MALAYSIA’s RECENT DEVELOPMENT IN RE & ASEAN POWER CONNECTIVITY

Sabar Md Hashim
TNB Special officer
Energy Section
Economic Planning Unit
Prime Minister’s Department, Putrajaya
CAVEAT

• The items presented are taken from official Government agencies
• However, the issues deliberated may not be necessarily reflect the official position of the institution that the author comes from
Sustainable Usage of Energy to Support Growth

Strategy Paper

17
## Malaysia Electricity Supply Industry

- Energy - is the cornerstone of any economy & vital to sustain positive economic growth
- Guided by the needs to ensure energy security and adequacy of supply
- In terms of fuel mix, the share of coal to the total generation mix is expected to experience minimal increase from 41.6% in 2010 to 43% in 2015, while natural gas is expected to decline from 51.5% in 2010 to 40.1% in 2015, as shown in Exhibit 17-7. [Source: 11MP, EPU]

### Exhibit 17-7:

<table>
<thead>
<tr>
<th></th>
<th>Oil</th>
<th>Coal</th>
<th>Gas</th>
<th>Hydro</th>
<th>RE</th>
<th>Total (GWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Malaysia</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>1.4</td>
<td>41.6</td>
<td>51.5</td>
<td>5.4</td>
<td>0.1</td>
<td>108,175</td>
</tr>
<tr>
<td>2013</td>
<td>3.2</td>
<td>38.3</td>
<td>46.9</td>
<td>10.4</td>
<td>1.1</td>
<td>143,497</td>
</tr>
<tr>
<td>2015e</td>
<td>0.4</td>
<td>43.0</td>
<td>40.1</td>
<td>14.4</td>
<td>2.1</td>
<td>158,843</td>
</tr>
<tr>
<td><strong>Tenaga Nasional Berhad</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>0.1</td>
<td>43.3</td>
<td>51.6</td>
<td>5.0</td>
<td>0.0</td>
<td>96,495</td>
</tr>
<tr>
<td>2013</td>
<td>2.5</td>
<td>43.0</td>
<td>49.6</td>
<td>4.6</td>
<td>0.2</td>
<td>120,893</td>
</tr>
<tr>
<td>2015e</td>
<td>0.0</td>
<td>51.5</td>
<td>41.9</td>
<td>4.5</td>
<td>2.1</td>
<td>128,006</td>
</tr>
<tr>
<td><strong>Sabah Electricity Sdn. Bhd.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>26.3</td>
<td>0.0</td>
<td>60.0</td>
<td>10.2</td>
<td>3.5</td>
<td>4,332</td>
</tr>
<tr>
<td>2013</td>
<td>18.0</td>
<td>0.0</td>
<td>58.3</td>
<td>6.6</td>
<td>17.2</td>
<td>7,433</td>
</tr>
<tr>
<td>2015e</td>
<td>3.0</td>
<td>0.0</td>
<td>85.0</td>
<td>3.3</td>
<td>8.7</td>
<td>8,383</td>
</tr>
<tr>
<td><strong>Sarawak Energy Berhad</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>3.6</td>
<td>43.3</td>
<td>45.7</td>
<td>7.4</td>
<td>0.0</td>
<td>7,347</td>
</tr>
<tr>
<td>2013</td>
<td>1.0</td>
<td>20.2</td>
<td>20.0</td>
<td>58.6</td>
<td>0.4</td>
<td>15,171</td>
</tr>
</tbody>
</table>
| 2015e          | 1.7 | 10.5 | 12.8| 75.0  | 0.0 | 22,453      

Note: Estimates
Source: Energy Commission
Malaysia Electricity Supply Industry (cont.)

