of importing 4 GW of renewables by 2035. Singapore, the United States, and Vietnam formed a working group to facilitate cross-border electricity trade. The working group was formed to establish regulatory frameworks, infrastructure, and a supportive ecosystem for greater cross-border electricity trade. The proposed interconnection project will use a subsea cable technology to import electricity from Vietnam.

Electrons imported from Vietnam will help diversify Singapore's energy sources, thereby strengthening Singapore's energy security. As the electrons are generated from an offshore wind farm built in the south of Vietnam, investments in the project would also catalyse transition to clean energy in the ASEAN region.

TECHNICAL SPECIFICATIONS

Connecting substations	:	
Interconnection Agreement	:	
Voltage	:	
Transmission System Type	:	HVDC
Line Capacity	:	1,200 MW
Commercial Operating Date	:	
Line Length	:	~1,000 km
Line Type	:	

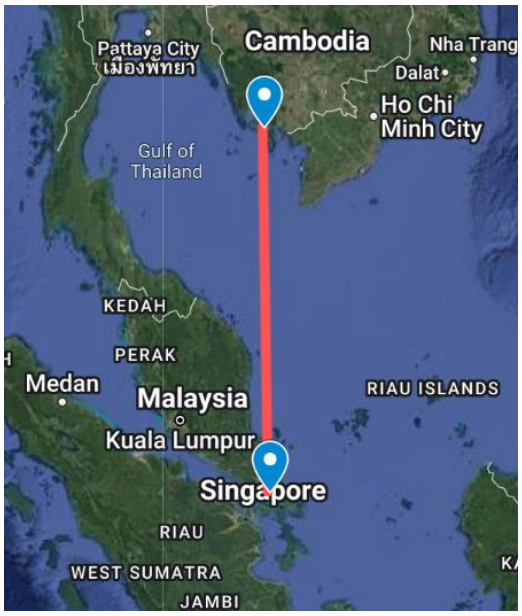
2. Singapore – Cambodia

Type : **Planned**

Implementing agency : **Energy Market Authority (EMA) Singapore & Ministry of Mines & Energy (MME) Cambodia**

Reference studies :

MAP OF THE INTERCONNECTION



PROJECT OVERVIEW

Singapore is planning to import up to 1 GW of clean electricity from Cambodia after EMA granted conditional approval for electricity import to Keppel Energy. The interconnection line will span over 1,000 kilometres long, using subsea cable technology. Singapore will mainly import generated electricity from solar, hydro, and potentially wind power plants. The Singapore – Cambodia project will catalyse the development of renewable energy projects in Cambodia and could potentially serve ASEAN demand.

Electrons imported from Cambodia will help diversify Singapore's energy sources, thereby strengthening Singapore's energy security. As the electrons are generated from hydropower farm in Cambodia, investments in the project would also catalyse transition to clean energy in the ASEAN region.

TECHNICAL SPECIFICATIONS

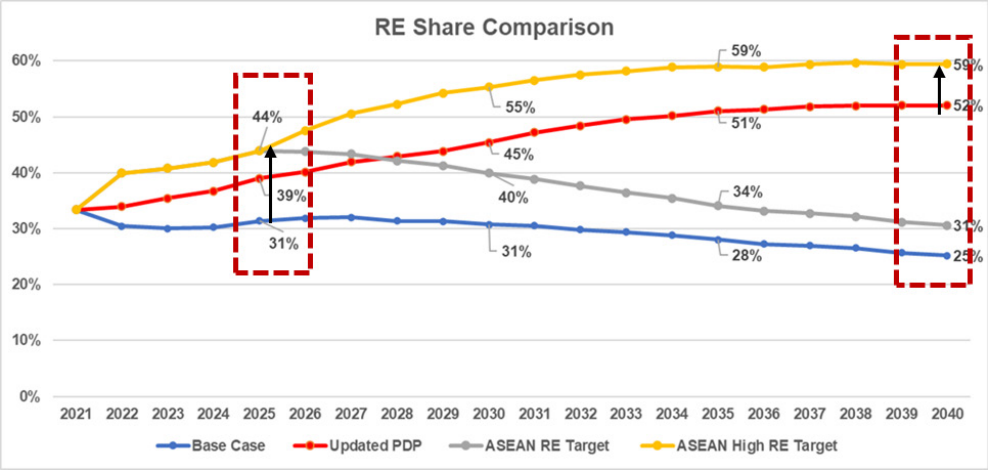
Connecting substations	:	
Interconnection Agreement	:	
Voltage	:	
Transmission System Type	:	HVDC
Line Capacity	:	1,000 MW
Commercial Operating Date	:	
Line Length	:	> 1,000 km
Line Type	:	

Benefits of Enhancing Region Interconnectivity through the Development of ASEAN Power Grid

According to the AIMS III study, cross-border interconnection projects within the ASEAN region would present various benefits for the ASEAN Member States. The following section lists out the advantages of developing the 18 prioritised interconnections under AIMS III.

