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# Solar PV in ASEAN – Key Challenges and Opportunities

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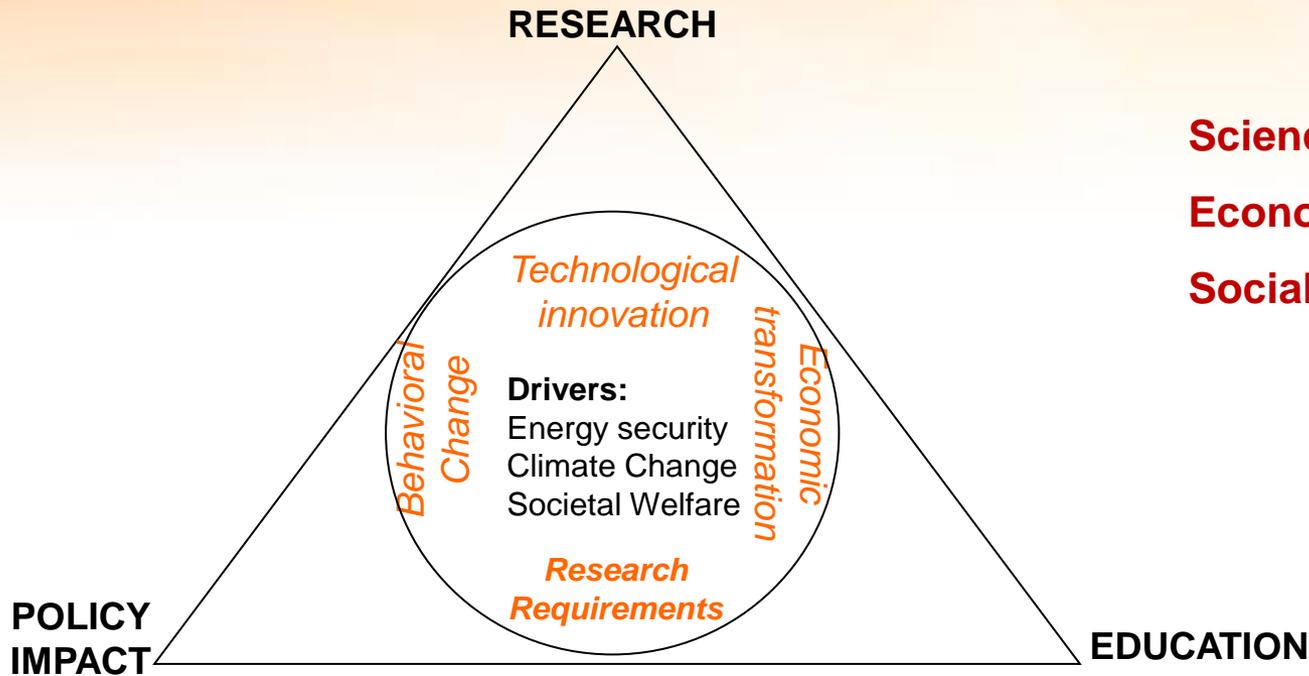
**Clean Energy Forum of East Asia Summit**

Haikou, China 18-19 November 2015



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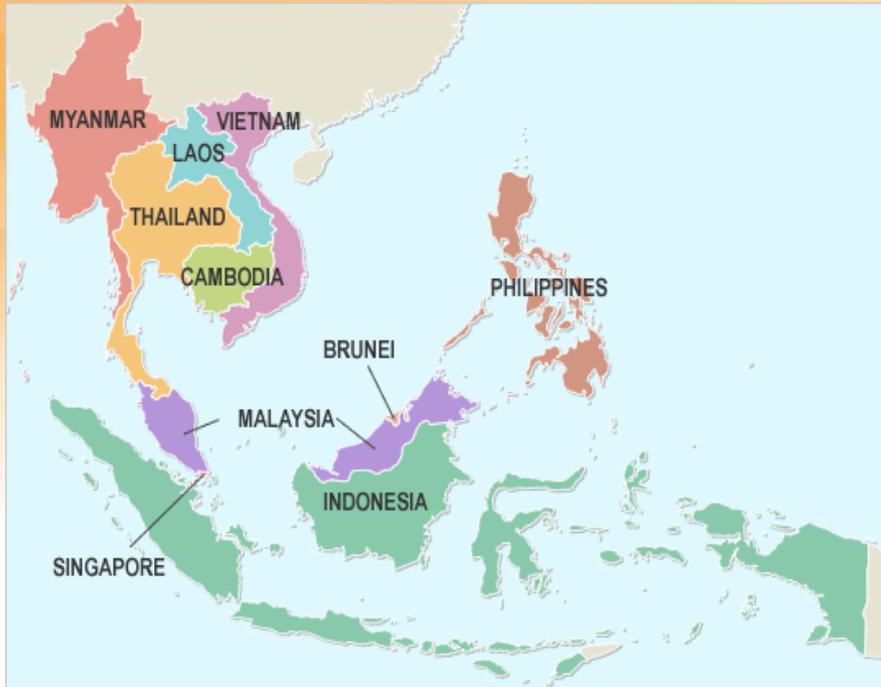


**Science & Engineering**  
**Economics**  
**Social Science**

# Presentation outline

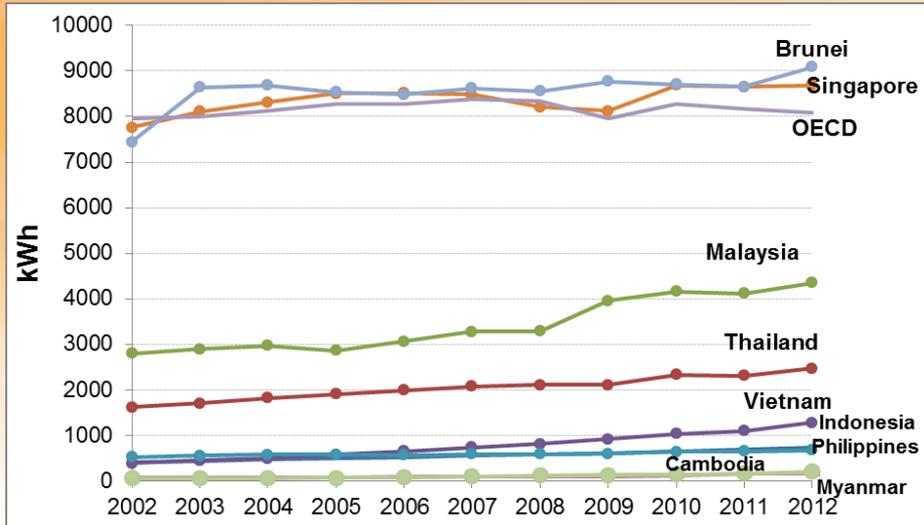
- Background - ASEAN context
- Challenges for ASEAN Electricity Sector
- Key technology trends and renewables in ASEAN
- PV potential and progress in ASEAN
- Policies and measures to support PV deployment
- Barriers to PV deployment
- PV in Australia – lessons for ASEAN

