



Interconnections in Southeast Asia: Implications for Singapore and the region

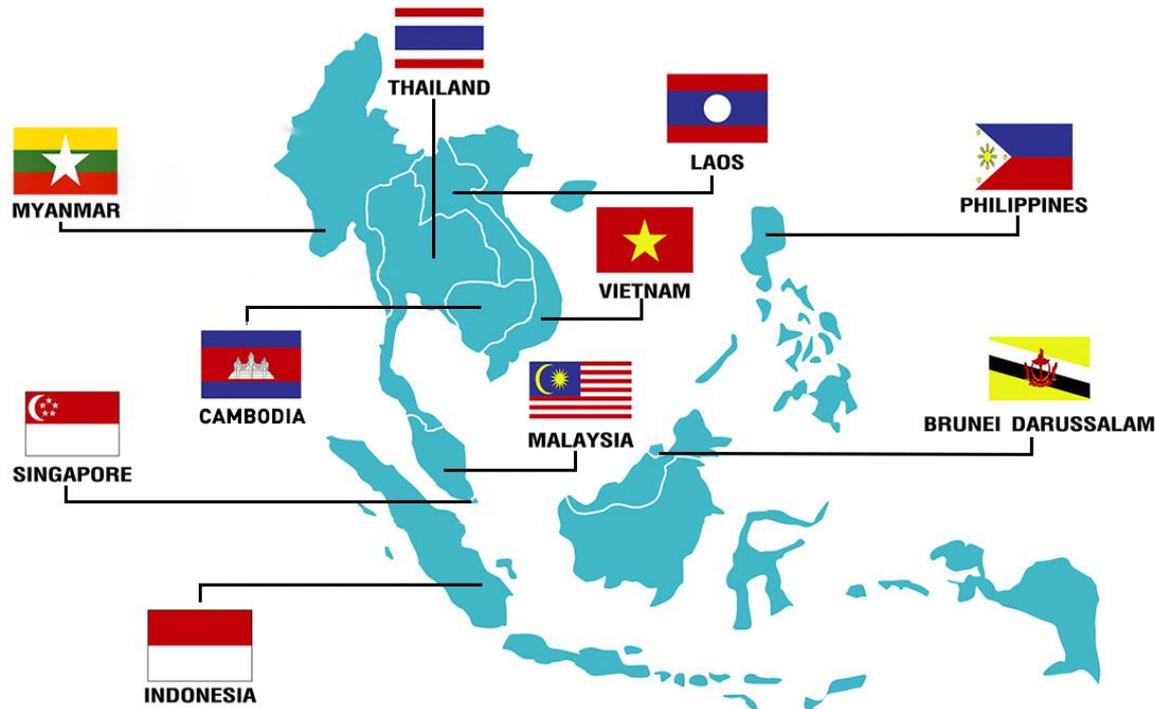
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Energy Market Authority of Singapore
28 April 2016

Agenda

- Development of interconnections in Southeast Asia
- Implications of regional interconnection for Singapore
- Role of interconnections in supporting greater deployment of renewable energy

