Role of cross-border interconnector to support decarbonisation

Asia Clean Energy Forum 2024
Session 3.1 - Governance and Optimal Planning of Electricity Transmission and Distribution Infrastructure

Dr. Peerapat Vithayasrichareon
Principal Consultant, Energy Systems APAC region

4 June 2024
Electricity is the main stream of the energy transition

- A massive shift in the electricity mix – Almost 70% of electricity will come from solar and wind in 2050
- Increasing share of wind and solar PV requires greater flexibility to ensure the security of electricity supply
- Grid infrastructure (domestic and cross-border) and other flexibility resources are key to integrate wind and solar
  - Grid (transmission and distribution) will both double in length
DNV’s insights report shows power grids cannot adequately connect renewable energy sources to areas of high demand.

76% of power industry professionals say grid infrastructure cannot adequately connect sources of renewable energy to areas of high demand.

Source: DNV Industry Insights 2023

| 81% | THERE IS AN URGENT NEED FOR GREATER INVESTMENTS IN THE POWER GRID |
| 65% | AGING POWER GRID INFRASTRUCTURES ARE A SIGNIFICANT BARRIER TO GREATER USE OF RENEWABLES |

- **Electrical power**
  1. Skills shortage
  2. Lack of policy/government support
  3. Lack of investment in technology/innovation

- **Renewables**
  1. Lack of policy/government support
  2. Permitting/licensing barriers for new projects
  3. Skills shortage

- **Energy consumers**
  1. Lack of investment in technology/innovation
  2. Skills shortage
  3. Global economic conditions
Flexibility resources are key to integrate renewables

**Electricity Grid**
- Cross-border interconnections
- FACTS devices, special protection schemes, DLR

**Generation**
- Inertia, fast frequency response, primary response
- Cycling and quick start;

**Storage**
- Battery (short-term), Pumped Storage Hydro (medium term)
- Hydrogen (long-term)

**Demand response**
- Demand side options (e.g. load shifting)
- Smart meters

- Appropriate policy, market and regulatory frameworks can enable participation of flexibility resources
- Power sector planning needs to be more integrated.
- Integrated and co-ordinated planning can help identify appropriate options for future power systems
Regional interconnection plays a key role to support RE integration and decarbonisation

- Regional cooperation in cross-border trading plays a key role towards decarbonisation in 2050
- Sharing low-cost and low-carbon resources
- Significant economic and environmental benefits
  - Reduce resource requirements and footprints
  - Net-zero emission vision

The regional approach will require 3.75 mil km of additional electrical infrastructure.

The regional approach will reduce the need of

- 600 GW less solar capacity to be installed
- 1.2 TWh electricity storage
- 16 TWh hydrogen storage
Potential value of cross-border interconnections

- **Economic benefits**
  - $800 billion cost savings in decarbonisation
  - Savings in peak capacity needs
  - Allowing sharing of low-cost renewables and enabling cross-border power trade.

- **Enhance energy security**
  - Sharing of reserve between systems
  - Larger geographical spread can smooth the variability of overall VRE generation
  - Sharing of resources (i.e. storage)

*Estimated costs for decarbonising ASEAN power systems*

*ASEAN Interconnector Study: Taking a regional approach to decarbonization*
The biggest challenges to implement regional power grid are more socio-political than technical

<table>
<thead>
<tr>
<th>Technical</th>
<th>Financial and economic</th>
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<tbody>
<tr>
<td>• Concerns over energy security due to unreliable domestic grids</td>
<td>• Uncertainties on funding source, ownership structure, and remuneration.</td>
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<td>• Impact of high RE penetration leading the country to prioritise domestic grid</td>
<td>• Vertically integrated market structure - investment in power grids needs support from governmental and private stakeholders</td>
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<td>• Limited technical expertise in building and operating cross-border interconnections (both HVDC and HVAC)</td>
<td>• Limited financial resources of electric utilities and governments to invest in grids, including cross-border interconnectors</td>
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<th>Policy and regulatory framework</th>
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<td>• A diverse set of policies and market structure among ASEAN countries</td>
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<tr>
<td>• Lack of policy support</td>
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<tr>
<td>• Uncertainty in political will and institutional arrangements</td>
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<td>• Lengthy regulatory process in permitting and licensing</td>
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## Priorities to support regional power grid in ASEAN

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<tr>
<th>Year</th>
<th>2023</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
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<tr>
<td><strong>Coordinate and harmonize regional policy framework</strong></td>
<td>Establish a taskforce and increase coordination</td>
<td>Conduct small-scale pilots</td>
<td>Learn from other regions and sectors</td>
<td>Setting a consistent and coordinated ASEAN power trading framework</td>
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<td><strong>Address financial risks and uncertainty to unlock investment</strong></td>
<td>Policy support for interconnector financing and de-risk investment</td>
<td>Remuneration certainty and clarity on transmission ownership</td>
<td>Regulatory streamlining for technology</td>
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<td><strong>Secure supply chain and resource development in Southeast Asia</strong></td>
<td>Establish a local supply chain for grid components in the region</td>
<td>Set common procurement processes and technical specifications</td>
<td>Develop local human resources</td>
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The energy transition is accelerating with decarbonisation goal
Solar and wind will be the main source of electricity generation

All system resources can facilitate the transition
Generation, power grids (domestic and cross-border), storage and demand response

Regional power grids cannot be ignored
Cross-border interconnections can provide significant technical and economic benefits and play a key role towards decarbonisation but there are challenges to develop and implement

Market design, rules and regulations need revisited
Appropriate market arrangements, rules and regulations can address technical and economic challenges

Engagement of policymakers, regulators, system operators and industry is key to facilitate the high penetration of renewables and regional integration
Thank you

Peerapat.vithaya@dnv.com

www.dnv.com
Backup slides
Why relevant: Grid congestion slows down economic growth, thwarts investment plans and delays the energy transition.

Improve insights
Increase grid capacity
Smarter grid operations
Reduce/change demand

Generation (feed-in)  Demand (off-take)

Source: https://capacitetskaart.netbeheernederland.nl/
Power sector planning needs to be more integrated

- Power sector planning traditionally focused on developing supply sources and infrastructure to meet demand but the landscape is changing
- Integrated and co-ordinated planning can help identify appropriate options for future power systems