# ASEAN context

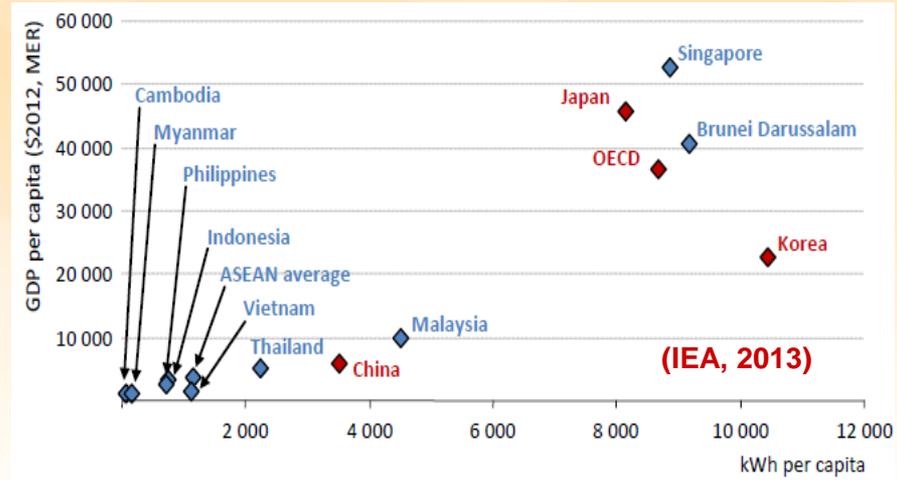


- Large population size – 9% of world population
  - Fast socioeconomic development
  - One of the fastest developing regions in the world
  - Play an increasingly important role in the world energy demand
    - Rapid energy demand growth
    - 5% share of world energy demand compared with 2% in 1980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



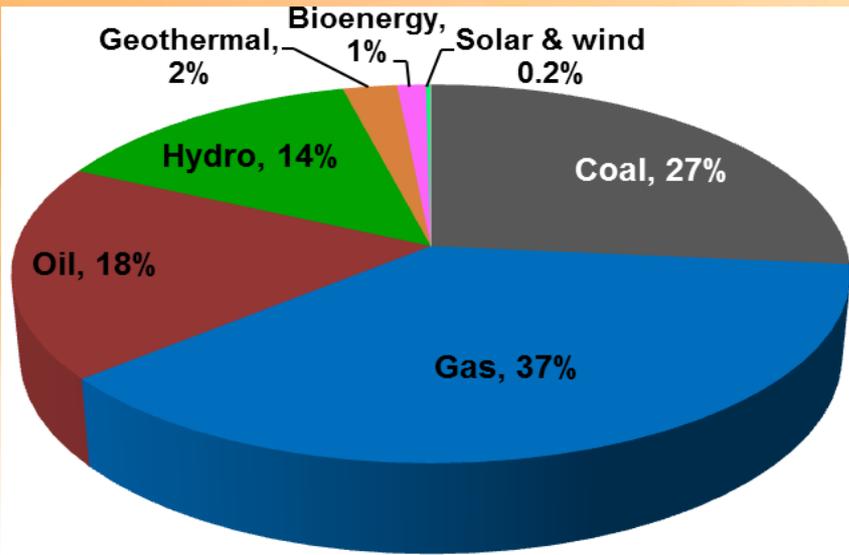
**Electricity consumption per capita**



**GDP and kWh per capita**

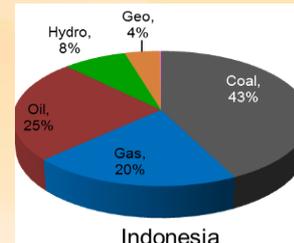
- Fast electricity demand growth – around 5% per year
- Low per capita electricity consumption - one fifth of the OECD.
- Brunei and Singapore have the largest kWh consumption per capita

# ASEAN Electricity Sector

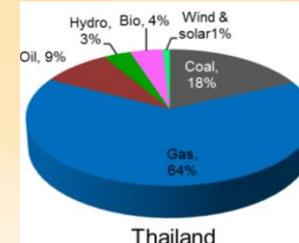


Share of electricity generation by fuel types in ASEAN in 2013

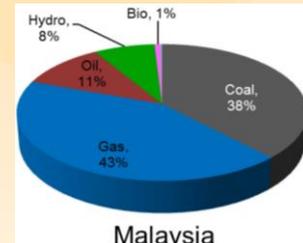
- Significant reliance on fossil fuels (coal, gas, oil) for electricity generation.
- Minimal non-hydro renewables