1. Impact on Renewable Energy Capacity and Share

As assessed under the AIMS III study, the ASEAN region possesses a hugh renewable energy potential to be utilized together. The study estimated approximately 8,119 GW of solar and 342 GW of gross wind capacity potential which could generate about 12,004 TWh/year and 766 TWh/year, respectively. This vRE potential could be utilized and evacuated optimally to be used together to achieve the ASEAN target of 23% RE share in total primary energy supply (TPES) by 2025, by contributing of 44% of RE share in installed capacity by 2025 if the region significantly increase the ASEAN Power Grid capacity.

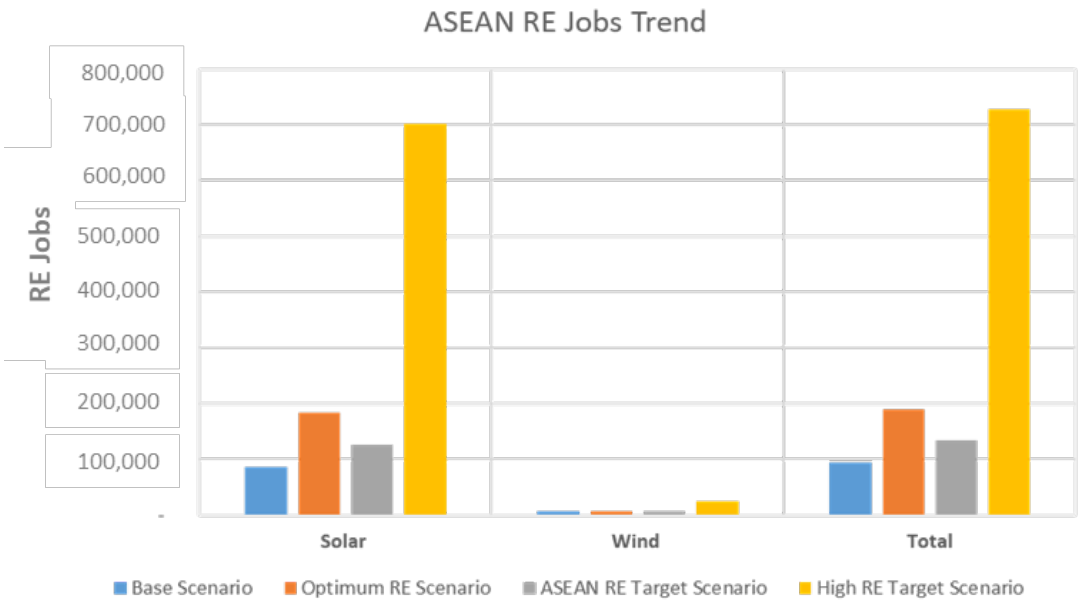


Source: AIMS III Phase 1 and 2 Update (2022)

Under the Updated PDP scenario (reflecting the current ASEAN Member States' power development plans up to 2022), the ASEAN Member States has a higher ambition towards carbon emission reduction and reaching the renewable energy aspirational target in 2025, as shown by a closer renewable energy share gap with the ASEAN RE target scenario (-5% gap). Beyond 2025, AIMS III projected that the **RE share of ASEAN Member States continues to grow towards 52% by 2040,** should the member states limit fossil-based policies and continue to increase the national and regional interconnection capacity.

