

Renewable Energy Development in Asia-Pacific Region: National Case from Thailand

Expert Round Table: “The Role of Common Electricity Markets and Renewable Energy Integration in Strengthening Energy Security”

**Moscow, Russia
24 October 2019,**

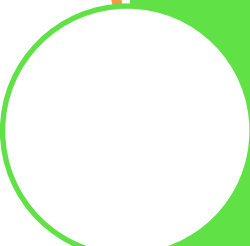
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CONTENT



Thailand's RE Integration Strategies



Thailand's Energy Blueprint, PDP2018 and Energy 4.0



RE Integration: Conclusion

- *Highlights on power system flexibility*
- *Thailand's Policy toward Future RE Integration*

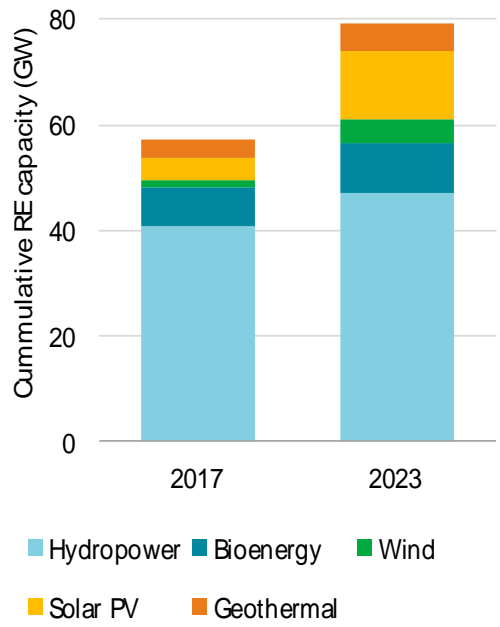
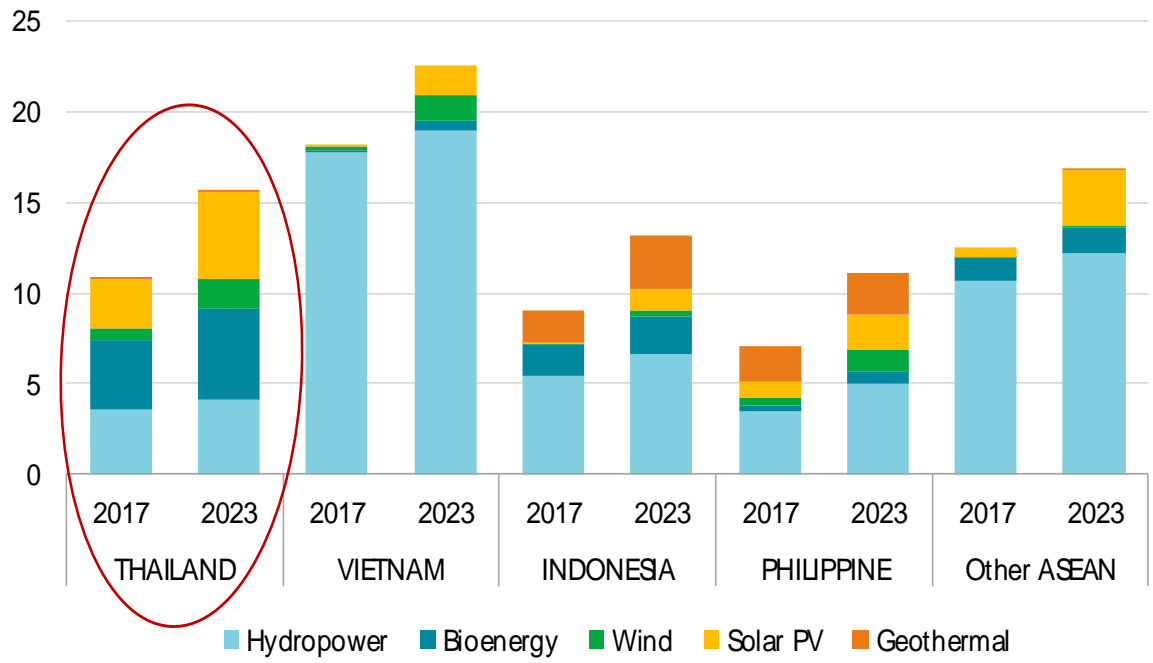
1. Thailand's RE Integration Strategies

Thailand's RE Integration Strategies

- **Thailand RE grid integration assessment** – a Thailand and IEA joint study since 2018
- Assess the value of **Thailand and Regional Power System Integration** to accommodate the growing share of renewables.
- Explore benefits of **multilateral power trading (MPT)** and **cross-border interconnectors**
- Take **economic, operational, environmental and policy-related issues** into consideration
- Analyze the **impact** and **value of flexibility resources** for the ASEAN Power Grid
 - Expanded **cross-border interconnectors**; and
 - Demand-side management (DSM)

ASEAN renewable capacity to grow over a third by 2023

ASEAN cumulative renewable capacity, 2017 and 2023



Source: Renewables 2018: Analysis and Forecasts to 2023

The share of RE is forecasted to account for around 20% of electricity generation in ASEAN. The growth of solar and wind raises system integration challenges.

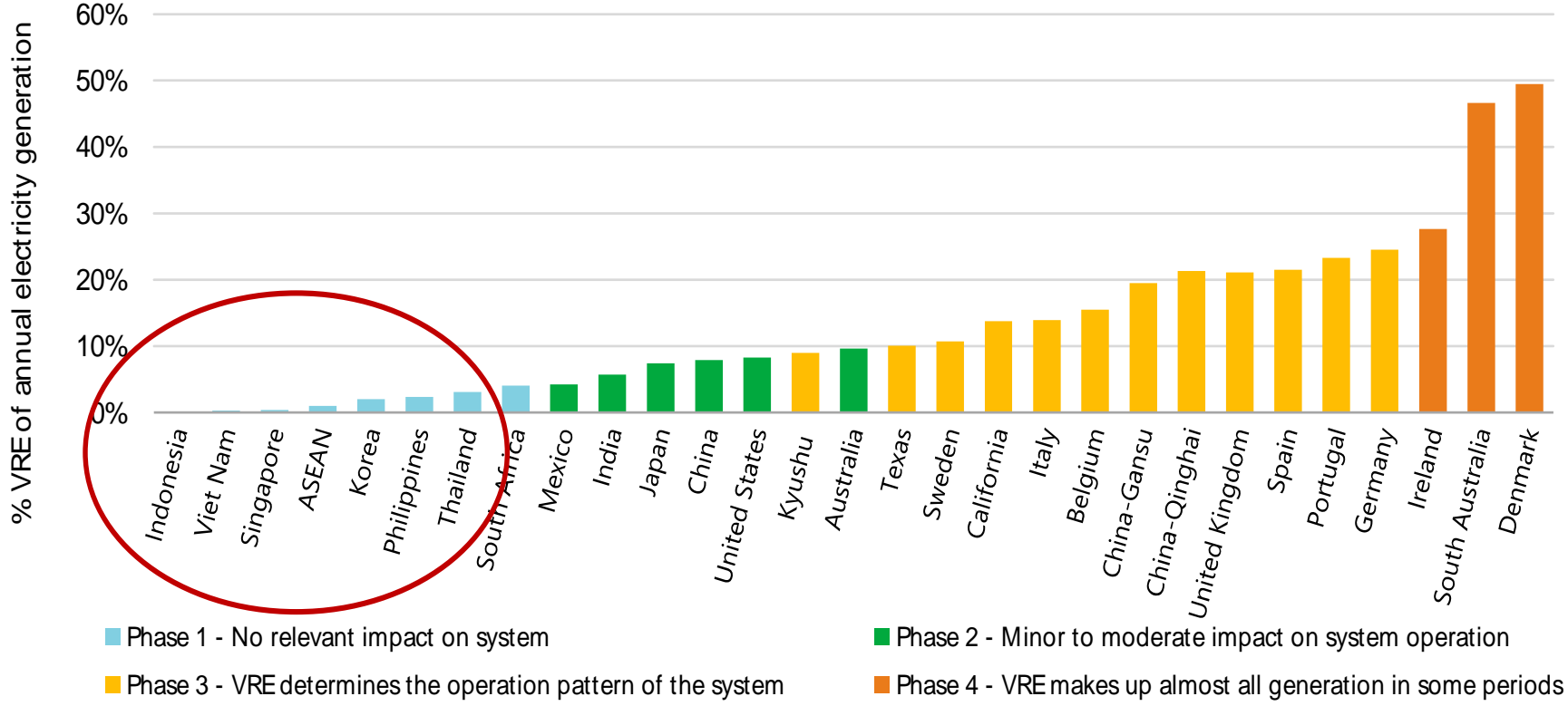
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Hydro is dominant followed by solar PV in ASEAN