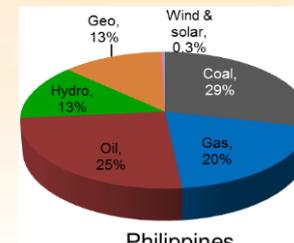
Indonesia



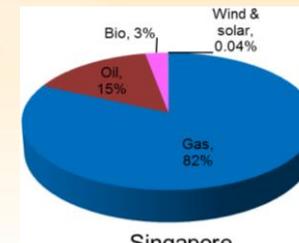
Thailand



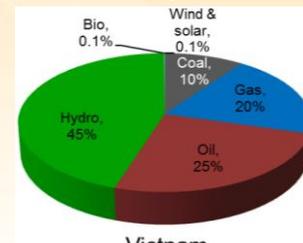
Malaysia



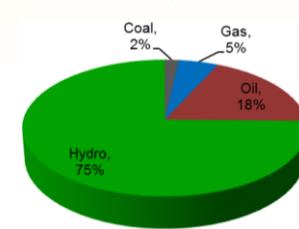
Philippines



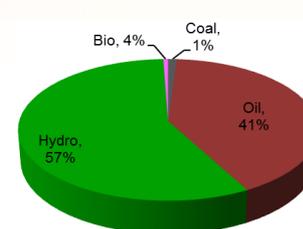
Singapore



Vietnam

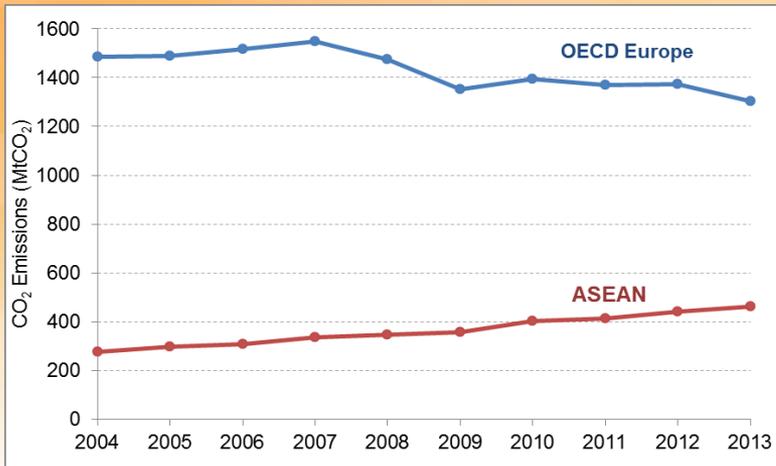


Myanmar

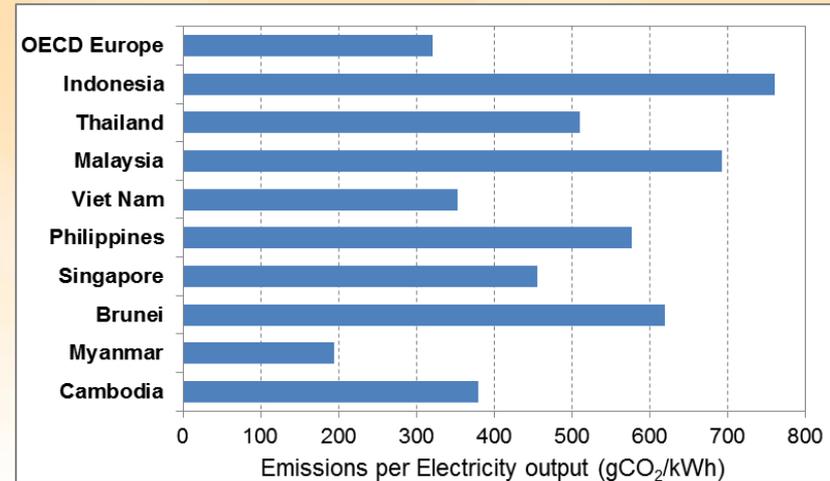


Cambodia

# Environmental situation in ASEAN



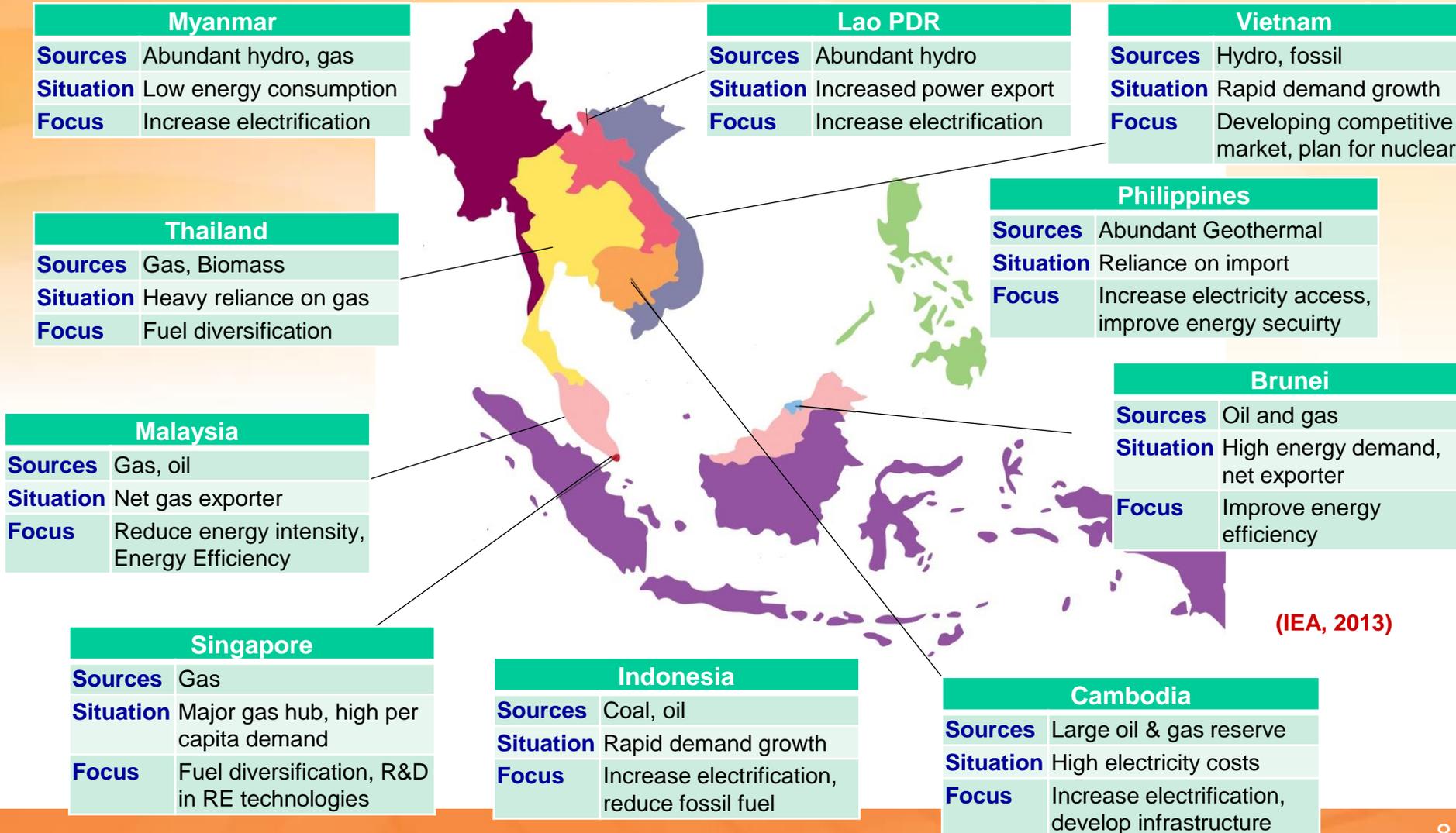
**CO<sub>2</sub> emissions from the electricity sector**



**Emission per kWh output in 2013**

- CO<sub>2</sub> emission is increasing – due to increased demand, large share of fossil fuel in electricity generation.
- CO<sub>2</sub> intensity (per kWh of electricity output) in ASEAN is high
  - High-emitting generation sources, inefficient power stations
- Share of global CO<sub>2</sub> emissions is 4% compared with 1% in 1980.