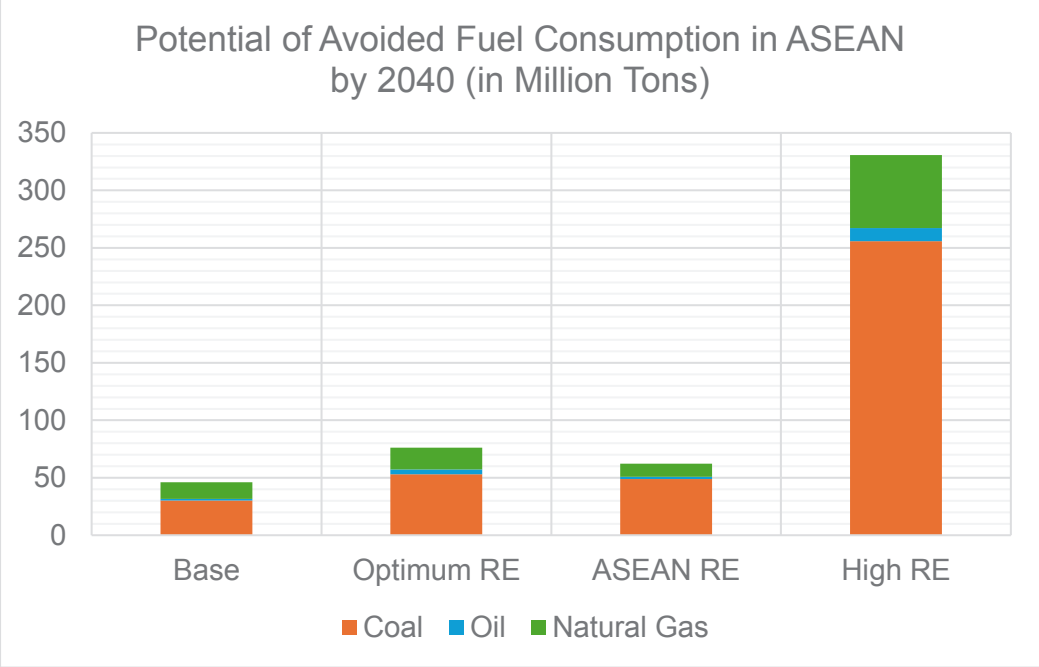
The interconnection projects listed under AIMS III would push higher utilisation of renewables in the energy mix by allowing generated renewable energy to be exchanged between the member states. The AIMS III study estimated that the ASEAN region need to **enhance the regional interconnection capacity to reach 15,246 MW** in order to support the achievement of 23% RE share in total primary energy supply (TPES) by 2025. Furthermore, a staggering **24,585 MW of interconnection capacity is needed by 2040** to support the growth of renewable energy in the future under the ASEAN RE Target Scenario of AIMS III Phase 1 and 2.

2. Socio-Environmental Impact



Source: AIMS III Phase 1 and 2 (2020)

Due to the increasing solar and wind capacity within the region, the AIMS III study estimated a total of **130,000 solar and wind-related jobs will be created by 2040** under the ASEAN RE Target Scenario – a scenario that envisions the ASEAN Member States to pursue the regional target of 23% RE share in TPES by 2025. In both solar and wind jobs created from the increasing RE integration, the "operation and maintenance (O&M)" line of work dominates the percentage of the job creation to ensure the safe operation and the longevity of each renewable energy technologies. Grid connection and installation follows as the second largest line of work, creating a demand for technical experts in variable renewable energy (VRE) integration. The "boom" in the job market would push the green economy to grow further since it would incentivise the labour market to pursue career in the renewable energy sector.