System integration can be classified into different phases

VRE shares in total electricity generation by region in 2018



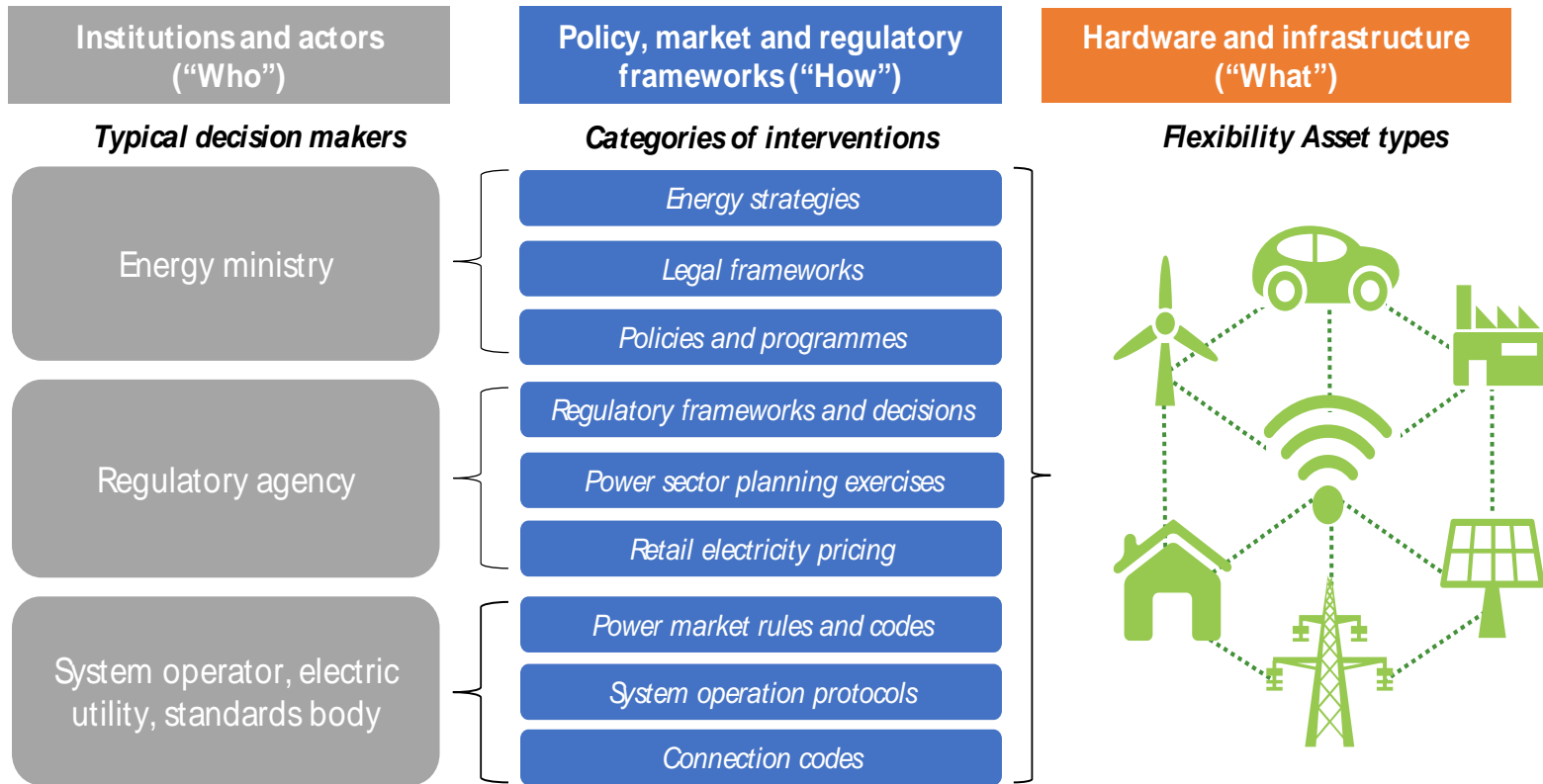
Specific power system regions can be at higher VRE integration phases due to limited interconnection and VRE penetration. Many countries/regions are still in Phase 1 and 2 of system integration.

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Thailand's higher RE integration almost reaches moderate impact on system operation

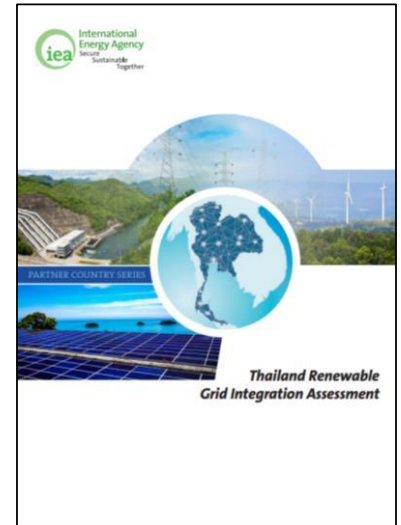
System flexibility: Identifying and engaging with the right actor is key



Source: Status of Power System Transformation 2019

A range of approaches to enhance power system flexibility are available at different levels of decision making. The institutional context defines the set of instruments available to boost system flexibility.

Thailand Renewable Grid Integration Assessment



Thailand RE Grid Integration Project Overview



- With growing share of variable renewable energy (VRE), particularly solar PV, Thailand's power sector is beginning to experience the impact on system operation
- MoEN has officially asked the IEA to provide support on the study of the impact of VRE and mitigation strategies through workshops, discussions and detailed study.
 - It aims to assist policy makers and key energy stakeholders: *System operators, Energy regulators, Energy policy and planning*
- The final report has officially been completed and published in **October 2018**
<https://webstore.iea.org/partner-country-series-thailand-renewable-grid-integration-assessment>

Main work streams of the study

1. Existing power system context

- VRE phase assessment for existing system
- Qualitative assessment of suitability of existing grid codes for VRE

2. Grid integration assessment

- Analysing options to accommodate RE integration
- Contractual and technical flexibility

