ASEAN Power Grid

by

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Urumqi, China, 3-5 September 2013

Electricity Generating Authority of Thailand
Power for Thai Happiness
ASEAN Energy Cooperation

**AMEM:** ASEAN Ministers on Energy Meeting (once a year)

**SOME:** Senior Officials Meeting on Energy (once a year)

**ACE:** ASEAN Centre for Energy (accelerate the integration of energy strategies within ASEAN by providing information, technology and expertise)

**AFOC:** ASEAN Forum on Coal

**EE&C-SSN:** Energy Efficiency and Conservation Subsector Network

**NRSE-SSN:** New and Renewable Sources of Energy Subsector Network

**ASCOPE:** ASEAN Council on Petroleum

**HAPUA:** Heads of ASEAN Power Utilities/Authorities

**AERN:** ASEAN Energy Regulatory Network (TOR being prepared)
# HAPUA & AIMS Background

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Details</th>
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<tbody>
<tr>
<td>Dec 1997</td>
<td>Heads of ASEAN governments committed to jointly develop ASEAN Power Grid (APG) and Trans-ASEAN Gas Pipeline as a part of the ASEAN Vision 2020</td>
<td>[The 2nd ASEAN Informal Summit in Kuala Lumpur, Malaysia]</td>
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<td>Jul 1999</td>
<td>HAPUA was assigned to materialized APG through ASEAN Interconnection Master Plan Study (AIMS)</td>
<td>[The 17th AMEM in Bangkok, Thailand]</td>
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<td>Apr 2000</td>
<td>AIMS Working Group was established</td>
<td>[The 16th Meeting of HAPUA in Chiang Rai, Thailand]</td>
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<td>Jul 2003</td>
<td>AIMS Final Report was endorsed</td>
<td>[The 21st AMEM in Langkawi, Malaysia]</td>
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<td>May 2004</td>
<td>HAPUA Structure was re-organized</td>
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<td>Feb 2006</td>
<td>TOR and Work Plan of AIMS-II was adopted and the study started</td>
<td>[The 1st Meeting of Power Interconnection Sub Working Group (PI SWG) in Krabi, Thailand]</td>
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<tr>
<td>Jul 2011</td>
<td>AIMS-II Final Report was endorsed</td>
<td>[The 27th Meeting of HAPUA in Danang, Vietnam]</td>
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<tr>
<td>Jun 2012</td>
<td>HAPUA Structure was re-organized</td>
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Objectives of ASEAN Power Grid (APG)

“Not only technical and economic aspects, but also cooperation and good relationship among the member countries”

- To create APG through interconnections among all ASEAN countries
- To promote more efficient, economic, and secure operation of power systems through harmonious development of national electricity networks in ASEAN by region-wide interconnections
- To optimize the use of energy resources in the region by sharing the benefits
- To reduce capital required for generation capacity expansion
- To share experiences among member countries
- To provide close power cooperation in the region
- To identify barriers to the implementation of APG
Restructured due to the approval of the 15th Meeting of HAPUA Committee and endorsement of the 28th Meeting of HAPUA Council (6th June 2012).
HAPUA Members

- Department of Electrical Services
  Brunei Darussalam
- Electricité du Cambodge
  Kingdom of Cambodia
- PT. PLN (Persero)
  Republic of Indonesia
- Electricité du Laos
  Lao PDR
- Tenaga Nasional Berhad
  Malaysia
- Department of Electric Power of Myanmar
  Union of Myanmar
- National Power Corporation
  Republic of the Philippines
- Singapore Power LTD
  Republic of Singapore
- Electricity Generating Authority of Thailand
  Kingdom of Thailand
- Electricity of Vietnam
  Socialist Republic of Viet Nam

EGAT
AIMS Concept

- different load shape among ASEAN countries
- sharing energy resources across ASEAN region (generation capacity/reserve capacity)
- Less dependency on fuel imports from non-ASEAN countries
- total cost savings from interconnection
Methodology

- Assumption and criteria of each system
- Data collection (Generation and Transmission)
- Formulation of least cost generation capacity and transmission expansion planning of each system
- Formulation of least cost generation capacity and transmission expansion planning of interconnection
- Determination of total cost savings
Demand & Gen Supply in 2025 (individual)