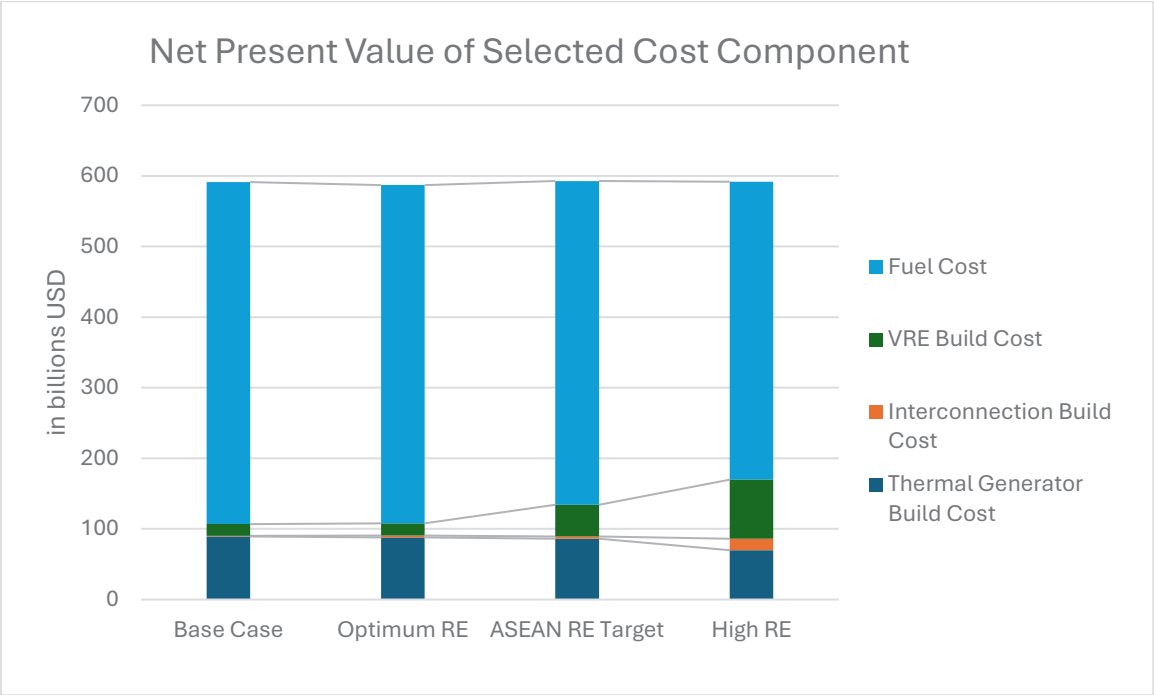


Source: AIMS III Phase 1 and 2 (2020)

One of the key messages in the AIMS III study is that VRE is pivotal in replacing fossil fuel use in thermal power generation, as it will avoid significant fuel consumption in the power sector. As the prior message suggests, the AIMS III study estimated that just by reaching the regional target of 23% of RE in TPES, **the region could potentially avoid over 60 million tons of fossil fuels consumption**, **potentially avoiding around 90,000 million tons of CO_2 and 57,000 tons of N_2O emissions by 2040**. Through the ASEAN Power Grid, cross-border interconnections could facilitate higher VRE integration and RE utilisation which could further support the ASEAN Member States in achieving the nations' target in emission reduction.

3. Economic Impact

The AIMS III study assessed the economic impact of higher VRE integration and interconnection capacity by calculating the net present value of each cost component, including the thermal generator build cost, renewable energy build cost, fuel cost, and O&M cost.



Source: AIMS III Phase 1 and 2 (2020)