3. Distributed solar PV

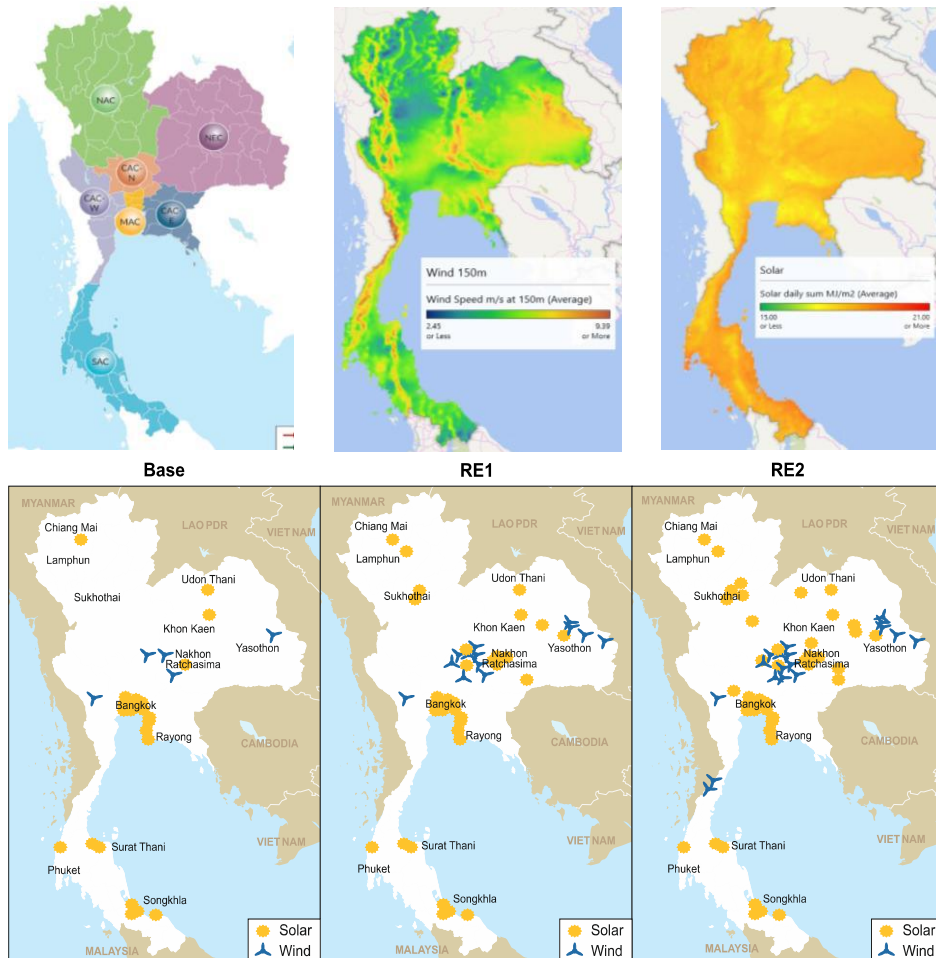
- Technical potential of rooftop PV in Thailand
- Economic impacts of PV
- Recommendations and action priorities

4. Power Development Plan (PDP) and VRE system costs

- Assessment of power sector planning in Thailand
- System cost and cost benefit analysis

Each work stream provides insights and recommended actions for VRE integration in Thailand

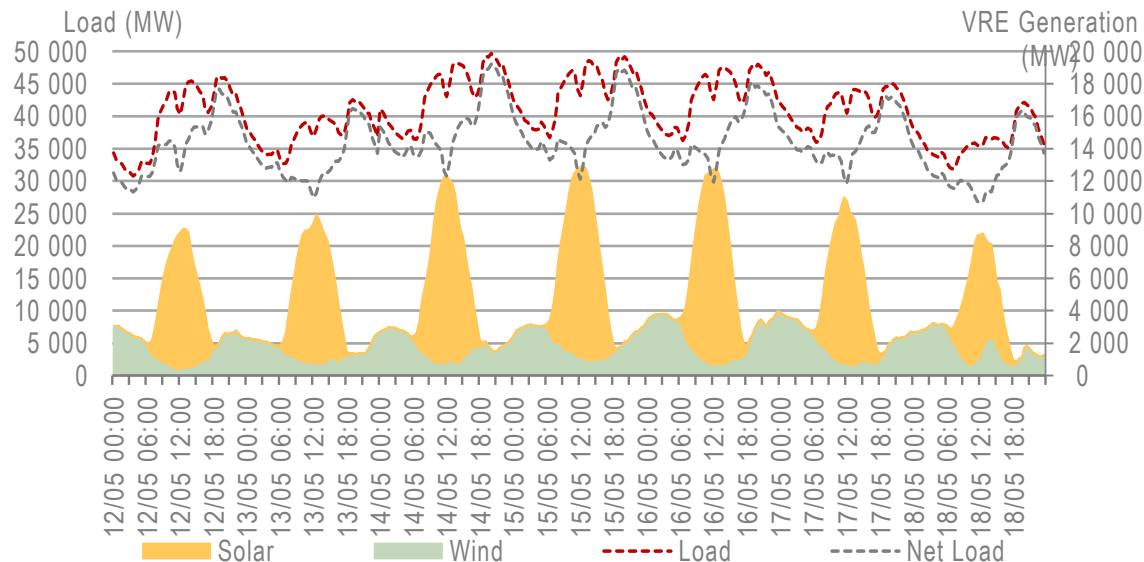
Future renewable scenarios considered in the study



- Analysing the impact of VRE on the power system and recommendation
- 3 scenarios of VRE penetration in 2036
 - Based scenario: 6 GW solar, 3 GW wind (PDP 2015 targets)
 - RE1 scenario: 12 GW solar, 5 GW wind
 - RE2 scenario: 17 GW solar, 6 GW wind
- 30-minute wind & solar generation for different locations
- Operational and contractual flexibility option scenarios
 - Fuel and power purchase contract
 - Gen. operating characteristics
 - DSM, EV, storage

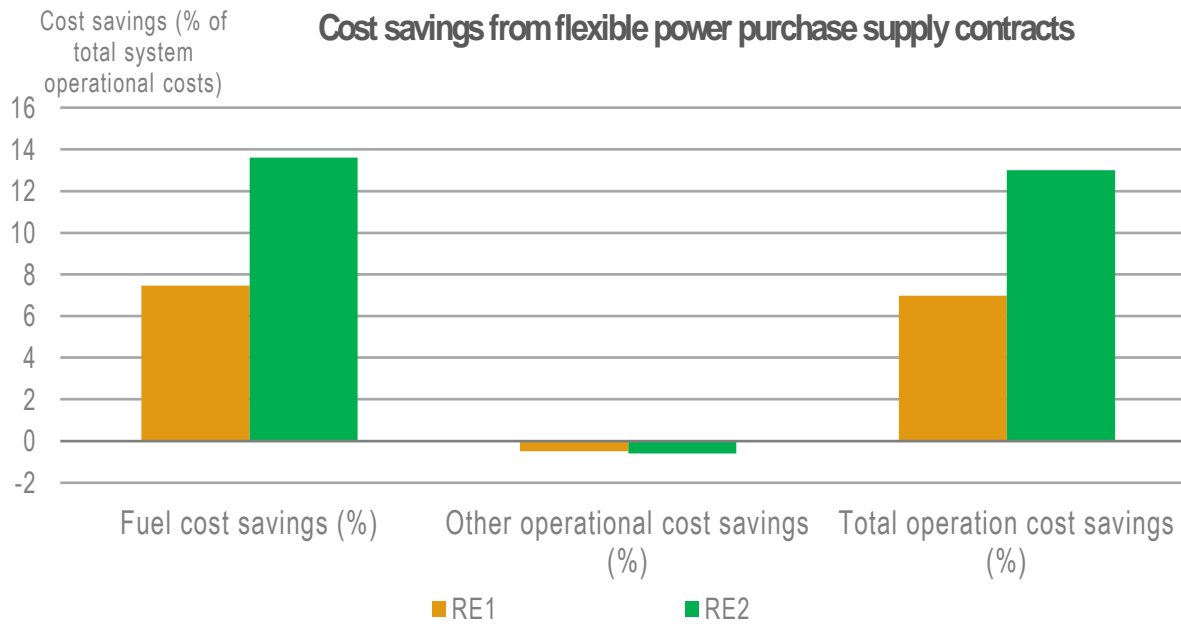
Key findings - Unlocking operational flexibility

- The generation fleet appears **flexible (reasonable shares of hydro and CCGT and large reserve margin)**
- **Thermal plants will be required to cycle** more often at higher shares of VRE
- **DSM, EV, storage and plant flexibility** leads to a more steady and efficient use of the system.
- **Complimentary profiles** between solar and wind generation and demand
- **Much more ambitious solar and wind energy targets are possible** from the operational aspect.