Non Co-in Demand 213,804 MW
Co-in Demand 189,098 MW
Total Gen Cap 254,992 MW

Demand 2,696 MW
Domestic 4,653 MW
Import - MW
EE - MW

Demand 74,277 MW
Domestic 82,874 MW
Import - MW
EE - MW

Demand 2,863 MW
Domestic 2,663 MW
Import - MW
EE - MW

Demand 54,588 MW
Domestic 57,494 MW
Import - MW
EE - MW

Demand 3,141 MW
Domestic 3,000 MW
Import - MW
EE - MW

Demand 300 MW
Domestic 300 MW
Import - MW
EE - MW

Note:
1) Peak demand of individual systems
2) Domestic capacity includes existing, committed and generic projects
3) Import and EE capacity includes existing and committed projects only
Demand & Gen Supply in 2025 (interconnected)

Demand and Gen Supply in 2025

Co-in Demand: 189,098 MW
Total Gen Cap: 252,979 MW
Reduced Gen Cap: 2,013 MW

Note:
1) Peak demand of individual systems
2) Domestic, import and EE capacity includes existing, committed and generic projects
Interconnection Master Plan

PP Cap 19,576 MW
(Include 300 MW purchase from grids, 1,010 MW purchase from China, and 409 MW La->Th PPA End.)

EE Cap 3,000 MW

Ca-Th
G PP: Ca->Th 100 MW
G EE (2015) 300 MW

Ca-Vn
E PP: Vn->Ca 100 MW (from grid)
C PP: Vn->Ca 100 MW (from grid)
C PP: Ca->Vn 207 MW
G PP: Ca->Vn 222 MW

Ph-Sb
G EE (2020) 500 MW

Sb-Sw
G PP: Sw->Sb 100 MW

Br-Sw
C EE 200 MW

Sw-WK
C EE 200 MW

La-Th
E PP: La->Th 1,260 MW
C PP: La->Th 2,290 MW
G PP: La->Th 3,521 MW
G EE (2015) 600 MW
PPA End
PP: La->Th 409 MW

La-Vn
C PP: La->Vn 2,146 MW

Vn-Cn
E PP: Cn->Vn 510 MW
G PP: Cn->Vn 500 MW

Ca-La
C PP: La->Ca 100 MW
(from grid)

Mm-Th
G PP: Mm->Th 3,829 MW

Th-PM
E EE 300 MW
G EE (2015) 300 MW

PM-Sm
G EE (2015) 600 MW

PM-Sg
G PP: PM->Sg 600 MW

Sg-Sm
G PP: Sm->Sg 600 MW

Sg-Bt
G PP: Bt->Sg 600 MW

PM-Sw
G PP: Sw->PM 3,200 MW

Sg-Bt
G PP: Bt->Sg 600 MW

PM-Sw
G PP: Sw->PM 3,200 MW

Sw-WK
C EE 200 MW

Note:
E = Existing Projects
C = Committed Projects (2010-2014)
G = Generic Projects (2015-2025)
## Demand & Supply in 2025

### Peak Demand
- Non Co-Incident: 213,804 MW
- Co-Incident: 189,098 MW

### Total Generation Capacity
- Individual Scenario: 254,992 MW
- Interconnection Scenario: 252,979 MW
- Reduction: 2,013 MW

### Power Purchase Capacity
19,576 MW
- (Include 300 MW purchase from grids, 1,010 MW purchase from China, and 409 MW La>Th PPA End)

### Economic Exchange Capacity
3,000 MW
Net Saving on Interconnection Plan

Savings on Generation Costs 4,475 MUSD
Required Investment on Interconnection 3,687 MUSD

Net Savings 788 MUSD
**Benefit**: Sharing energy resources among ASEAN Countries to optimize the utilization of ASEAN resources for highest efficiency

**Results:**

- By 2025, there will be up to 19,576 MW of cross-border power purchase and 3,000 MW of economic exchange through the cross border interconnections.

- The integration of ASEAN Network resulted in a net saving of 788 MUSD and a reduction in installed capacity by 2,013 MW.
AIMS-II Results

1) P. Malaysia - Singapore (New) 2018
2) Thailand - P. Malaysia
   - Sadao - Bukit Keteri Existing
   - Khlong Ngae - Gurun Existing
   - Su Ngai Kolok - Rantau Panjang 2015
   - Khlong Ngae - Gurun (2nd Phase, 300MW) 2016
3) Sarawak - P. Malaysia 2015-2021
4) P. Malaysia - Sumatra 2015
5) Batam - Singapore 2015-2017
6) Sarawak - West Kalimantan 2012
7) Philippines - Sabah 2020
8) Sarawak - Sabah - Brunei
   - Sarawak - Sabah 2020
   - Sabah - Brunei Not Selected
   - Sarawak - Brunei 2012-2016
9) Thailand - Lao PDR
   - Roi Et 2 - Nam Theun 2 Existing
   - Sakon Nakhon 2 - Thakhek - Then Hinboun (Exp.) Existing
   - Mae Moh 3 - Nan - Hong Sa 2015
   - Udon Thani 3- Nabong (converted to 500KV) 2017
   - Ubon Ratchathani 3 - Pakse - Xe Plan Xe Namnoy 2018
   - Khon Kaen 4 - Loei 2 - Xayaburi 2019
   - Thailand - Lao PDR (New) 2015-2023
10) Lao PDR - Vietnam 2011-2016
11) Thailand - Myanmar 2016-2025
12) Vietnam - Cambodia (New) 2014-2017
13) Lao PDR - Cambodia 2011
14) Thailand - Cambodia (New) 2015-2017
15) East Sabah - East Kalimantan Newly Proposed
16) Singapore - Sumatra 2020
APG Present Status
(May 2013)