- Malaysia has been endowed with a lot of natural resources. We are oil & gas producing nation. In terms of reserve life span, our oil reserves can last for about 27 years while gas reserve life is 51 years.
- However, we want to be prudent in the management and utilization of resources.
- For generation-mix, we want to achieve a sustained and cost-efficient energy supply without depriving future generations.
- Traditional approach – least-cost.
- But we are aware there are overarching items and concerns such as sustainability agenda.
- We also want to ensure adequate connectivity and social safety net.
- But we are gradually doing away with subsidies.
- Malaysia’s efforts in transforming and ensuring sustainability of the rural electrification system.
- But we have challenges - and that include legacy issues and other challenges… faces multi-dimensional challenges to deliver reliable and affordable electricity supply to consumers as well as to support national development objectives.
  - Depleting indigenous energy resources,
  - Overdependence on fossil fuels;
  - increasing costs of new planting up,
  - volatile fuel prices,
  - high consumption growth rate
  - Lack of holistic demand side management
  - strong public concerns on the issues of environment
  - Moderate growth in RE
Generation Mix by Fuel, 2006–2013

<table>
<thead>
<tr>
<th></th>
<th>Hydro</th>
<th>Gas</th>
<th>Coal</th>
<th>Oil</th>
<th>Biomass</th>
<th>Renewables*</th>
<th>Others**</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>6.08</td>
<td>64.82</td>
<td>25.62</td>
<td>2.14</td>
<td>0.55</td>
<td>0.07</td>
<td>0.71</td>
</tr>
<tr>
<td>2011</td>
<td>6.30</td>
<td>43.86</td>
<td>41.16</td>
<td>7.41</td>
<td>1.04</td>
<td>0.21</td>
<td>0.02</td>
</tr>
<tr>
<td>2013</td>
<td>8.45</td>
<td>48.54</td>
<td>38.86</td>
<td>3.21</td>
<td>0.56</td>
<td>0.33</td>
<td>0.05</td>
</tr>
</tbody>
</table>

Notes: * Renewables including solar PV, mini hydro, biogas, municipal solid waste except biomass
** Others refer to co-generation and self-generation
Source: Energy Commission
Fuel Mix Projection: Peninsular Malaysia

- **2014**: 52% Coal, 44% Gas, 5% Hydro, 1% RE
- **2015**: 50% Coal, 44% Gas, 5% Hydro, 1% RE
- **2016**: 56% Coal, 37% Gas, 5% Hydro, 2% RE
- **2017**: 57% Coal, 37% Gas, 5% Hydro, 2% RE
- **2018**: 59% Coal, 34% Gas, 5% Hydro, 2% RE
- **2019**: 64% Coal, 29% Gas, 4% Hydro, 2% RE
- **2020**: 64% Coal, 29% Gas, 3% Hydro, 4% RE

Legend:
- Red: Coal
- Blue: Gas
- Green: Hydro
- Light Blue: RE
ELECTRIFICATION

- We have some degree of success in ensuring high electrification rates.

**Electrification Rates by Region, 2010-2015**

<table>
<thead>
<tr>
<th>Region</th>
<th>2010 (%)</th>
<th>2013 (%)</th>
<th>2015(^e) (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peninsular Malaysia</td>
<td>98.9</td>
<td>99.7</td>
<td>99.9</td>
</tr>
<tr>
<td>Sabah</td>
<td>84.4</td>
<td>92.9</td>
<td>95.1</td>
</tr>
<tr>
<td>Sarawak</td>
<td>72.1</td>
<td>88.0</td>
<td>94.0</td>
</tr>
<tr>
<td>National</td>
<td>92.5</td>
<td>96.9</td>
<td>98.2</td>
</tr>
</tbody>
</table>

Notes: \(^e\) Estimates
Source: Ministry of Rural and Regional Development

- Majority of the rural electrification projects were undertaken through grid connection. For remote areas and to far from the grid, alternative systems such as mini hydro, solar hybrid and biomass were utilised.
- By the end of the year 2014, the electrification programme in the whole of Malaysia was 98.22%.
Initiatives to Address Energy Access in Energy-Poverty-Stricken Areas in Malaysia

In order to increase energy access in energy-poverty-stricken areas especially in remote parts of the country, the Malaysian Government has adopted a three-pronged approach:

- innovative financial support,
- renewable energy driven initiatives, and
- social security net programmes for low income households
The RE development was given an impetus after the Renewable Energy Act, 2011 was enforced on 1 December 2011 and the Feed-in Tariff (FiT) mechanism was introduced. The FiT allows electricity to be generated from RE sources to be sold to utility companies at a fixed premium price for a specific duration.