Key findings – Economics and Institutional aspects

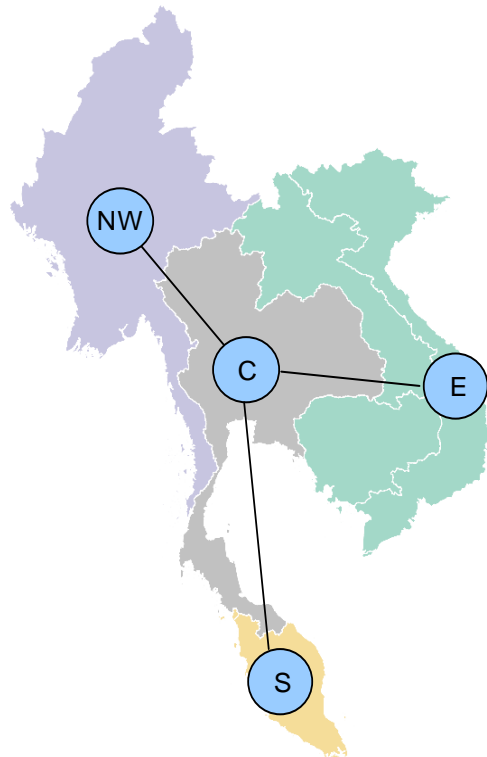
- **Higher shares of wind and solar reduce operating costs**, with the savings dominated by a reduction in fuel costs as gas generation is displaced by renewables.
- **Flexibility options** reduce system integration costs (profile, grid, balancing costs)
- **Cost savings can be enhanced** by ensuring sufficient flexibility in **power purchase and fuel supply contracts**.



ASEAN Renewable Integration Study

ASEAN renewable grid integration analysis

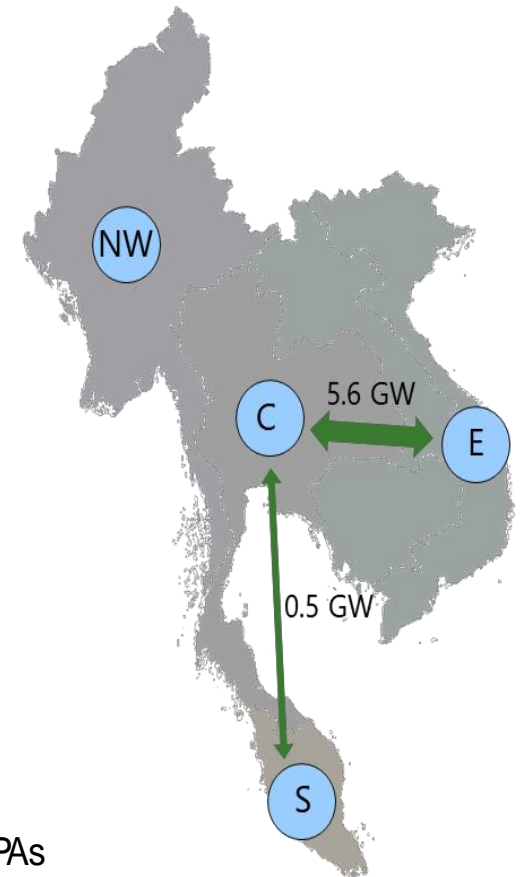
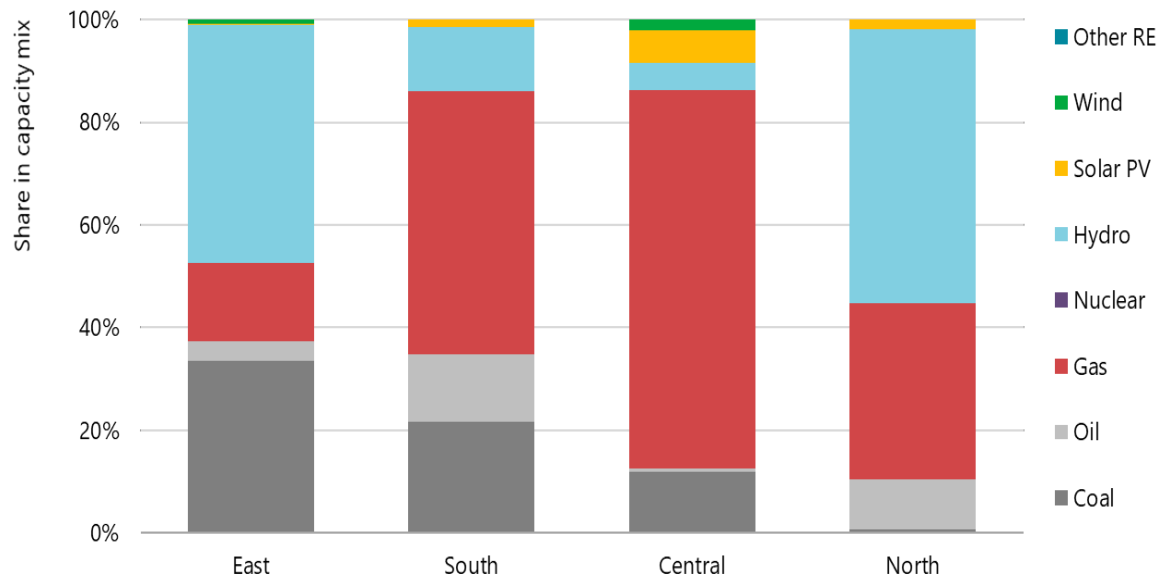
Four selected transmission zones in ASEAN



- Assess the value of regional power system integration to accommodate the growing share of renewables
 - Economic, operational, environmental and policy-related considerations
 - The role of flexible resources (interconnectors, DSM)
- An hourly production cost modelling of ASEAN's power system in 2035.
 - **C:** Central (Thailand); **E:** East (Cambodia, Lao PDR and Viet Nam); **NW:** Northwest (Myanmar) and **S:** South (Malaysia and Singapore).

The IEA has undertaken Phase 1 of a quantitative assessment of the impact of cross-border multilateral trade in accommodating the growing share of variable renewable energy in ASEAN.

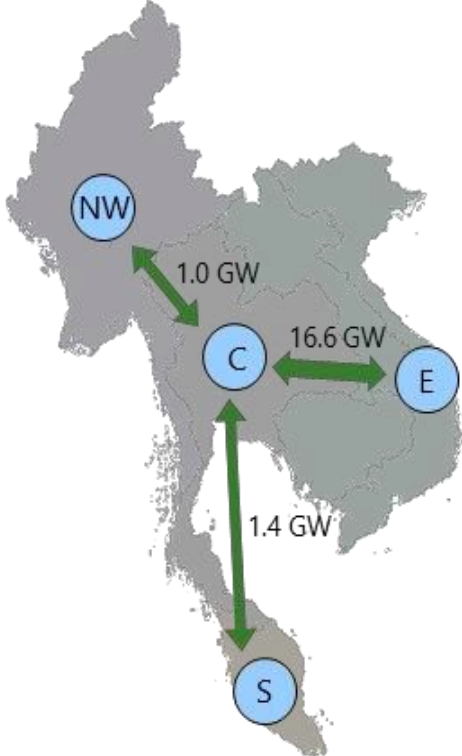
Existing generation capacity and interconnectors