Earliest COD

1) P.Malaysia - Singapore (New) 2018
2) Thailand - P.Malaysia
   • Sadao - Bukit Keteri Existing
   • Khlong Ngae - Gurun Existing
   • Su Ngai Kolok - Rantau Panjang 2015
   • Khlong Ngae - Gurun (2nd Phase, 300MW) 2016
3) Sarawak - P. Malaysia 2015-2021
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12) Vietnam - Cambodia (New) 2017
13) Lao PDR - Cambodia 2016
14) Thailand - Cambodia (New) 2015-2020
15) East Sabah - East Kalimantan 2020
16) Singapore - Sumatra 2020
## Existing APG Projects

(May 2013)

<table>
<thead>
<tr>
<th>Project No.</th>
<th>Interconnected Systems</th>
<th>Capacity (MW)</th>
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<tbody>
<tr>
<td>1</td>
<td>P.Malaysia - Singapore</td>
<td>450</td>
</tr>
<tr>
<td>2</td>
<td>Thailand - P.Malaysia</td>
<td>380</td>
</tr>
<tr>
<td></td>
<td>- Sadao - Bukit Keteri</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Khlong Ngae - Gurun</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Thailand - Lao PDR</td>
<td>2,105</td>
</tr>
<tr>
<td></td>
<td>- Nakhon Phanom - Thakhek - Theun Hinboun</td>
<td>214</td>
</tr>
<tr>
<td></td>
<td>- Ubon Ratchathani 2 - Houay Ho</td>
<td>126</td>
</tr>
<tr>
<td></td>
<td>- Roi Et 2 - Nam Theun 2</td>
<td>948</td>
</tr>
<tr>
<td></td>
<td>- Udon Thani 3 - Nabong - Nam Ngum 2</td>
<td>597</td>
</tr>
<tr>
<td></td>
<td>- Nakhon Phanom 2 - Thakhek - Theun Hinboun (Exp)</td>
<td>220</td>
</tr>
<tr>
<td>10</td>
<td>Lao PDR - Vietnam</td>
<td>248</td>
</tr>
<tr>
<td>12</td>
<td>Vietnam - Cambodia</td>
<td>170</td>
</tr>
<tr>
<td>14</td>
<td>Thailand - Cambodia</td>
<td>100</td>
</tr>
<tr>
<td>Project No.</td>
<td>Interconnected Systems</td>
<td>Capacity (MW)</td>
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<tr>
<td>------------</td>
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</tr>
<tr>
<td>4</td>
<td>P.Malaysia – Sumatra (2017)</td>
<td>600</td>
</tr>
<tr>
<td></td>
<td>- Melaka – Pekan Baru</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>West Kalimantan - Sarawak (2015)</td>
<td>230</td>
</tr>
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Challenges

- Harmonization of common technical standards codes or guidelines in the areas of Planning and Design, System Operation and Maintenance
- Harmonization of legal and regulatory framework for bilateral and cross-border power interconnection and trade
- Functional area knowledge (skills, experiences)
- Financing Modalities for funding sources to APG realization
- National Policy
- Cooperation among ASEAN Energy Agency such as HAPUA, ASCOPE, AFOC
- High penetration of intermittent renewable energy sources
- Fuel subsidiary (price distortion)
Way to Overcome Challenges

- Hiring an expert to conduct harmonization study for ASEAN Power Grid
  (conceptual road map for technical harmonization is to set up 1. ASEAN TSOs 2. Grid Planers Platform 3. ASEAN Electricity Regulators 4. Trial Operation of Guidelines 5. Minimum Common Standards)

- Establishment of ASEAN Residential School in Electric Power Engineering (ARSEPE)

- Funding sources or financial support to be assisted and sought by AIFM

- Deregulation or relaxation of regulation to assist private investment

- National Expert Group on specific field
  (less dependency on non ASEAN countries)

- Introduction on sub-regional interconnection (such as GMS)

- Restructure HAPUA Working Group