Development of interconnections in Southeast Asia

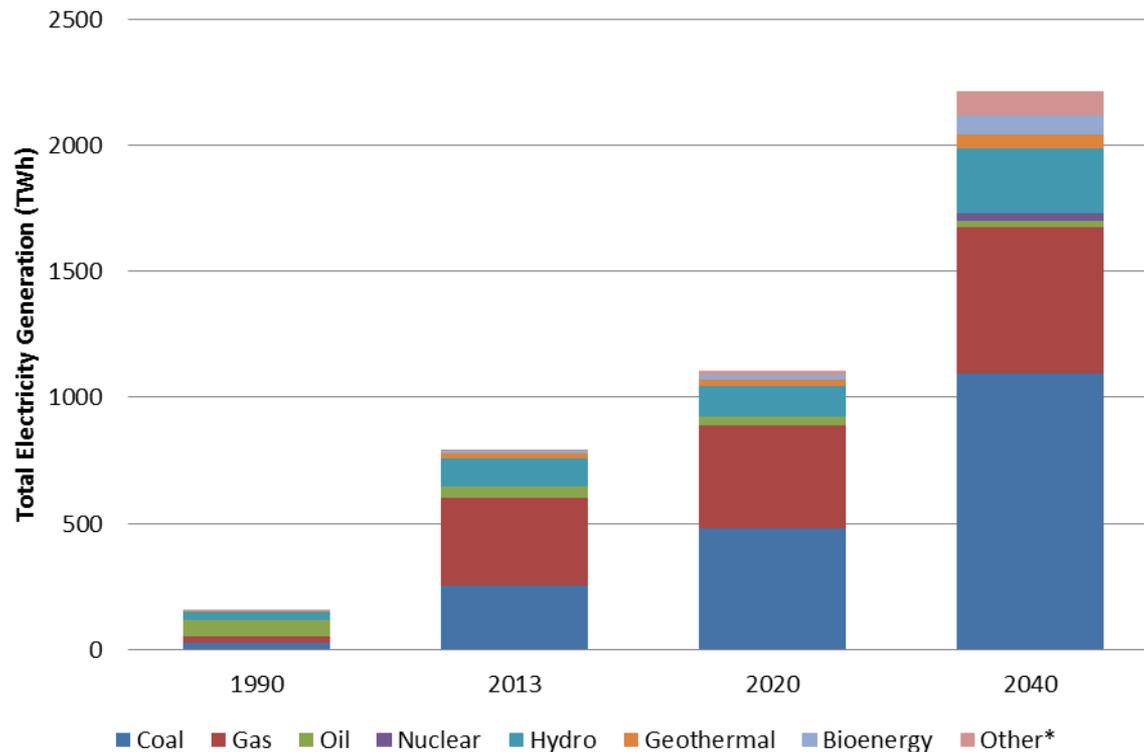
- The Association of Southeast Asian Nations, or ASEAN, was established on 8 August 1967 with 5 founding members, and now include 10 member states in total.



- To meet the region's energy needs, ASEAN has been working towards enhancing energy connectivity and market integration in ASEAN to achieve energy security, accessibility, affordability and sustainability for all member states.

Development of interconnections in Southeast Asia

- Energy demand in Southeast Asia is expected to grow rapidly in the coming decades, almost tripling from 789TWh in 2013 to about 2,200TWh in 2040.



Fuel Mix	2013	2040
Fossil fuels	82%	77%
Coal	32%	50%
Gas	44%	26%
Oil	6%	1%
Nuclear	0%	1%
Renewables	17%	22%
Hydro	14%	12%
Geothermal	2%	3%
Bioenergy	1%	3%
Other*	0%	4%
Total	100%	100%

* Includes wind and solar PV

Source: Southeast Asia Energy Outlook 2015, IEA

ASEAN Power Grid

The ASEAN Power Grid (APG) is a flagship programme set up in 1997 by the ASEAN Heads of States/Governments under the ASEAN Vision 2020

The MOU of the APG was signed by Energy Ministers in July 2007; to strengthen and promote power interconnection and trade in order to ensure greater regional energy security and sustainability on the basis of mutual benefit