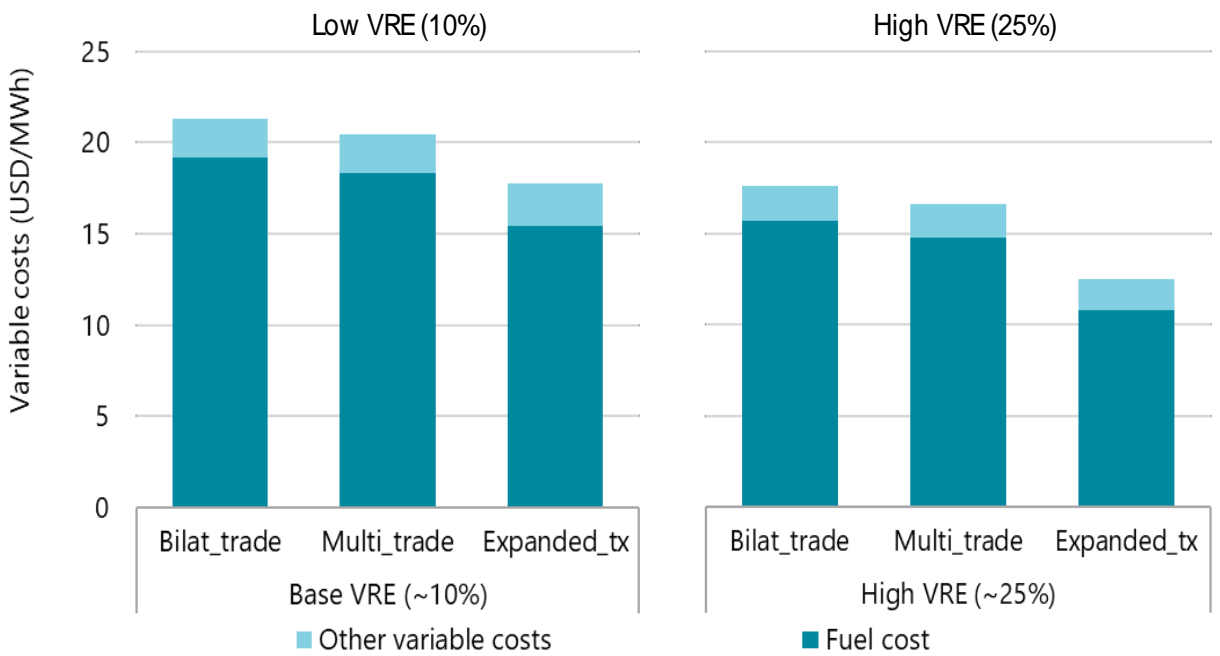
- Existing and committed interconnectors are treated as “existing”
- Modelled on a line-by-line basis
- In the scenarios which assume bilateral trade, the power flows of interconnectors that have been built for power import/export based on PPAs are constrained

Cross-border network can facilitate VRE integration in ASEAN

Capacity of the interconnectors



Annual operation cost

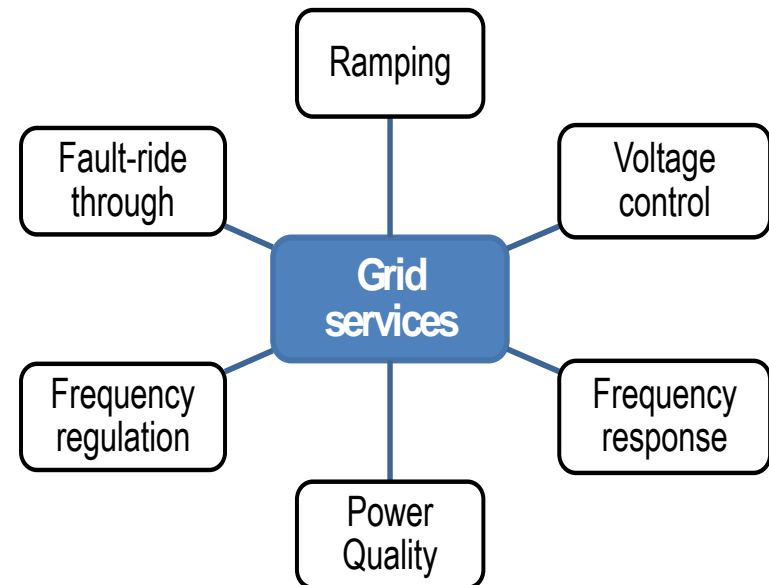


Allowing multilateral trade and expanding interconnectors can lead to operational cost savings. It enables the integration of higher share of VRE that provides economic and environmental benefits

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PPA plays a key role to facilitate RE integration

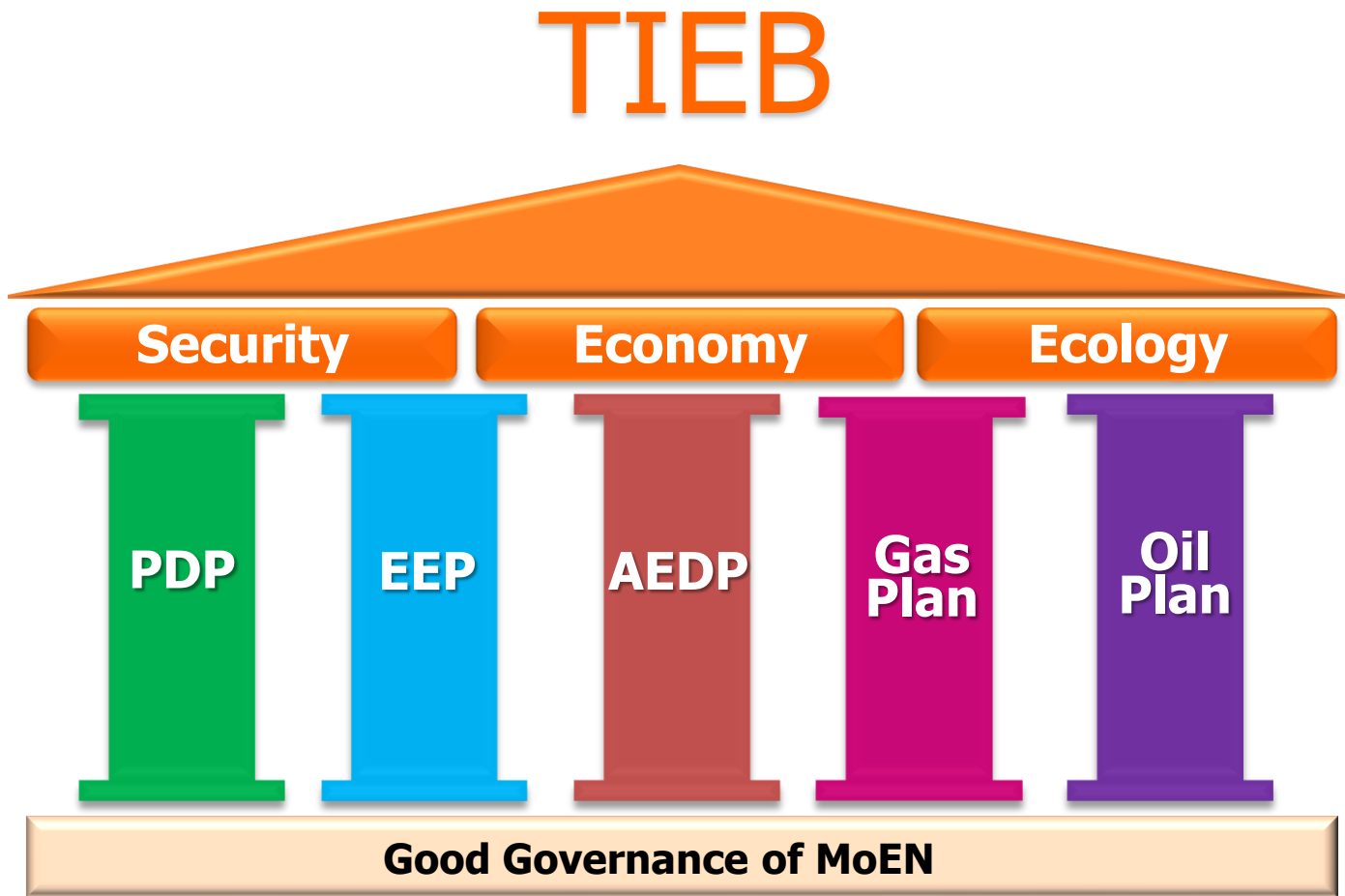
- PPAs (along with grid codes) can play a key role to facilitate integration of renewables (and increasing flexibility)
- Incentivising and/or mandating RE generators to provide grid services (ancillary services)
- To ensure controllability and visibility of VRE generators
 - SCADA
 - AGC capability
 - Share relevant forecasting data (centralised or decentralised)



