Solar PV in ASEAN –
Key Challenges and Opportunities

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Our Centre at UNSW Australia

The Centre for Energy and Environmental Markets (CEEM) inspires and informs the transition to a more sustainable energy future nationally and internationally through objective interdisciplinary research.
Presentation outline

- Background - ASEAN context
- Challenges for ASEAN Electricity Sector
- Key technology trends and renewables in ASEAN
- PV potential and progress in ASEAN
- Policies and measures to support PV deployment
- Barriers to PV deployment
- PV in Australia – lessons for ASEAN
ASEAN context

- Large population size – 9% of world population
- Fast socioeconomic development
- One of the fastest developing regions in the world
- Play an increasing important role in the world energy demand
  - Rapid energy demand growth
  - 5% share of world energy demand compared with 2% in 1980

- Large investment in electricity supply infrastructure required to meet electricity demand growth.
- Five largest energy consumers in ASEAN are Indonesia, Thailand, Malaysia, Philippines and Vietnam
**ASEAN context**

- Fast electricity demand growth – around 5% per year
- Low per capita electricity consumption - one fifth of the OECD.
- Brunei and Singapore have the largest kWh consumption per capita

**Electricity consumption per capita**

**GDP and kWh per capita**

(IEA, 2013)
ASEAN Electricity Sector

- Significant reliance on fossil fuels (coal, gas, oil) for electricity generation.
- Minimal non-hydro renewables

Share of electricity generation by fuel types in ASEAN in 2013
Environmental situation in ASEAN

- CO₂ emission is increasing – due to increased demand, large share of fossil fuel in electricity generation.
- CO₂ intensity (per kWh of electricity output) in ASEAN is high
  - High-emitting generation sources, inefficient power stations
- Share of global CO₂ emissions is 4% compared with 1% in 1980.
## Characteristics of ASEAN

<table>
<thead>
<tr>
<th>Country</th>
<th>Sources</th>
<th>Situation</th>
<th>Focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Myanmar</td>
<td>Abundant hydro, gas</td>
<td>Low energy consumption</td>
<td>Increase electrification</td>
</tr>
<tr>
<td>Lao PDR</td>
<td>Abundant hydro</td>
<td>Increased power export</td>
<td>Increase electrification</td>
</tr>
<tr>
<td>Vietnam</td>
<td>Hydro, fossil</td>
<td>Rapid demand growth</td>
<td>Developing competitive market, plan for nuclear</td>
</tr>
<tr>
<td>Thailand</td>
<td>Gas, Biomass</td>
<td>Heavy reliance on gas</td>
<td>Fuel diversification</td>
</tr>
<tr>
<td>Philippines</td>
<td>Abundant Geothermal</td>
<td>Reliance on import</td>
<td>Increase electricity access, improve energy security</td>
</tr>
<tr>
<td>Malaysia</td>
<td>Gas, oil</td>
<td>Net gas exporter</td>
<td>Reduce energy intensity, Energy Efficiency</td>
</tr>
<tr>
<td>Indonesia</td>
<td>Coal, oil</td>
<td>Rapid demand growth</td>
<td>Increase electrification, reduce fossil fuel</td>
</tr>
<tr>
<td>Cambodia</td>
<td>Large oil &amp; gas reserve</td>
<td>High electricity costs</td>
<td>Increase electrification, develop infrastructure</td>
</tr>
<tr>
<td>Brunei</td>
<td>Oil and gas</td>
<td>High energy demand, net exporter</td>
<td>Improve energy efficiency</td>
</tr>
<tr>
<td>Singapore</td>
<td>Gas</td>
<td>Major gas hub, high per capita demand</td>
<td>Fuel diversification, R&amp;D in RE technologies</td>
</tr>
<tr>
<td>Cambodia</td>
<td>Large oil &amp; gas reserve</td>
<td>High electricity costs</td>
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*(IEA, 2013)*
Challenges for electricity sectors in ASEAN

- Satisfying electricity demand growth in a sustainable manner – minimise costs, energy security, environmental impacts
- 134 million people in ASEAN have no electricity access – 22%.
- **Renewables** have the potential to address most of these challenges
  - Cheap to run, no emissions, high investment cost but reducing rapidly.
  - No energy security concerns due to reliance on fuel import or fossil-fuel price fluctuation.
Key technology trends

- PV is one of the fastest growing RE technologies worldwide
  - Rapid technological progress and cost reductions.
  - Potential to address energy security and climate change concerns.
  - Third most important RE sources in terms of installed capacity
- Largest growth has been in Europe but Asia (excl. China) is catching up

Leading countries in Asia Pacific:
- Japan, Korea, Australia, Thailand, Taiwan

PV potential in ASEAN

- Huge renewable energy potential in ASEAN
  - Hydro, solar, biomass
- PV deployment is still low – economic and non-economic barriers

- PV attractiveness – i.e. cost competitiveness, irradiation, size of the elec. market.
- Country’s attractiveness – i.e. political and business environment
PV potential in ASEAN – Global Context