# Characteristics of ASEAN

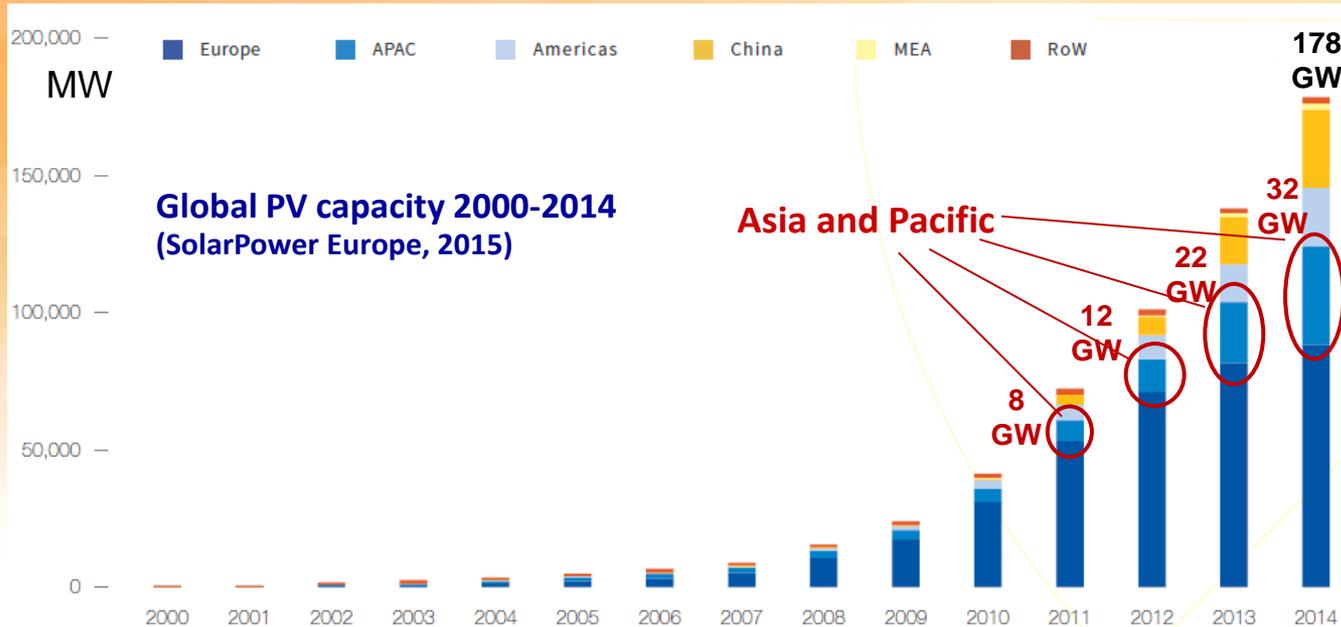


# Challenges for electricity sectors in ASEAN



- 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

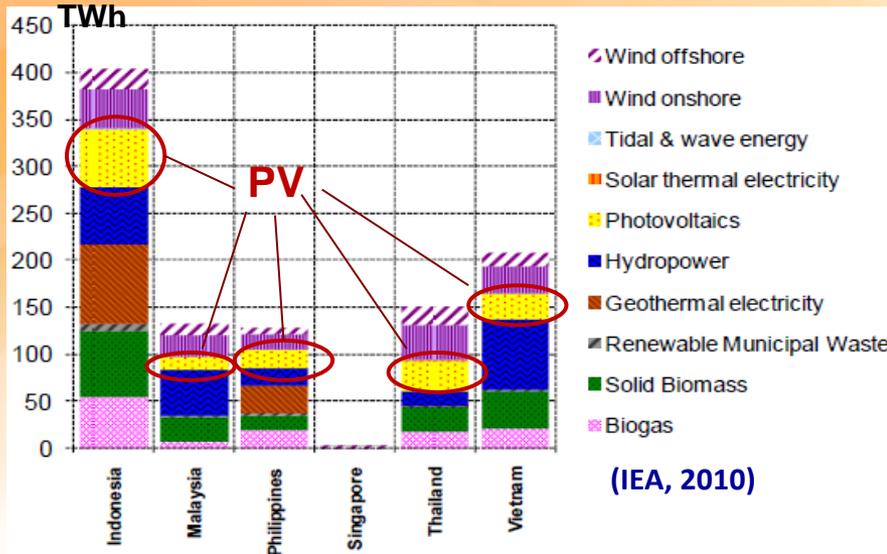
# Key technology trends



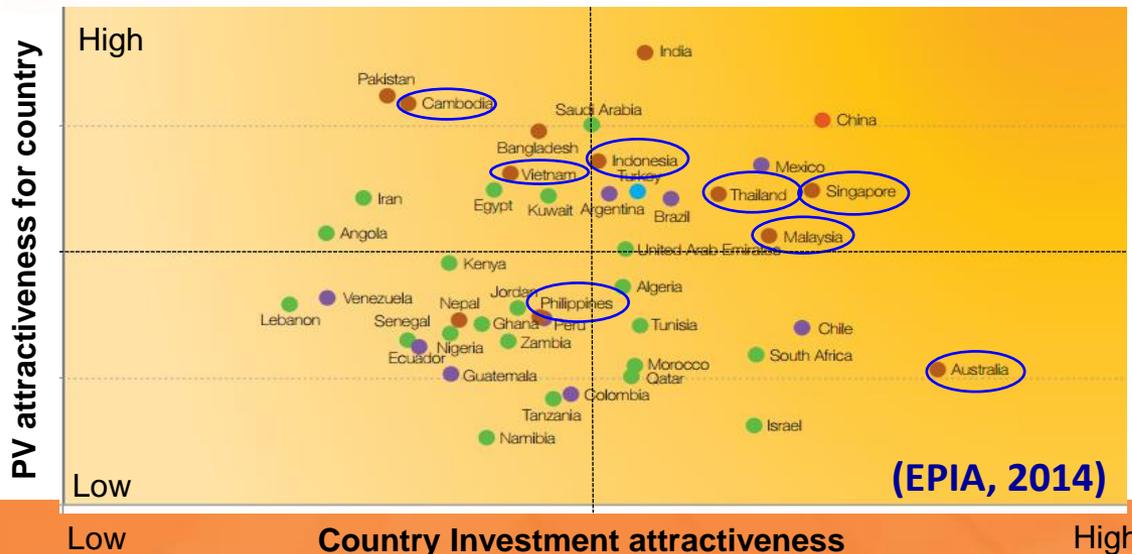
**Leading countries in Asia Pacific:**  
Japan, Korea, Australia, Thailand, Taiwan

- 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

# PV potential in ASEAN

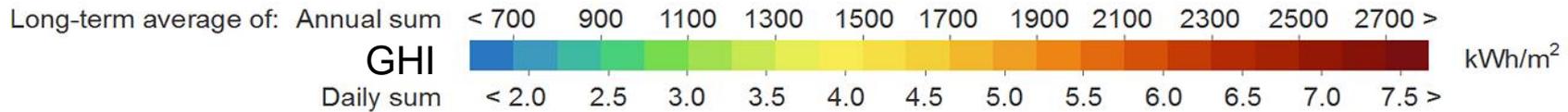
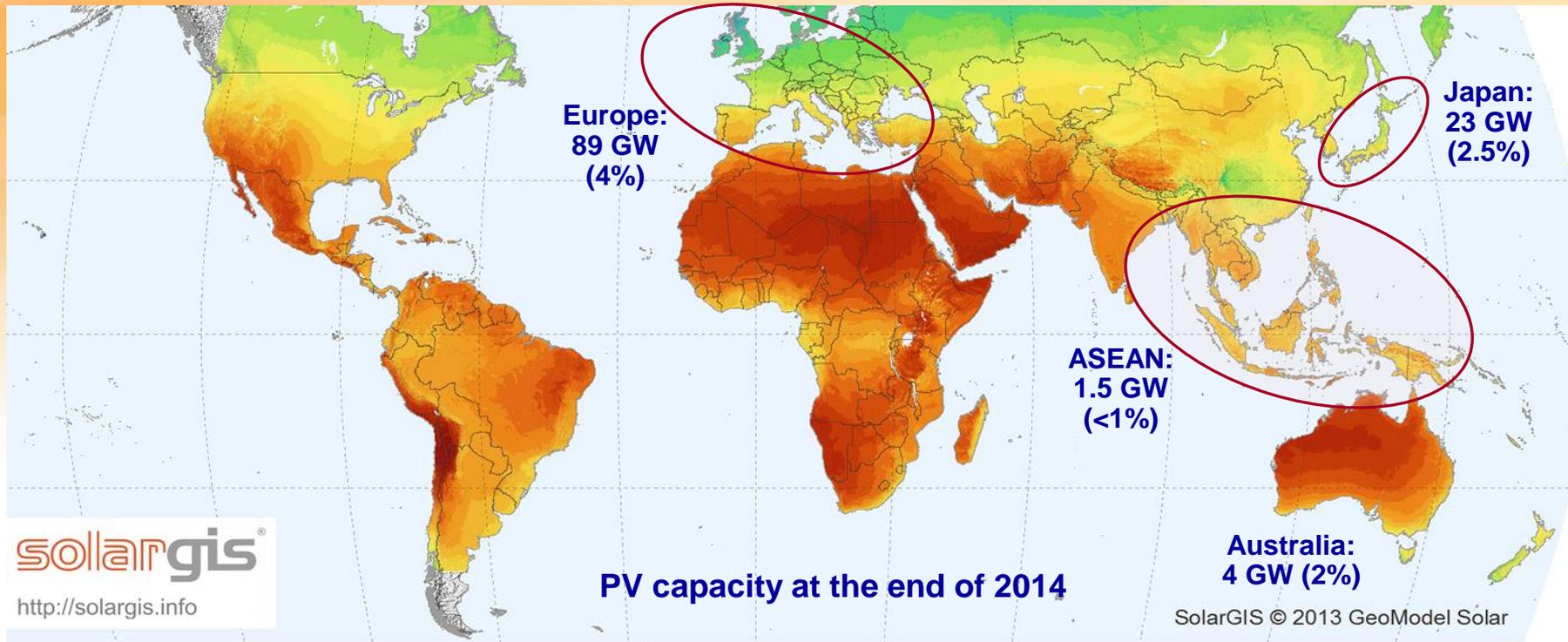