Key findings and recommendations

- Power system flexibility is essential with increasing VRE penetration in ASEAN
 - Different flexibility requirements and resources depending on the context
- Four main resources to provide system flexibility: *Power plants, electricity grid, storage, DSM*
 - Allow for the *reliable* and *cost-effective* integration of high shares of VRE
- Cross-border interconnectors and multilateral power trade enhance the flexibility of the ASEAN power sector to accommodate an increasing share of renewables,
- Shared understanding that flexibility can be provided by all system resources – including VRE – but we need policy maker engagement to unlock this potential

2. Thailand's Energy Blueprint, PDP2018 and Energy 4.0



A long-term master plan for Thai energy sector development in the next 20 years, covering clean fossil uses, new & renewables, technology & innovation, smart application & sustainable city planning concept to balance energy security, economy prosperity and ecological sustainability.

Power Generation by Fuel (2018 – 2037)

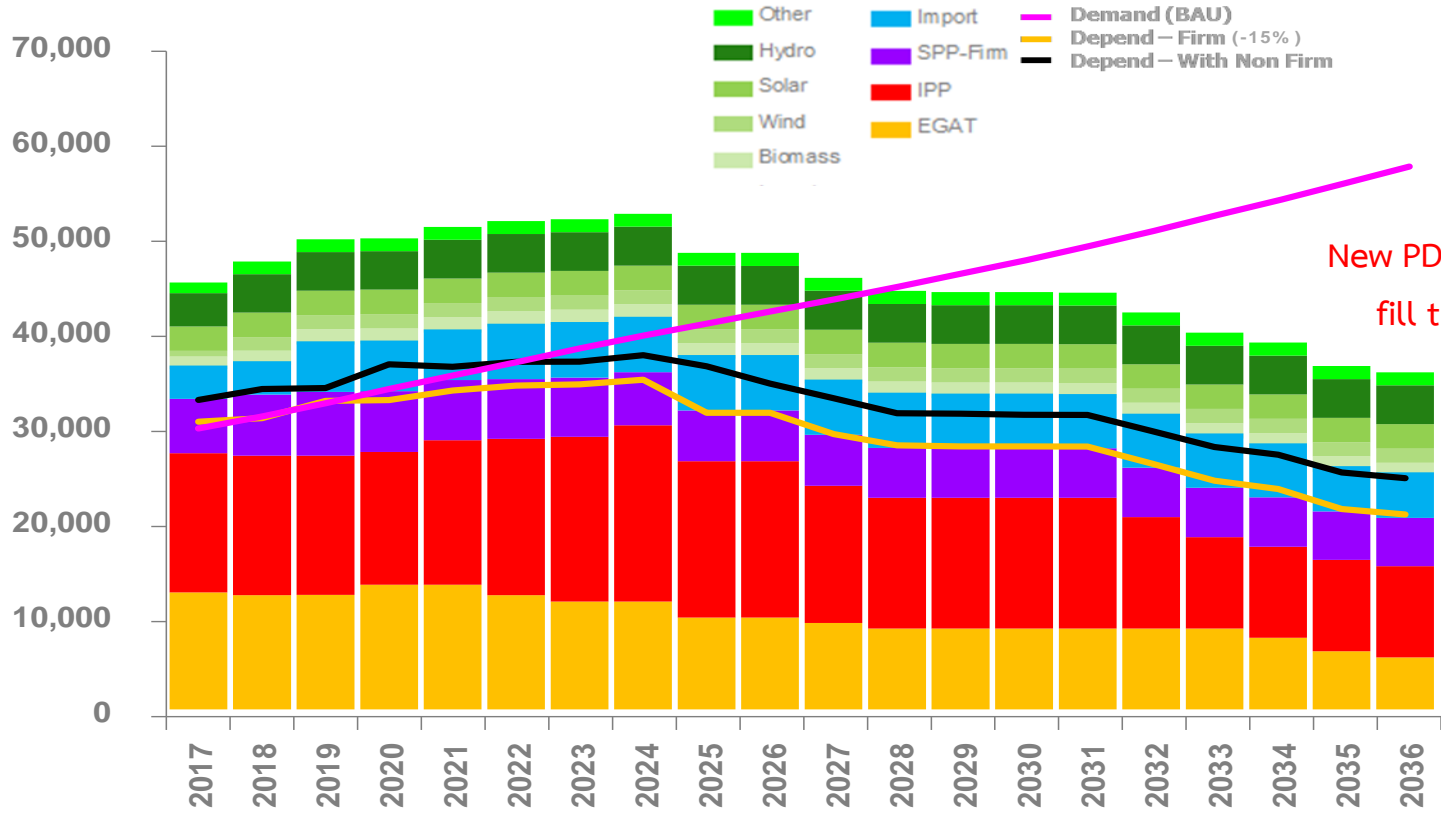
➤ Fossil Fuel 65%

- NG 53%
- Coal & Lignite 12%

➤ Non-Fossil Fuel 35%

- Hydro from neighbors 9%
- RE 20%
- EE 6%

Electricity demand forecasting



Thailand needs effective PDP to fill the gap for future power security

New Renewable Energy PP under Government Support Policy:

- Municipal Solid Waste 400 MW
 - Biomass (in southern boarder provinces) 120 MW
- Total: 520 MW**



New Renewable Energy PP under AEDP Plan:

- **Solar** 10,000 MW (start 2019@100MW/yr for 10 yrs first)
 - Biomass 3,376 MW
 - Biogas 546 MW
 - **Hydro-Floating Solar Hybrid** 2,725 MW
 - Wind 1,485 MW
 - Industrial Waste 44 MW
- Total: 18,176 MW**



Large-scale Non-fossil Renewable Power Contribution

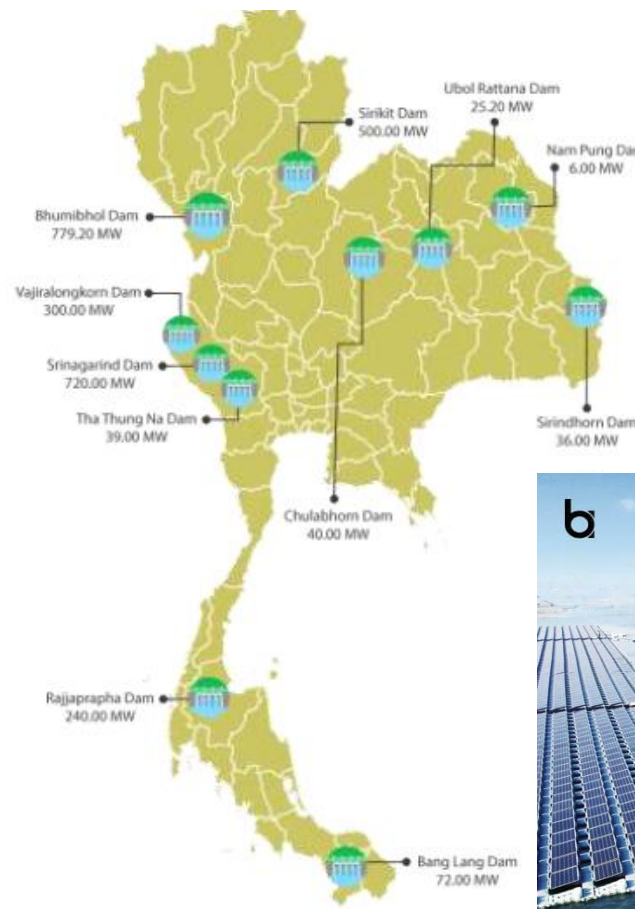
Revise every 5 years with updated situation