Slow growth - In 2014, RE sources contributed 243.4 MW or 1% of the total installed capacity in Peninsular Malaysia and Sabah, as shown in Exhibit 17-12. As of 2013, this initiative reduced GHGs emission by 432,000 tCO₂eq. (11MP, EPU)
Outcome-based Strategy 1: Aspirational target to increase the component of RE to 23% by 2025 in the ASEAN Energy Mix.

Action Plans:

a. The AMS to enhance and implement RE policy and targets.
b. Develop and adopt ASEAN RE Roadmap by 2020.
c. Monitor RE capacity additions/deployment of the AMS on an annual basis.

Outcome-based Strategy 2: Enhance awareness on the role of renewable energy among policy makers, private sectors and public.

Action Plans

a. Develop a nodal network with at least minimum two (2) regional or international institutions on renewable energy by 2020.
b. Develop an RE-hub information sharing mechanism among AMS on renewable energy data, policy instruments, policy update, and best practices for promoting renewable energy.
ASEAN

- ASEAN Member States will intensify collaboration with its partners to work towards achieving greater energy security and enhancing ASEAN connectivity
- called for greater support and cooperation from Governments, industries, companies and individuals in order to achieve a sustained and cost-efficient energy supply without depriving future generations
- Electrification to all citizens is a major goal too
- We value mutual understanding and cooperation
THE ASEAN PLAN OF ACTION FOR ENERGY COOPERATION (APAEC) 2016-2025
PHASE 1: 2016-2020
Theme: “Enhancing Energy Connectivity and Market Integration in ASEAN to Achieve
Energy Security, Accessibility, Affordability and Sustainability for All”.

“Energy is key to the realisation of the ASEAN Economic Community (AEC) which calls for a
well-connected ASEAN to drive an integrated, competitive and resilient region.
ASEAN is now one of the most dynamic and fastest growing economic regions in the world,
and through the implementation of the AEC by end of December 2015, this growth is expected
to continue. The region is projected to grow by at least 4% per year on average over the next
five years, but could be as high as 6% - provided ASEAN moves towards greater integration,
where member states continuously implement domestic structural reforms to raise their
productivity and competitiveness under the framework of the AEC.”

The key initiatives under this APAEC include embarking on multilateral electricity trading to
accelerate the realisation of the ASEAN Power Grid (APG), enhancing gas connectivity by
expanding the focus of the Trans-ASEAN Gas Pipeline (TAGP) to include Liquefied Natural Gas
(LNG) regasification terminals as well as promoting clean coal technologies. It also includes
strategies to achieve higher aspirational targets to improve energy efficiency and increase the
uptake of renewable energy sources, in addition to building capabilities on nuclear energy.
The key strategies of the seven Programme Areas of the APAEC 2016-2025 Phase 1:

<table>
<thead>
<tr>
<th>1. ASEAN Power Grid</th>
<th>To initiate multilateral electricity trade in at least one sub-region by 2018.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Trans ASEAN Gas Pipeline</td>
<td>To enhance connectivity for energy security and accessibility via pipelines and regasification terminals.</td>
</tr>
<tr>
<td>3. Coal &amp; Clean Coal Technology</td>
<td>To enhance the image of coal through promotion of clean coal technologies (CCT).</td>
</tr>
<tr>
<td>4. Energy Efficiency &amp; Conservation</td>
<td>To reduce energy intensity by 20% in 2020 based on 2005 level.</td>
</tr>
<tr>
<td>5. Renewable Energy</td>
<td>Aspirational target to increase the component of renewable energy to 23% by 2025 in ASEAN Energy Mix.</td>
</tr>
<tr>
<td>6. Regional Energy Policy and Planning</td>
<td>To better profile the energy sector internationally.</td>
</tr>
<tr>
<td>7. Civilian Nuclear Energy</td>
<td>To build capabilities in policy, technology and regulatory aspects of nuclear energy.</td>
</tr>
</tbody>
</table>
ASEAN POWER GRID