- Huge renewable energy potential in ASEAN
  - Hydro, solar, biomass
- PV deployment is still low – economic and non-economic barriers



- **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



# 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

## Regulatory policies and mandate

- RETs, carbon pricing, FiTs, RPS, RE Certificates (REC).
- RET schemes create demand for additional RE energy by placing a legal obligation on electricity utilities.
- FiTs is the most widely used scheme

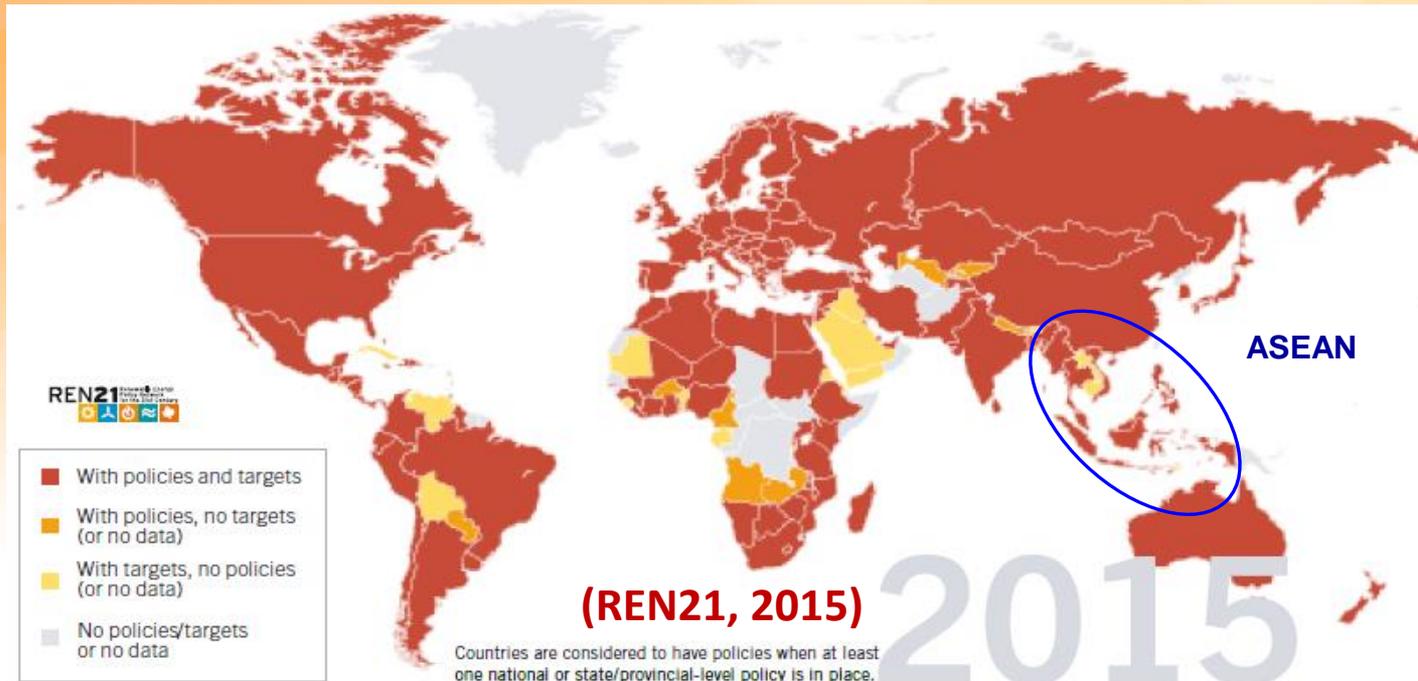
## Fiscal incentives

- Address the cost and finance barriers that hinder investment in RE technologies
- Capital subsidies, rebates and tax reduction
- Providing social, economic, environmental benefits

## Public financing

- provided by governments in the forms of loans and grants to support innovation in RE technologies

# 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)

Country	Key Energy Policies	Renewable targets
<b>Indonesia</b>	<ul style="list-style-type: none"> <li>• Increase electricity access to 99% by 2020</li> <li>• 26% GHG reduction targets by 2020</li> <li>• Reduce the share of fossil fuel</li> </ul>	<ul style="list-style-type: none"> <li>• 26% renewable electricity by 2025</li> <li>• 160 MW of PV capacity or 1% share of generation by 2025</li> </ul>
<b>Thailand</b>	<ul style="list-style-type: none"> <li>• Diversify fuel mix from natural gas</li> <li>• Reduce energy intensity by 25% by 2030 compared with 2005 levels</li> </ul>	<ul style="list-style-type: none"> <li>• 10% renewable electricity by 2021</li> <li>• 6 GW of PV by 2036</li> </ul>
<b>Malaysia</b>	<ul style="list-style-type: none"> <li>• Reduce energy intensity by 10% by 2025 compared to BAU</li> <li>• Reduce CO<sub>2</sub> intensity by up to 40% compared to 2005 levels by 2020.</li> </ul>	<ul style="list-style-type: none"> <li>• 2.1 GW of renewable electricity by 2030</li> <li>• 14% renewable electricity by 2030</li> </ul>
<b>Vietnam</b>	<ul style="list-style-type: none"> <li>• 100% electricity access by 2020</li> <li>• Reduce CO<sub>2</sub> intensity by 10% by 2020 compared with 2010 levels</li> </ul>	<ul style="list-style-type: none"> <li>• 5% renewable electricity by 2020</li> </ul>
<b>Philippines</b>	<ul style="list-style-type: none"> <li>• Increase electricity access to 20% by 2017 (for small township)</li> <li>• Expand the grid to interconnect major islands</li> </ul>	<ul style="list-style-type: none"> <li>• 40% renewable energy by 2020</li> <li>• 15 GW of renewables by 2030</li> <li>• Additional 280 MW of PV</li> </ul>