Thailand 4.0 Power System Shift 10,000 MW Household's Solar Rooftop Program



Launched 1,000 MW Pilot Project

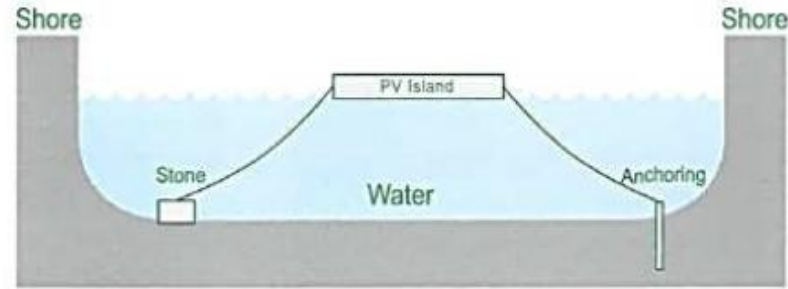
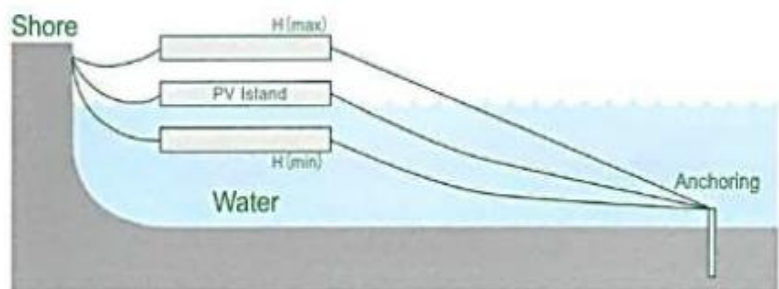
- Max 10 MW per household
- Grid-connected In-Out smart meter
- Sale excess power at the Grid's Short Run Marginal Cost (current SRMC = 1.68 Baht/kWh)
- 10 years program

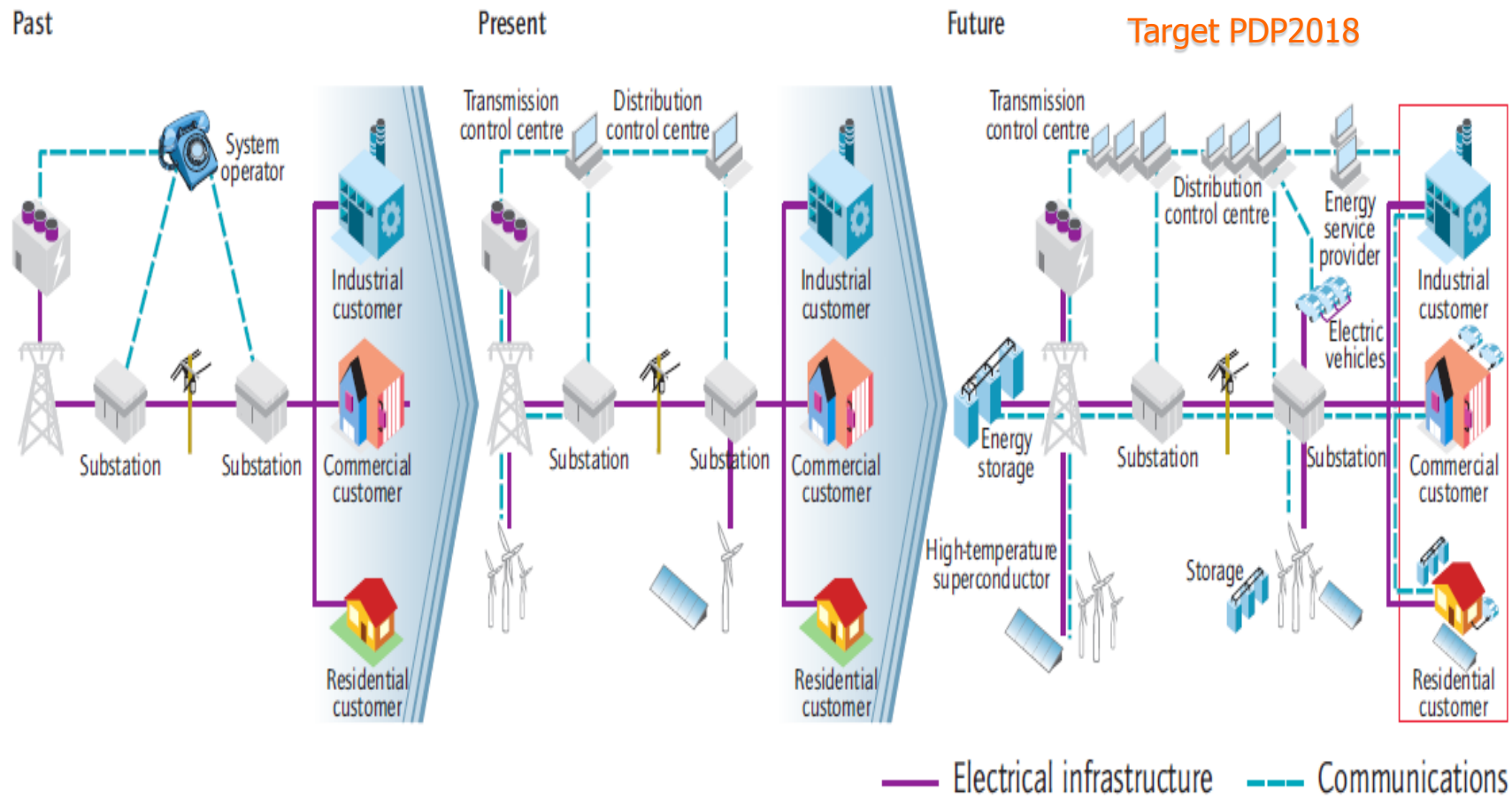


- Thailand plans to build the World's largest floating solar farm to power our economy and to boost the country's share of clean energy.
- 16 floating solar farm will be installed with combined capacity of more than 2,725 MW in 9 of its hydroelectric dam reservoir by 2037.