HAPUA has also identified three (3) APG Priority Projects for completion and three (3) additional APG projects which will commence construction, out of the sixteen (16) APG planned and committed projects for commencement, as shown in Figure 1. Through these interconnection projects, it is expected that power exchange and purchase will almost triple from 3,489 MW in 2014 to 10,800 MW in 2020, and further increase to 16,000 MW post-2020.
Malaysia’s electricity cooperation in ASEAN

- Regionally, Malaysia’s electricity power grid, operated and owned by Tenaga Nasional Berhad (TNB), is electrically connected to Thailand and Singapore under the framework of ASEAN Power Grid (APG).
- Peninsular Malaysia is presently connected via a 200 MW capacity network with Singapore and 380 MW capacity with southern Thailand.[1]

Malaysia also aspire to be interconnected to Indonesia via
- West Kalimantan via Sarawak in 2015 (a SEB-PLN arrangement) with quantum power of 230 MW (nominal 200 MW). Both parties have signed an agreement for bilateral exchange. Currently, the project is ongoing, and it is expected to be completed by next year.
- Sumatra through Malacca-Pekan Baru in 2017 with quantum of 600 MW or more[2].
- Now Malacca-Riau interconnection by 2020.
- East Kalimantan via Sabah in 2019 for a 200 MW transfer.
The Sarawak-Brunei-Sabah 600 MW transfer also sounds promising,
- With regard to connection to Brunei, the project is still at the conceptual stage at this moment in time.

[1] With Thailand, the original 117 MVA, 132 kV Single Circuit Line HVAC interconnection of 80 MW with Electricity Generating Authority of Thailand (EGAT) was commissioned in 1981, linking Bukit Ketri in the state of Perlis with Sadao in Thailand. A second interconnection was made via the HVDC Thailand-Malaysia rated at 300 kV HVDC and 300 MW transmission capacity. For Singapore, the National Grid is connected to the transmission system of Singapore Power Limited (SP) at Senoko via two 230 kV submarine cables with a transmission capacity of 200 MW.
Peninsular Malaysia is interconnected with Thailand in the North and Singapore in the South.

1. **TNB-EGAT Interconnection**
   - **Gurun – Khlong Ngae**
     - 300kV HVDC Monopole
     - Capacity of 300MW
     - Mode of Operation: Power Purchase
   - **Chuping - Sadao**
     - 132kV HVAC
     - Capacity of 80MW
     - Mode of Operation: Energy Transaction

2. **TNB-PGL Interconnection**
   - **Plentong-Senoko**
     - 275kV HVAC
     - Capacity of 2x250MVA (450MA)
     - Mode of Operation: Energy Exchange
ASEAN POWER GRID – Future
projects

Peninsular Malaysia – Sumatera interconnection

The commercial arrangement governing the HVDC i.e. Power Exchange Agreement (PEA) & Interconnection Agreement (IA) have achieved progress and substantial closure.

PLN wants to develop HVDC ICX on commercial basis (involve commercial transaction) instead of strategic basis (includes security of supply and optimum use of resources).