Europe: 89 GW (4%)
Japan: 23 GW (2.5%)
ASEAN: 1.5 GW (<1%)
Australia: 4 GW (2%)

PV capacity at the end of 2014
Progress of PV in ASEAN

- Majority is in solar farms but less for distributed and off-grid PV systems
- Thailand, Malaysia and Philippines are leading the development.
- Potential to become a new manufacturing base of PV systems
- Thailand has the highest PV capacity
  - 1.5 GW in 2014 but is increasing to 2.5 GW by the end of 2015
  - Feed-in-Tariffs (FiTs) with long-term PPAs (at $0.2/kWh for 25 years)
  - Mainly solar farms but expanding to residential

- ASEAN has one of the largest solar farms in the world – 84 MW capacity
  - Lopburi, Thailand
  - 220 hectare, 0.5 million solar panels
  - US$335 million investment
Influence of energy and climate policies

- Policies have a key role to play to promote and ensure successful integration of RE technologies.
  - Increase the value of RE in relation to fossil-fuel technologies
  - Increase confidences for investment and deployment in solar PV
- As with other new RE tech, PV remains a policy driven market
  - FiTs are the main policy for driving deployment of renewables in ASEAN.
  - New investment/installation is influenced by support schemes.
  - Asia and Pacific region has become a significant market for PV installation – China, Korea, Japan, Australia, Thailand
# Renewables supporting measures

<table>
<thead>
<tr>
<th>Category</th>
<th>Measures</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Regulatory policies and mandate</strong></td>
<td>• RETs, carbon pricing, FiTs, RPS, RE Certificates (REC).  &lt;br&gt; • RET schemes create demand for additional RE energy by placing a legal obligation on electricity utilities.  &lt;br&gt; • FiTs is the most widely used scheme</td>
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<tr>
<td><strong>Fiscal incentives</strong></td>
<td>• Address the cost and finance barriers that hinder investment in RE technologies  &lt;br&gt; • Capital subsidies, rebates and tax reduction  &lt;br&gt; • Providing social, economic, environmental benefits</td>
<td></td>
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<tr>
<td><strong>Public financing</strong></td>
<td>• provided by governments in the forms of loans and grants to support innovation in RE technologies</td>
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Energy and climate policies

- Countries with RE policies and targets have increased significantly
- Energy policies vary across ASEAN countries - depends on political and economic situations, resource endowments
  - Common themes – increase energy security, reduce costs, environmentally sustainable.
## Key Energy Policies and RE Targets (1)

<table>
<thead>
<tr>
<th>Country</th>
<th>Key Energy Policies</th>
<th>Renewable targets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indonesia</td>
<td>• Increase electricity access to 99% by 2020</td>
<td>• 26% renewable electricity by 2025</td>
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<td></td>
<td>• 26% GHG reduction targets by 2020</td>
<td>• 160 MW of PV capacity or 1% share of generation by 2025</td>
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<td></td>
<td>• Reduce the share of fossil fuel</td>
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<td></td>
<td>• 2.1 GW of renewable electricity by 2030</td>
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<td></td>
<td>• 14% renewable electricity by 2030</td>
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<td>Thailand</td>
<td>• Diversify fuel mix from natural gas</td>
<td>• 10% renewable electricity by 2021</td>
</tr>
<tr>
<td></td>
<td>• Reduce energy intensity by 25% by 2030 compared with 2005 levels</td>
<td>• 6 GW of PV by 2036</td>
</tr>
<tr>
<td>Malaysia</td>
<td>• Reduce energy intensity by 10% by 2025 compared to BAU</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Reduce CO₂ intensity by up to 40% compared to 2005 levels by 2020.</td>
<td></td>
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<tr>
<td>Vietnam</td>
<td>• 100% electricity access by 2020</td>
<td>• 5% renewable electricity by 2020</td>
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<tr>
<td></td>
<td>• Reduce CO₂ intensity by 10% by 2020 compared with 2010 levels</td>
<td></td>
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<tr>
<td>Philippines</td>
<td>• Increase electricity access to 20% by 2017 (for small township)</td>
<td>• 40% renewable energy by 2020</td>
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<td></td>
<td>• Expand the grid to interconnect major islands</td>
<td>• 15 GW of renewables by 2030</td>
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<td></td>
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<td>• Additional 280 MW of PV</td>
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### Key Energy Policies and RE Targets (2)

<table>
<thead>
<tr>
<th>Country</th>
<th>Key Energy Policies</th>
<th>Renewable targets</th>
</tr>
</thead>
</table>
| **Singapore** | • Energy supply diversification  
• Reduce energy intensity by 35% by 2030 compared with 2005 levels  
• Reduce CO$_2$ intensity by 10% below the 2020 BAU levels | • 5% share of renewables by 2020  
• 350 MW of PV by 2020 |
| **Brunei**   | • Improve energy efficiency  
• Reduce energy intensity by 25% by 2030 from 2005 levels | • 10 MW PV by 2030  
• 10% RE by 2035 |
| **Myanmar**  | • Reduce primary energy consumption by 8% by 2030 compared to BAU | • 15-20% RE by 2020 |
| **Cambodia** | • Develop hydropower  
• Increase electricity access through off-grid RE | • 15% RE by 2015 |
| **Lao PDR**  | • Increase electricity access to 90% by 2020  
• Upgrade interconnectors to increase power exchange between Vietnam and Thailand | • 30% RE by 2025  
• 33 MW from solar |

*(OECD/IEA, 2013), (REN21, 2015)*
Policy Measures for PV

- In addition to RE targets, effective financial and non-financial measures must also be in place.
- Policies related with solar are bundled with other RE technologies.