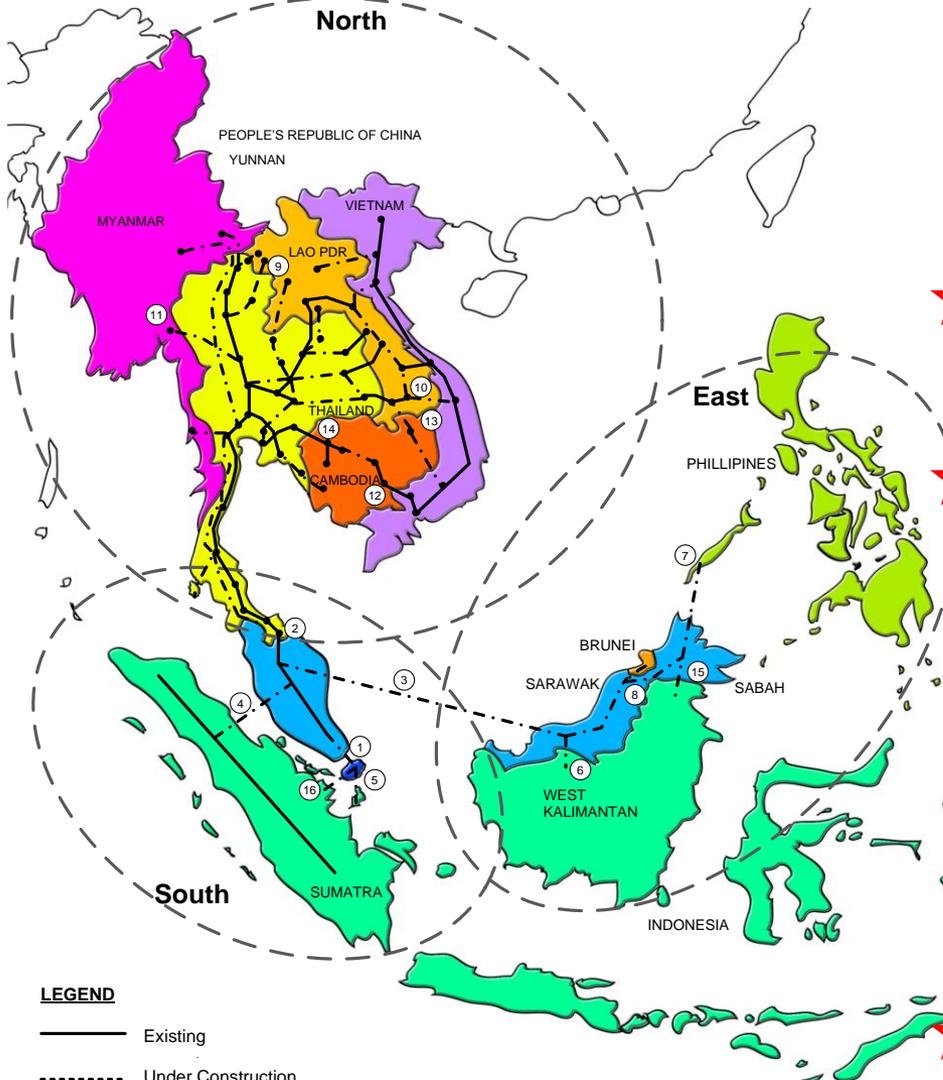


The APG to meet growing electricity demand and to reap the potential advantages from integration of electrical systems.

Objectives & Benefits of the APG

- The creation of a regional power system serves to improve energy security, reliability and electricity generation. The benefits include:
 - More effective development and utilization of energy resources
 - Better optimization of power transfer from diverse energy sources to demand centers
 - Reduction of capital expenditure by lowering the need for additional generation capacity
 - Improved demand response through capitalizing on different regional demand peak timings
- The APG also provides a platform to facilitate regional electricity trade