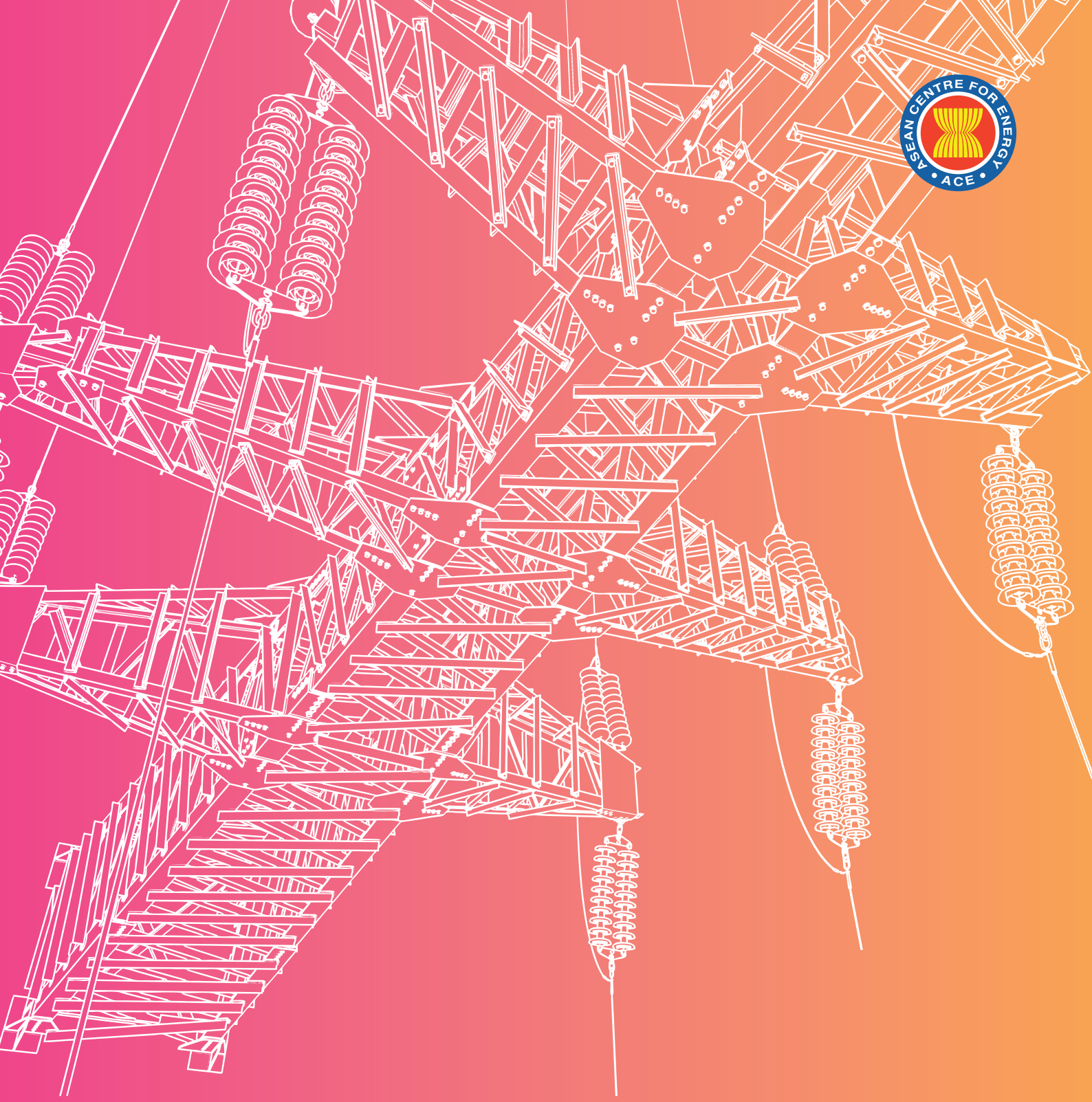
According to the study, the growth in VRE will generally increase the costs of interconnections and VRE capacity builds. However, significant thermal generation cost and fuel cost could be dropped as an impact of the fuel shifting. As seen in the graph above, the higher VRE capacity being installed and integrated into the grid, the lower the build cost of thermal generator build; the same goes with the fuel cost which experiences significant drop in the ASEAN RE Target and High RE scenario. Comparing the ASEAN RE Target to the base case scenario, the total fuel cost that the ASEAN region could avoid by achieving the RE share target is around 25,72 billion USD. The number is enough to support the **interconnection build cost of 2.98 billion USD in achieving the 23% RE Share target by 2025**. Hence, it is important that the ASEAN Member States release cleaner policies in the future, noting the significant economic advantages that higher VRE integration to the grid may poses. Investment from foreign organisations and private sectors will be useful in easing the AMS' financial burdens on VRE.

Further details on the benefits of interconnections among the ASEAN Member States and the key findings of the AIMS III Phase 1 and 2 could be found in the report, which could be accessed through the following **[Link]**.

Way Forward in Enhancing Regional Interconnectivity Through the Development of ASEAN Power Grid

Accelerating the development of the ASEAN Power Grid (APG) is pivotal for the region to fully harness variable renewable energy (vRE) potential and meet both national and regional energy targets. Several key actions to advance cross-border interconnections under the APG are outlined below:

- **Regional transmission system planning** through the ASEAN Interconnection Master Plan Study (AIMS) is crucial for identifying potential cross-border connections. This study serves as a technical guide, demonstrating how enhanced interconnectivity benefits each nation and the region. It also provides a platform for regional utilities to align grid planning, share priorities, and explore energy trade opportunities that optimize resource generation.
- **Regular updates** to AIMS and the APG project profiles are necessary to reflect changing dynamics and priorities of ASEAN countries regarding cross-border interconnections.
- **Detailed planning and feasibility studies** are essential next steps to ensure that APG interconnection projects are technically, economically, environmentally, and regulatorily viable. This will accelerate the development of projects listed in this document.
- As emphasized earlier, **APG interconnections will enable energy exchange between ASEAN member states**, supporting bilateral power trade and fostering the development of a regional power market through multilateral trade. Efficient use of existing infrastructure and innovative business models will be key to funding new projects.
- **Financing** is critical for APG development. ASEAN must prioritize identifying diverse financing mechanisms and business models to bring APG projects to life. Collaboration with partners, international organizations, and financial institutions is essential to securing the funding necessary for advancing these interconnectors.



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