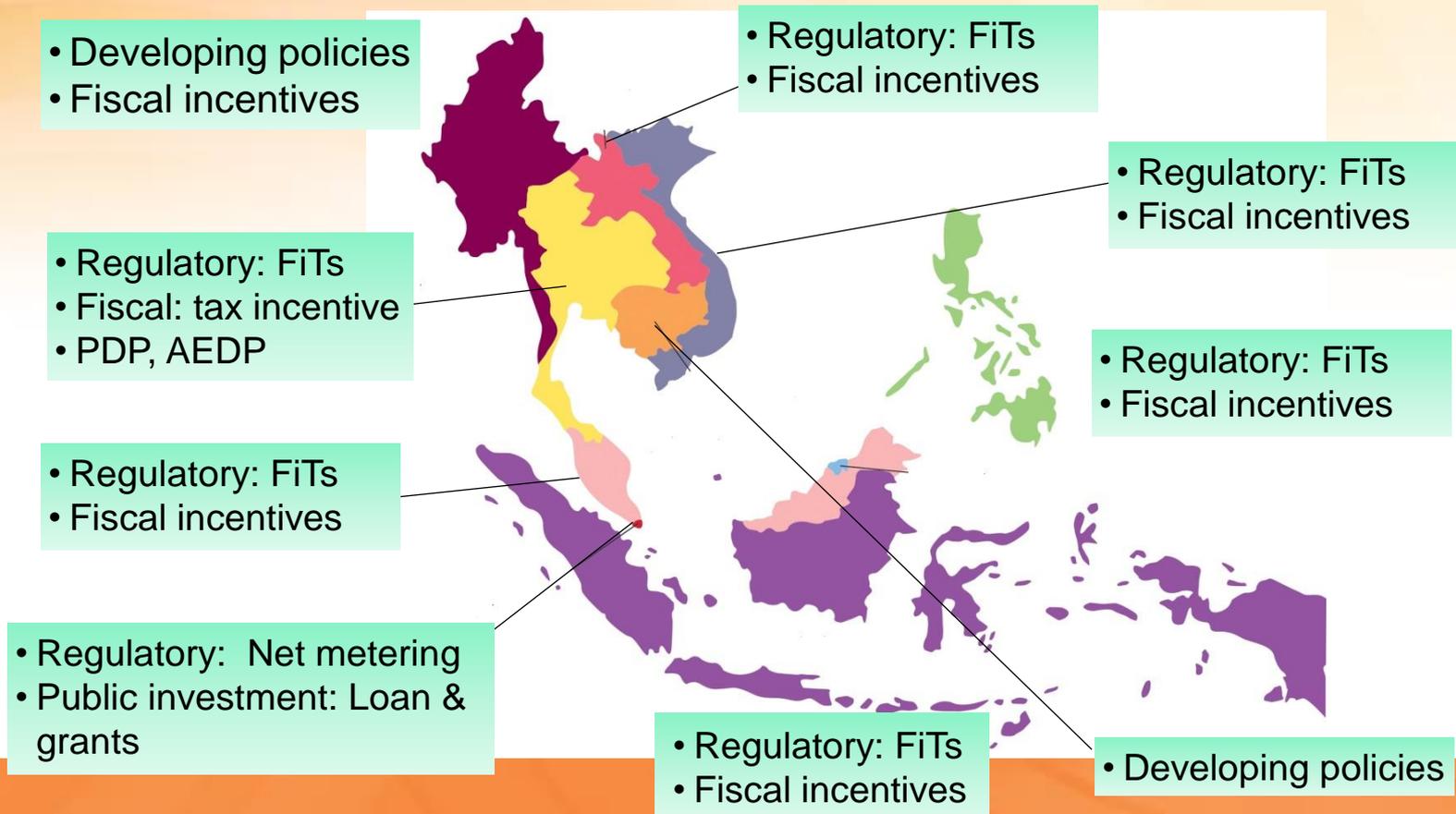
# Key Energy Policies and RE Targets (2)

Country	Key Energy Policies	Renewable targets
<b>Singapore</b>	<ul style="list-style-type: none"> <li>• Energy supply diversification</li> <li>• Reduce energy intensity by 35% by 2030 compared with 2005 levels</li> <li>• Reduce CO<sub>2</sub> intensity by 10% below the 2020 BAU levels</li> </ul>	<ul style="list-style-type: none"> <li>• 5% share of renewables by 2020</li> <li>• 350 MW of PV by 2020</li> </ul>
<b>Brunei</b>	<ul style="list-style-type: none"> <li>• Improve energy efficiency</li> <li>• Reduce energy intensity by 25% by 2030 from 2005 levels</li> </ul>	<ul style="list-style-type: none"> <li>• 10 MW PV by 2030</li> <li>• 10% RE by 2035</li> </ul>
<b>Myanmar</b>	<ul style="list-style-type: none"> <li>• Reduce primary energy consumption by 8% by 2030 compared to BAU</li> </ul>	<ul style="list-style-type: none"> <li>• 15-20% RE by 2020</li> </ul>
<b>Cambodia</b>	<ul style="list-style-type: none"> <li>• Develop hydropower</li> <li>• Increase electricity access through off-grid RE</li> </ul>	<ul style="list-style-type: none"> <li>• 15% RE by 2015</li> </ul>
<b>Lao PDR</b>	<ul style="list-style-type: none"> <li>• Increase electricity access to 90% by 2020</li> <li>• Upgrade interconnectors to increase power exchange between Vietnam and Thailand</li> </ul>	<ul style="list-style-type: none"> <li>• 30% RE by 2025</li> <li>• 33 MW from solar</li> </ul>

**(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



# Barriers to PV development in ASEAN

## Social

- Lack of public awareness on the impact of climate change and the benefits of RE technologies

## Economic

- Relatively high capital and financing cost at present.

## Technical

- Lack of knowledge in the technology, installation, maintenance
- Impact on the grid due to its variability and partly unpredictability
- Inadequate transmission networks

## Environmental

- Land size for utility-scale solar PV – limited in some countries

## Institutional

- Lack of effective policies - uncoordinated and incoherent policies, weak RE targets
- Regulatory arrangements - long process in obtaining licenses
- Political stability