As at May 2015, PLN has reiterated their goal to explore an IPP-like concept for the commercial arrangement;
Peninsular Malaysia – Sumatera HVDC Interconnection (HVDC ICX)

LEGEND:
- Converter Station
- HVDC overhead line
- HVDC submarine cable

Teluk Gong Converter Station
Perawang Converter Station
Challenges: additional requirements

a) Indonesian party wants to develop HVDC ICX on commercial basis (involve commercial transaction) instead of strategic basis (includes security of supply and optimum use of resources);

b) Consider various financing options

c) Pricing - Due to PLN’s intention to develop the Project on commercial basis the commercial viability would be achieved if only Piped Natural Gas (PNG) price in Malaysia is higher than RM 40/mmbtu, 1USD = RM4;

d) Current PNG price is RM16.70/mmbtu;

e) Gas price was increased based on two-tier pricing mechanism starting 1st Jan 2014:
   i. supply up to 1,000 mmscfd at 16.7 RM/mmbtu (increase of 1.5 RM/mmbtu every 6 month); and
   ii. supply beyond 1,000 mmscfd at discounted LNG market price (revised quarterly).

f) Only by January 2026 the forecasted gas price of RM 40/mmbtu (provided the increase is according to planned fuel subsidy rationalization).
LAOS-THAILAND-MALAYSIA-SINGAPORE (LTMS)

At the 32nd AMEM held on 23 September 2014 in Vientiane, Lao PDR, Ministers welcomed the new initiative to undertake a pilot project to explore cross-border power trade involving four (4) ASEAN Member States. The pilot project, entitled “Lao PDR, Thailand, Malaysia, Singapore (LTMS) Power Integration Project (PIP)”, will serve as a pathfinder to enhance multilateral electricity trading beyond neighbouring borders towards realising the APG.
Existing and Plan Cross – border interconnection

- **Existing Grid System and Cross-Border Interconnections**
  (as of the end of October, 2014.)

<table>
<thead>
<tr>
<th>Voltage Level</th>
<th>EDC</th>
<th>EVN</th>
<th>CSG</th>
<th>EGAT</th>
<th>PEA</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>22/35 kV</td>
<td>1</td>
<td>5</td>
<td>3</td>
<td></td>
<td></td>
<td>16</td>
</tr>
<tr>
<td>115 kV</td>
<td></td>
<td>1</td>
<td>5</td>
<td></td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>230 kV</td>
<td>1</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>500 kV</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1</td>
<td>6</td>
<td>4</td>
<td>9</td>
<td>7</td>
<td>27</td>
</tr>
</tbody>
</table>

**Remarks:**
- 22/35kV – Import
- 115kV – Exchange
- 230kV – Purely Export
- 500kV – Purely Export
Physical Flow

Note:
• Between Lao PDR-Thailand: without Power Flow Control (without ACE)
• Between Thailand-Malaysia: Controlled by Pole Control of HVDC
• Between Malaysia-Singapore: AGC setting of Area Control Error (ACE)
Legal & Regulatory Framework
▪ Requirements to import and sell electricity in Singapore’s Wholesale Electricity Market

Commercial Arrangement
▪ Possible Contractual Frameworks to import electricity from Laos to Singapore

Tax & Tariff Structure
▪ Wheeling Charges
▪ Balancing Charges
▪ Taxes

MOU
▪ Draft prepared by Malaysia under discussion
OVERALL CHALLENGES & OBSTACLES IN ANY TRANSCOUNTRY AGENDA - COMMON ITEMS & PARAMETER

- POLITICAL WILL
- TRUST
- FINANCE
- TECHNICAL*
- LEGAL & REGULATORY*
- HARMONISATION OF STANDARDS*

DONE under previous APAEC:
“A key achievement of HAPUA was the completion, in 2012, of the ASEAN Interconnection Master Plan Studies (AIMS) II, which incorporates key updates from ASEAN Member States including long-term power demand forecasts and identification of feasible interconnection projects.

To move forward on the harmonisation of the technical, legal and regulatory framework and identification of financial modalities, HAPUA successfully worked with the Asian Development Bank (ADB) on the “Harmonisation of Technical Codes and Guidelines in the Area Planning and Design, System Operation and Maintenance for the ASEAN Power Grid” project which was completed in 2013.
Thank You
www.epu.gov.my