Updated List of APG Projects

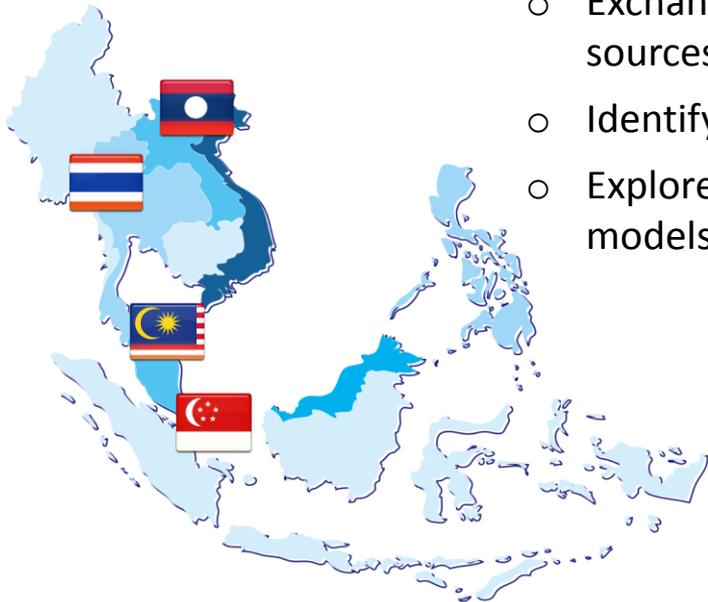


 Priority Projects

	Earliest COD
1) P.Malaysia - Singapore	
• Plentong - Woodlands	Existing
• P.Malaysia - Singapore	post 2020
2) Thailand - P.Malaysia	
• Sadao - Bukit Keteri	Existing
• Khlong Ngae - Gurun	Existing
• Su Ngai Kolok - Rantau Panjang	TBC
• Khlong Ngae – Gurun (2 nd Phase, 300MW)	TBC
3) Sarawak - P. Malaysia	2025
4) P.Malaysia - Sumatra	2020
5) Batam - Singapore	2020
6) Sarawak - West Kalimantan	Existing
7) Philippines - Sabah	2020
8) Sarawak - Sabah – Brunei	
• Sarawak –Sabah	2020
• Sarawak – Brunei	2018
9) Thailand - Lao PDR	
• Roi Et 2 - Nam Theun 2	Existing
• Sakon Nakhon 2 – Thakhek – Then Hinboun (Exp.)	Existing
• Mae Moh 3 - Nan - Hong Sa	2015
• Udon Thani 3- Nabong (converted to 500KV)	2019
• Ubon Ratchathani 3 – Pakse – Xe Pian Xe Namnoy	2019
• Khon Kaen 4 – Loei 2 – Xayaburi	2019
• Nakhon Phanom – Thakhek	2015
• Thailand – Lao PDR (New)	2019-2023
10) Lao PDR – Vietnam	
• Xekaman 3 - Tranhmy	Existing
• Xekaman 1- Pleiku 2	2016
11) Thailand - Myanmar	2018-2026
12) Vietnam - Cambodia (New)	
• Chau Doc – Takeo – Phnom Penh	Existing
• Tay Ninh – Stung Treng	TBC
13) Lao PDR - Cambodia	2017
14) Thailand - Cambodia (New)	post 2020
• Aranyaprathet – Banteay Meanchey	Existing
• Thailand - Cambodia	post 2020
15) East Sabah - East Kalimantan	post 2020
16) Singapore – Sumatra	post 2020

Lao PDR-Thailand-Malaysia-Singapore Power Integration Project (LTMS-PIP)

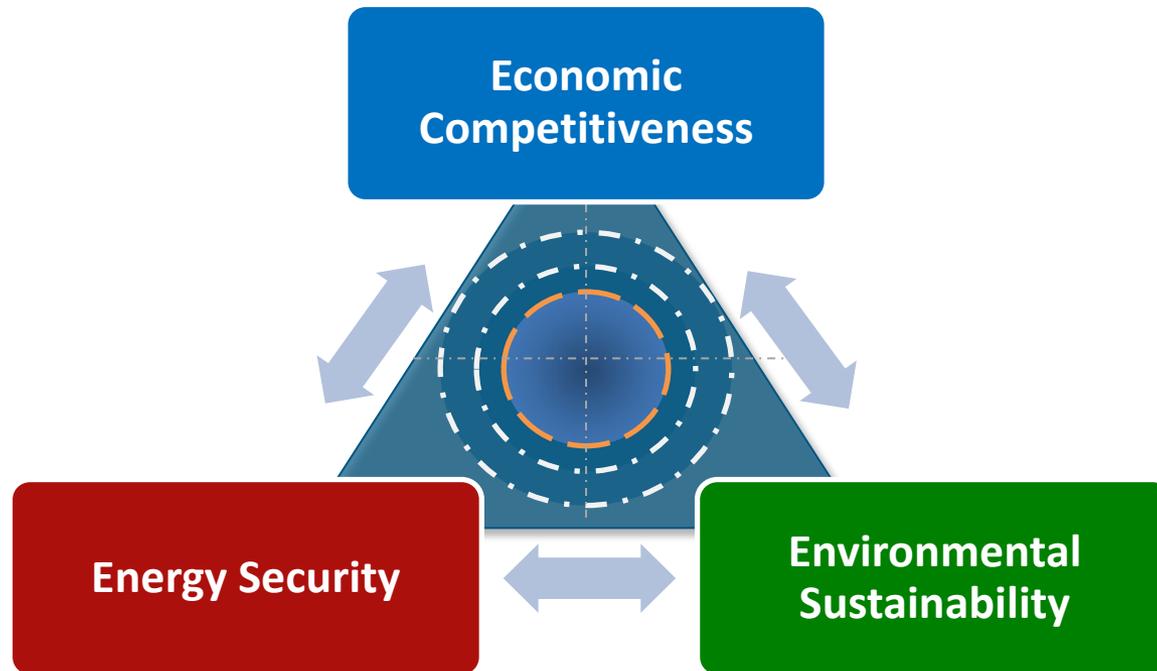
- First conceptualised by Lao PDR and Singapore during bilateral discussions on energy cooperation, thereafter included Thailand and Malaysia in discussions
- Working Group set up between the 4 countries to study the viability of cross-border power trade of up to 100 MW from Lao PDR to Singapore. The scope includes:
 - Explore the technical feasibility and viability of cross-border power trade using existing interconnections
 - Exchange information on existing and planned electricity generation sources, electricity demand
 - Identify the legal and regulatory issues
 - Explore possible commercial arrangements and possible business models