# 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)

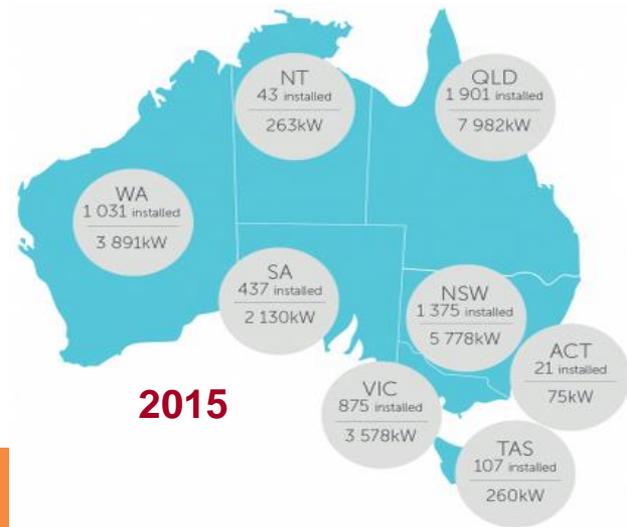
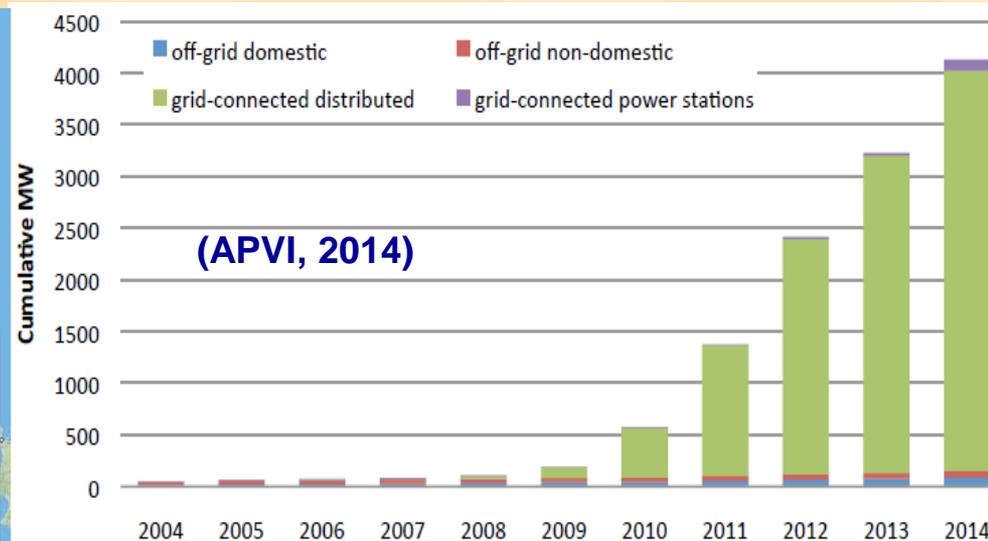
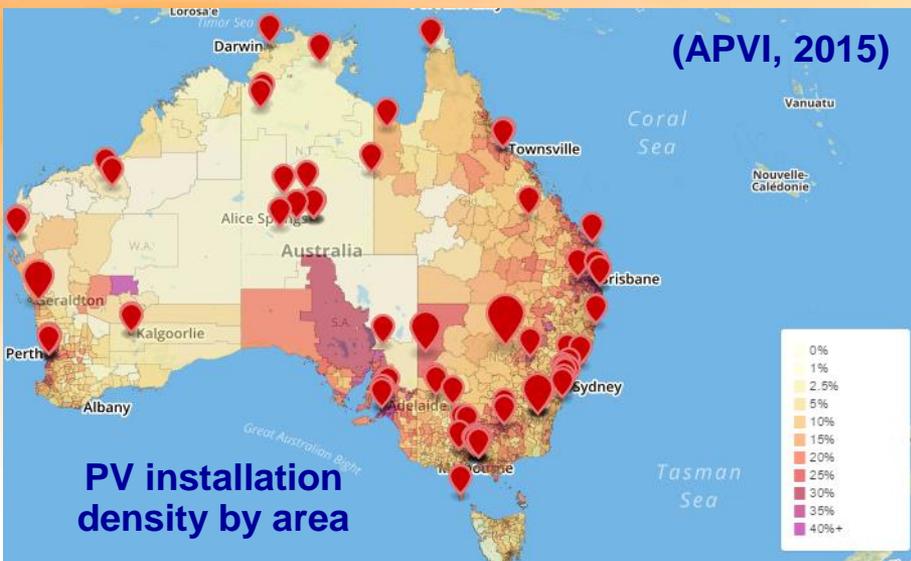
## Institutional

- 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

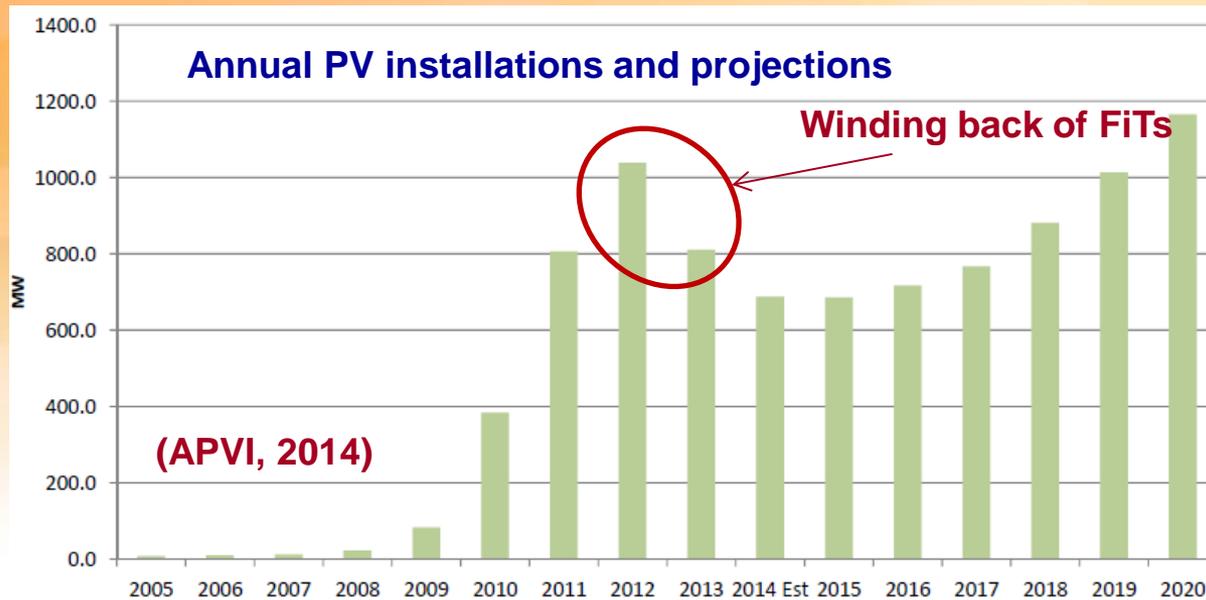
- Collaborations among ASEAN countries are essential to achieve higher PV deployment (and other RE technologies)
  - R&D collaboration, transfer of knowledge, know-how.
  - Optimising and sharing of solar resource through cross-border interconnection
  - Geographical diversifications - improved matching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