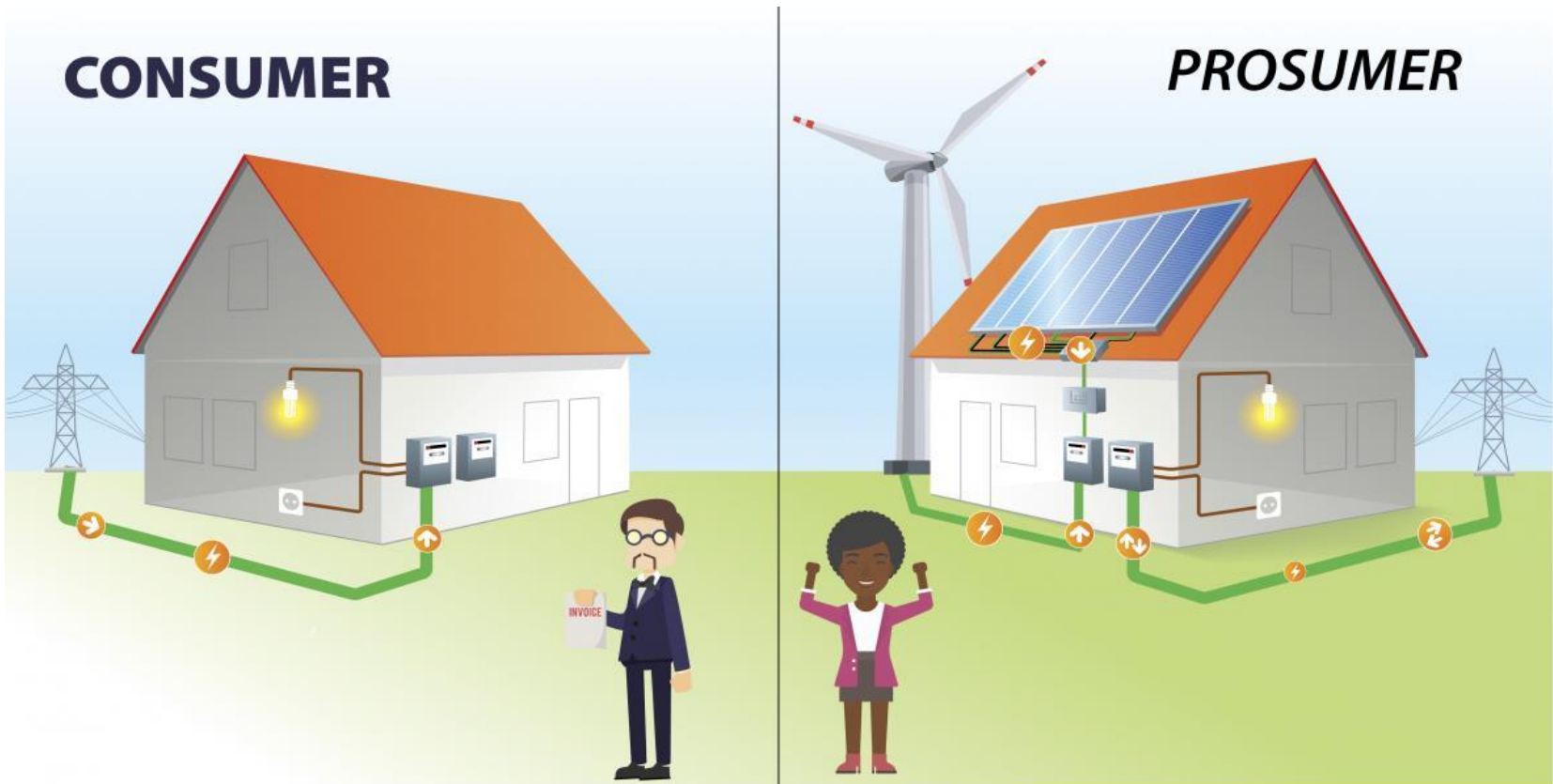


Floating Solar Capacity
= 2,725 MW





Future power system will be designed on a 'Distributed Generation' Basis to serve RE advance technologies, with two-way electricity flow system and high-efficient data communication among users



Users' behavior change: consumer can produce electricity for own use and sell the excess amount back to the grid and peer-to-peer. This increases self-sustained & self-managed power consumption at household level



Focus on CLMTV+MS countries

- Increase LTM Power Trade from current 100 MW to 300 MW, and complete the Singapore link
- Explore connectivity with Myanmar through 230 KV MaeSod-Myawaddy new network
- Increase Lao-Thai long term Power Purchase from current 6,000 MW to 9,000 MW
- Expand power purchase and sale transaction between Laos and Thailand from exclusive long-term contracts, to flexible short and medium term non-firm contracts and marginal pricing concept

1. Technology Trend

- **IPS** (Independent Power Supply)
- Disruptive Technology e.g. **Battery Energy Storage System, EV, Pumped Storage.**
- Market change to **Prosumer**
- **Smart Grid for RE** including **RE Forecast Center, Digitalized/Virtual PP** (Big Data, AI)

2. Balance of Security

- Increasing security **by zone**, apart from Metropolitan area
- Increase **Grid Flexibility** to support **RE power generation and integration**
- **Interconnectivity** with Neighbors e.g. **East-West Corridor, LTM, ASEAN Power Grid**

3. Remain Affordable Retailed Price of Electricity to consumers

- Consistent **Government policy** supporting low-cost power generation

4. Compliance to COP21 Agreement

- Predictable policy to promote power generation from **renewable energy / Bio-Circular-Green (BCG) Economy Model** for Sustainability
- Promote **EE**
- **Optimize coal-fired power generation** while increase public participation

3. RE Integration: Conclusion

- Highlights on flexibility***
- Thailand's Policy toward Future RE Integration***

RE Integration: Conclusion (1) – *Highlights on flexibility*

- Thailand's electricity system is flexible from a **technical** standpoint, but **institutional and contractual** constraints limit the mobilization of this flexibility
- **System flexibility** becomes an important factor for system *operations and planning with increasing shares of VRE* for future power system and *Integration*.
 - To **unlock** existing power plant flexibility.
 - To **develop and implement** a harmonized national **grid code** in a collaborative process, given the right actors to the right policy instruments.
 - To **establish** a National Renewable Energy Control Centre (avoid blackout)
- To accommodate higher shares of VRE generation, future electricity system is expected to have **sufficient flexibility** options
- **Solar and wind** resources have highly complementary generation profiles contributing to **different peak demand** patterns. While, **demand-side flexibility** options also help to **shift peak demand** and further **reduce total system operational costs**.

Renewable Energy Integration in Thailand

RE ?
Integration

9 PPAs relaxation

- must take basis
- Minimum generation

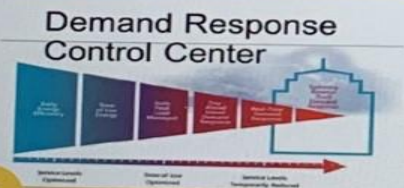


8 Fuel supply contract

- Take or pay, minimum take

7 RE forecast center

- facilitate RE
- reduce cost of electricity generation



6 Demand Response

- DRCC
- Load Aggregator
- Target of **4,000 MW** by 2037

1 Flexible Plant

- Retrofit combined cycle
- Characteristics of new combined cycle



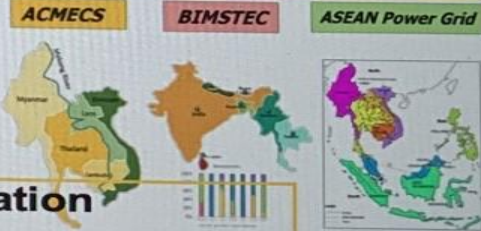
2 Energy Storage

- Variable speed pumped storage



3 Grid Connection

- Multilateral power trade
- Inter-regional transmission grid



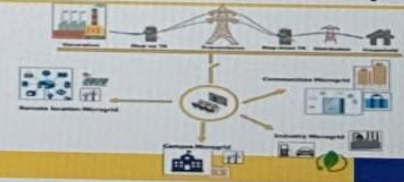
5 RE hybrid

- EGAT's Solar floating +Hydro 2,725 MW
- SPP hybrid 300 MW



4 Grid Modernization

- Smart grid
- Flexible AC transmission system devices



“To accelerate RE integration requires game changes in technology, in policies, in societal acceptance and in global coordination..”

RE Integration: Conclusion (2) - *Thailand's Policy toward Future RE Integration*

- Thailand has formulated an “**Energy for all**” policy that support the **public** particularly the **community** and raise the country’s **competitiveness**.
- The policy will support the country’s sustainable development by providing **affordable** clean and renewable energy to the people and community through future **game-changers** *i.e.* **community energy grid modernization, electricity sales platform, and smart meter**, while turning *consumer* into **prosumer**.
- Under *Power Development Plan (PDP) 2018-2037*, Thailand will scale up the **renewable energy** such as solar, wind, biogas and biomass through community power plants and connectivity under an **RE integration basis**.
- For policy actions to cope with **RE Integration** and **Energy Transition**, Thailand is planning to tackle this disruption era through **4D1E Policy** (*digitalisation, decarbonisation, decentralisation, deregulation and electrification*) towards cleaner and low-carbon society for all.

THANK YOU