- Developing policies
  - Fiscal incentives

- Regulatory: FiTs
  - Fiscal incentives

- Regulatory: FiTs
  - Fiscal: tax incentive
  - PDP, AEDP

- Regulatory: FiTs
  - Fiscal incentives

- Regulatory: Net metering
  - Public investment: Loan & grants

- Regulatory: FiTs
  - Fiscal incentives

- Regulatory: FiTs
  - Fiscal incentives

- Developing policies
### Barriers to PV development in ASEAN

<table>
<thead>
<tr>
<th>Category</th>
<th>Issues</th>
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<tbody>
<tr>
<td>Social</td>
<td>Lack of public awareness on the impact of climate change and the benefits of RE technologies</td>
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<tr>
<td>Economic</td>
<td>Relatively high capital and financing cost at present.</td>
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<tr>
<td>Technical</td>
<td>Lack of knowledge in the technology, installation, maintenance</td>
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<td></td>
<td>Impact on the grid due to its variability and partly unpredictability</td>
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<td></td>
<td>Inadequate transmission networks</td>
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<tr>
<td>Environmental</td>
<td>Land size for utility-scale solar PV – limited in some countries</td>
</tr>
<tr>
<td>Institutional</td>
<td>Lack of effective policies - uncoordinated and incoherent policies, weak RE targets</td>
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<td></td>
<td>Regulatory arrangements - long process in obtaining licenses</td>
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<td></td>
<td>Political stability</td>
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## Overcoming the barriers

| Social                      | • Disseminating information and consumer awareness on the impact of climate change and the benefits of PV  
|                            | • Transparency and public involvement in the electricity sector |
| Economic                   | • Providing fiscal incentives and public financing  
|                            | • Increase R&D efforts to reduce costs and increase efficiency  
|                            | • Internalising environmental externality costs |
| Technical                  | • Encourage more research and studies on the grid impact of PV  
|                            | • Need other grid technologies to complement PV – Storage options, smart grids |
| Environmental              | • Build solar farms in remote areas  
|                            | • Promote residential and community-scaled PV (e.g. rooftops) |
| Institutional              | • Schemes with fair remuneration and predictable level of support  
|                            | • FiTs, RPS, Net metering  
|                            | • Coherent policies among different governmental agencies  
|                            | • Streamlined procedures for providing permits/licences |
Regional collaboration is key

- Collaborations among ASEAN countries are essential to achieve higher PV deployment (and other RE technologies)
  - R&D collaboration, transfer of knowledge, know-how.
  - Optimising and sharing of solar resource through cross-border interconnection
  - Geographical diversifications - improved matching of PV generation and demand across different countries

- Common regulatory frameworks need to be established to ensure benefits for every country in the region.
- ASEAN Plan of Action for Energy Cooperation (APAEC) 2016 – 2025 provides a good framework – but need serious commitment and inputs from all member countries.
PV in Australia – Lessons for ASEAN

- 2.4 million installed, 4.5 GW capacity
- 5.6 TWh of PV generation (2.5% of total electricity consumption)
- Mostly grid-connected distributed but off-grid is increasing
PV in Australia – lessons for ASEAN

A range of PV support measures

- Regulatory policies and mandates – RE targets, RPS, FiTs, Carbon pricing (abolished in 2014)
- Fiscal incentives – capital subsidies, investment funds
- Public financing – loan and grants for R&D and commercialisation
According to the National Transmission Network Development Plan (NTNDP), PV will be the largest growth technology.
According to AEMO 100% renewable modelling study

Operational issues are manageable – no fundamental technical limitations to operate the 100% renewable power system generation portfolios

- Utilities and electricity market operators are preparing for high RE future
There are tools and publicly available data on solar PV
- Disseminating information to facilitate investment and research (capacity installed data, historical and live performance data)
- An example Live solar PV map is developed by the Australian PV Institute (APVI) to track the uptake and impact of PV
Summary and a way forward

- Huge potential for solar PV in ASEAN but needs support schemes
  - High solar irradiance in ASEAN but PV energy penetration level is still extremely low (less than 1%)
  - Need effective and coordinated policies and support schemes.

- Solar PV can help to address some of the main challenges facing ASEAN electricity sector
  - Electricity access in remote areas (Philippines, Indonesia, Cambodia),
  - Energy security – diversify fuel mix from fossil-fuel
  - Environment - climate change and local air pollution

- Need to strengthen regional collaboration among ASEAN countries in a number of aspects
Thank you,
and
Questions?
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