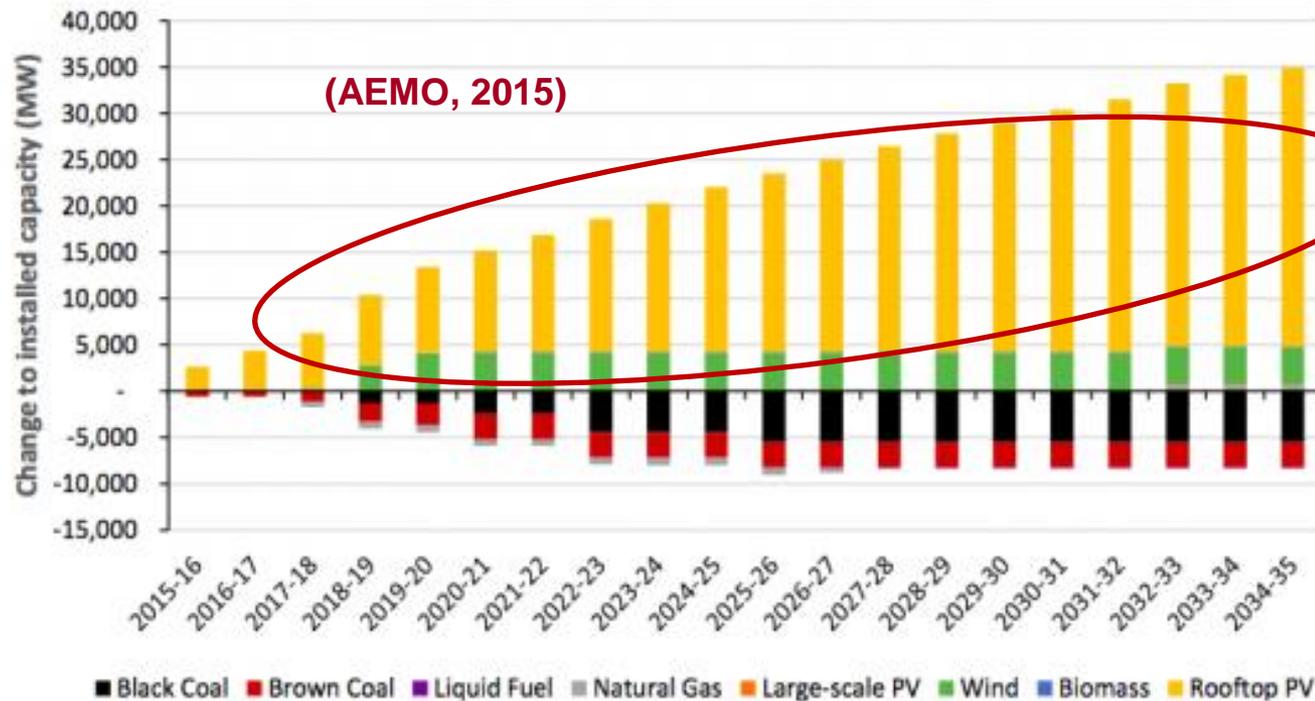
# PV in Australia – lessons for ASEAN



- 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

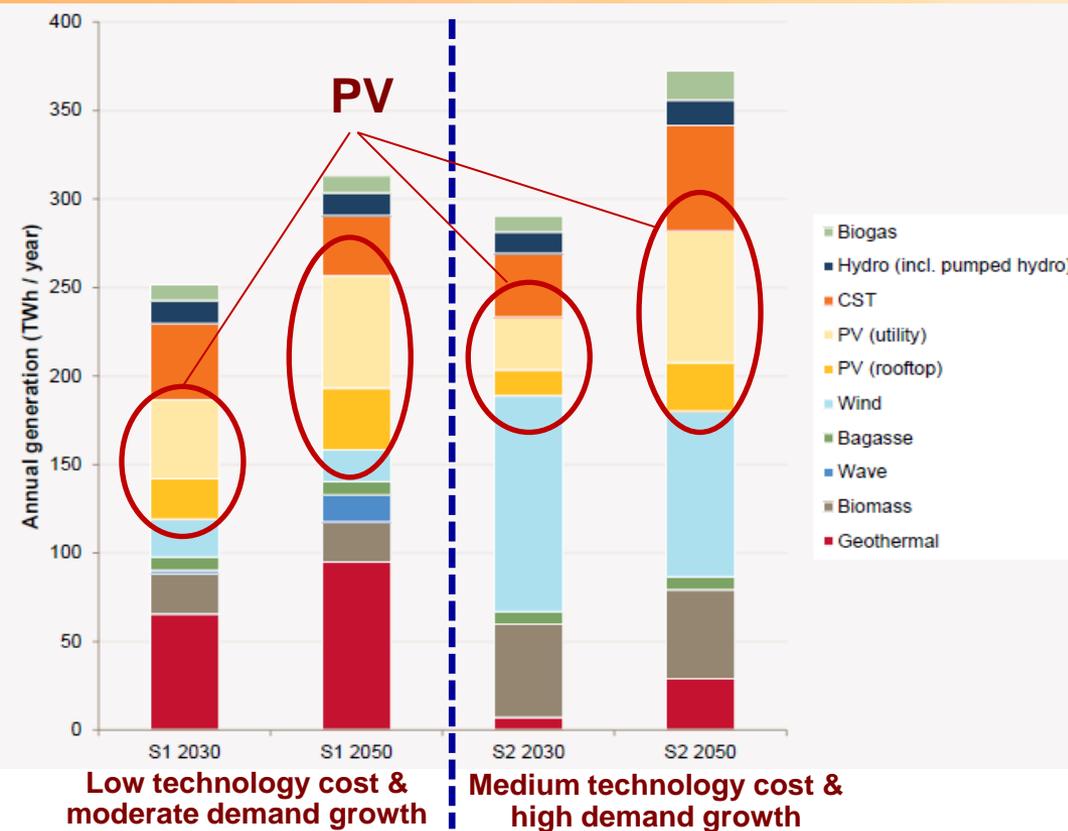
# PV in Australia – Lessons for ASEAN

Figure 20 Rapid Transformation scenario – cumulative generation capacity installations and withdrawals (NEM regions)



- According to the National Transmission Network Development Plan (NTNDP), PV will be the largest growth technology.

# PV in Australia – Lessons for ASEAN



## 100 PER CENT RENEWABLES STUDY – MODELLING OUTCOMES

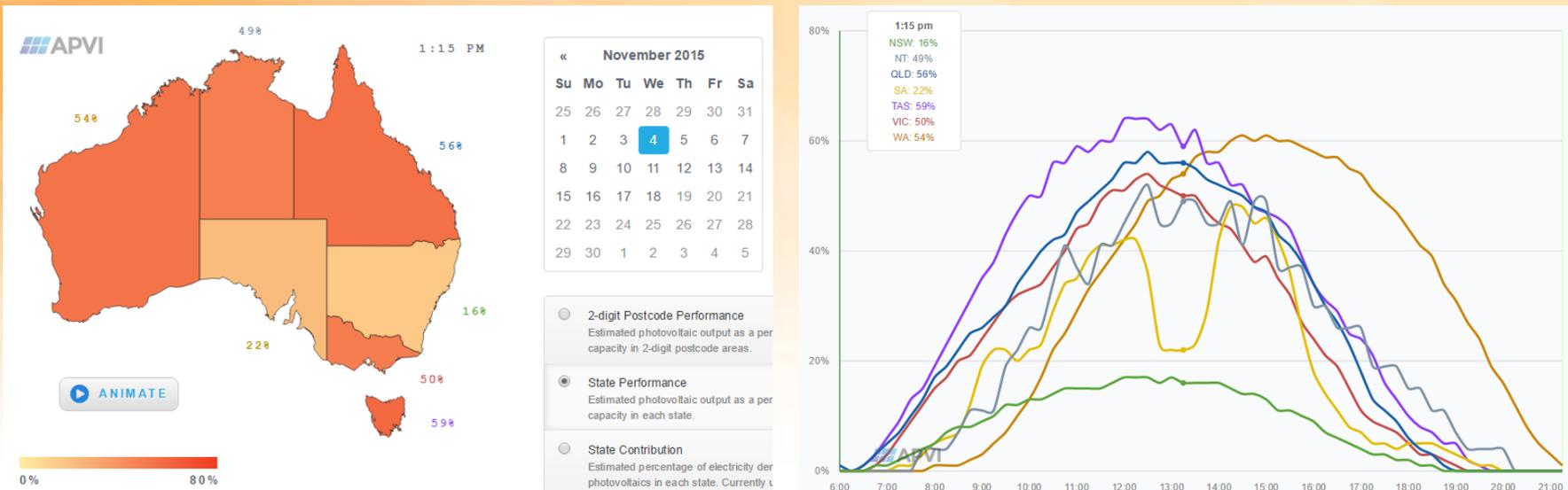
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DATE: July 2013

- Utilities and electricity market operators are preparing for high RE future

- According to AEMO 100% renewable modelling study  
*Operational issues are manageable – no fundamental technical limitations to operate the 100% renewable power system generation portfolios*

# PV in Australia – Lessons for ASEAN

<http://pv-map.apvi.org.au/>



- 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



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