- If materialized, the LTMS project will be the first multilateral power trade in ASEAN and is expected to be a pathfinder towards realising the broader ASEAN Power Grid

Implications of regional interconnection for Singapore

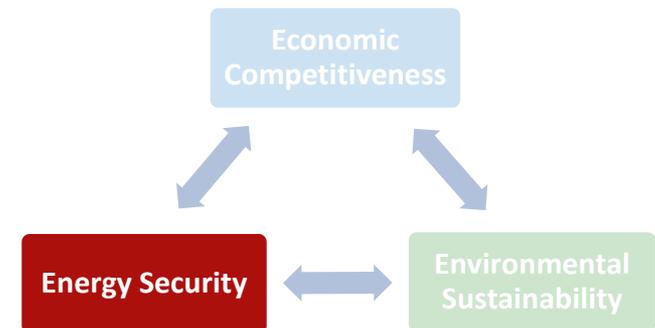
- What does regional interconnection mean for Singapore? We take a look through the lenses of the energy trilemma



Implications of regional interconnection for Singapore:

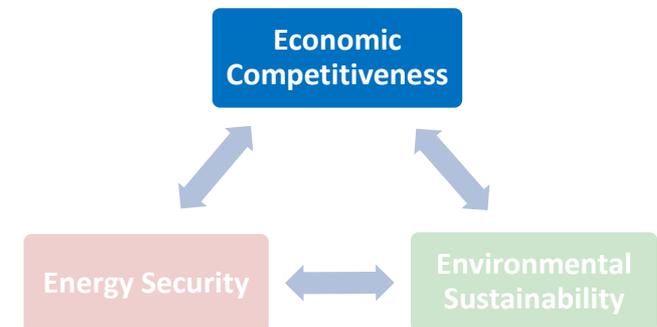
Energy Security

- Importing electricity will allow Singapore to enhance our energy security by diversifying our energy mix, both in terms of fuel type as well as supply sources. This will allow us to tap into new energy options that may be unavailable or economically infeasible in Singapore.
- Greater interconnections with our neighbouring countries would also support the establishing of a larger regional market for electricity trading, promoting investments and ultimately enhancing regional electricity supply security.
- However, we need to ensure that the security and reliability of our power system are not comprised by being over-reliant on energy imports and spreading imports across various sources to mitigate concentration risk.



Implications of regional interconnection for Singapore: Economic Competitiveness

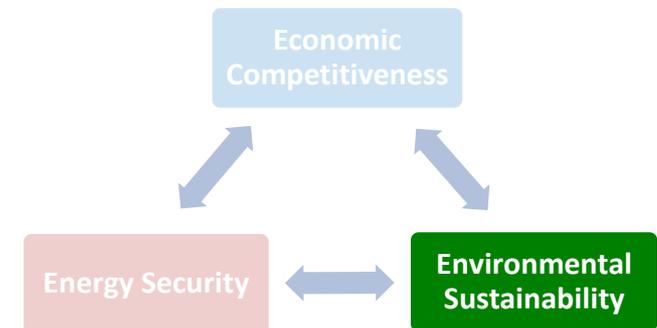
- Electricity imports can also bring about economic benefits for Singapore, by spurring greater competition in our electricity market through the introduction of new power sources
- Overseas power producers could have access to lower-cost fuels, labour and land, which allow them to offer cost-competitive prices even after factoring in the cost of transmission to Singapore, and exert downward pressure on electricity prices in Singapore
- Importing electricity would also reduce the demand for land to build power plants in Singapore, which can then be used for other purposes



Implications of regional interconnection for Singapore:

Environmental Sustainability

- Regional interconnection could allow Singapore to tap on other renewable sources like hydro and geothermal that are unavailable in Singapore
- Being a part of a larger interconnected power grid could also allow us to support a greater level of penetration of intermittent renewable energy sources (such as solar) without putting excessive strain on the stability of our power system



Framework for electricity imports

- To facilitate electricity importers in making their investment decisions, Singapore will put in place a regulatory framework to govern the orderly entry of electricity imports that translates to cost savings for all consumers, while ensuring that the security and reliability of the power system is not compromised
- The proposed regulatory framework is as follows:

Legal/regulatory requirements	<ul style="list-style-type: none">• Obtain an import licence from EMA• Participate in wholesale electricity market to secure dispatch
Quantity of electricity imports	<ul style="list-style-type: none">• Up to 600MW per source country
Selection process	<ul style="list-style-type: none">• Two stage competitive tender process<ol style="list-style-type: none">1) Shortlisting of interested parties based on track record, preliminary proposals2) Submission of detailed proposal for evaluation, final selection
Securing benefits for consumers	<ul style="list-style-type: none">• Enter into a one-way CfD to lock in the price of electricity supply at no higher than the agreed strike price

Solar PV offers greatest deployment potential for Singapore

- Due to our physical constraints, Singapore has **limited renewable energy options**:

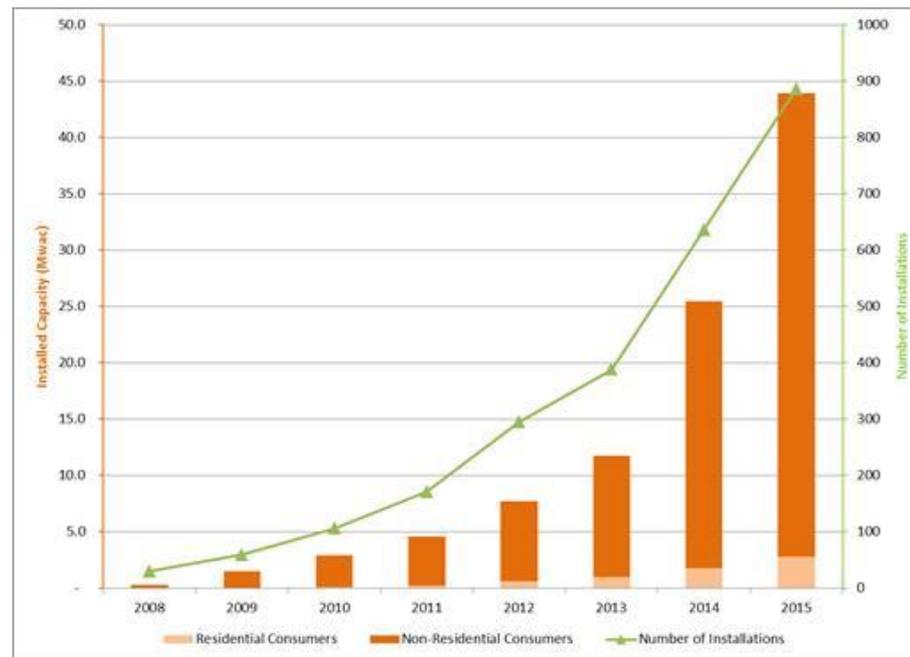
1	2	3	4
Solar	Hydro	Tidal	Wind
			
Singapore is located in the tropical sunbelt with good irradiance	Singapore's terrain is relatively flat	Tidal range in Singapore is generally low and our waters are relatively calm	Singapore has low average wind speeds



Amongst the renewable energy technologies, **solar generation** offers the **greatest deployment potential**

Steady growth in solar PV deployment in Singapore

- Market interest in solar has been growing in Singapore. Since 2008:
 - The number of installations has increased from 30 to 886 (end 2015);
 - The installed capacity has increased from 0.3 MWac to 43.8 MWac (end 2015).
- The take-up is expected to accelerate over the next few years, as prices fall and technology continues to improve.



Singapore's efforts to maximise solar deployment

- Recognising the multiple benefits of solar to our environmental sustainability, energy security and price competitiveness, Singapore is taking proactive steps to maximise solar deployment.
- We are continually reviewing our rules, policies and processes to ensure continued relevance, and have recently introduced several regulatory enhancements. These include:

**#1: Streamlining
deployment process**

**#2: Market-based
solutions**

**#3: Managing
intermittency**

#3: Managing Intermittency

- We take a multi-prong approach towards addressing the issue of managing the intermittency of renewable generation sources such as solar:

Dynamic Pathway Approach

- Allow the amount of reserves to grow in tandem with solar deployment
- Allocate the cost of additional reserves required in an equitable way on a causer-pay principle

Technical Solutions

- Develop better solar forecasting to better cater for real-time weather fluctuations and solar output
- Deploy energy storage to manage intermittency

Regional Inter-connection

- Tap on regional interconnections to manage fluctuations within the system
- Being part of a larger grid network better smoothens the output of intermittent generation sources across the system

THANK YOU