FACILITATING DEPLOYMENT OF RENEWABLE ENERGY IN SINGAPORE

43rd APEC New and Renewable Energy Technologies Expert Group
12 – 13 November 2014

ENERGY MARKET AUTHORITY

Smart Energy, Sustainable Future

Solar PV offers **greatest deployment potential** for Singapore

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

Renewable Energy	Our Constraints
Hydro	Singapore's terrain is relatively flat
Tidal	Tidal range in Singapore is generally low and our waters are relatively calm
Wind	Singapore has low average wind speeds

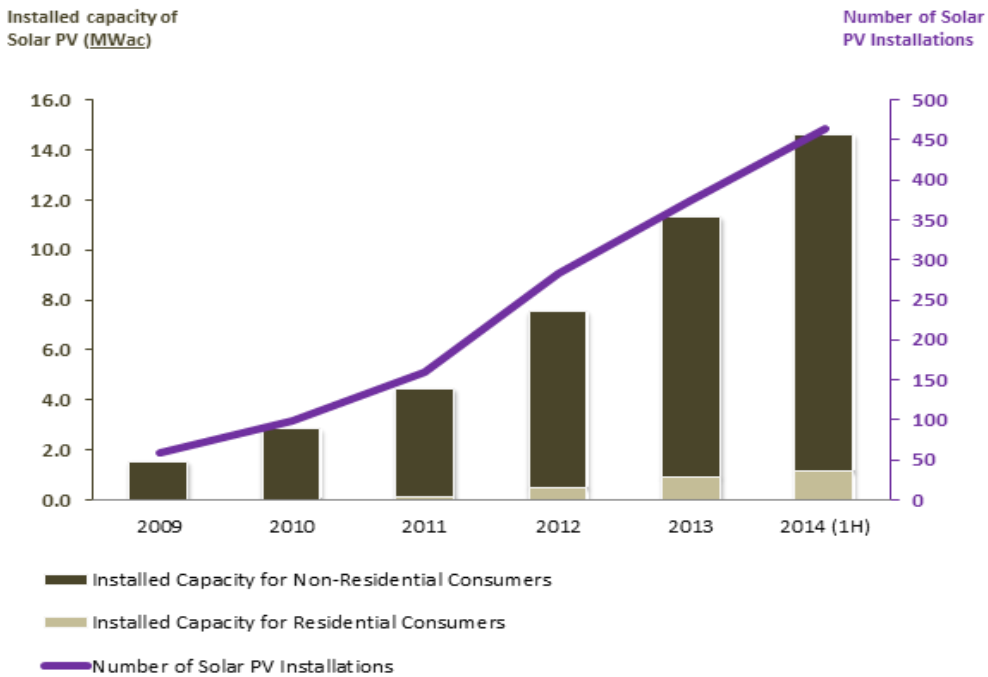
- Nonetheless, Singapore is located in the tropical sunbelt with good irradiance. Hence, amongst the renewable energy technologies, **solar generation offers the greatest deployment potential.**

Steady growth in solar PV deployment in Singapore

- **Market interest in solar has been growing in Singapore**. Since 2009:
  - ✓ The number of installations has increased from **60 to 465 (end 1H 2014)**;
  - ✓ The installed capacity has increased from **1.5 MWac to 15 MWac (end 1H 2014)**.

- The take-up is expected to accelerate over the next few years, as prices fall and technology continues to improve.

Solar PV Installations in Singapore as at end period



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: Simplifying payment procedures

#3: Managing Intermittency

#1: Streamlining deployment process

- To facilitate increasing market interest in solar, we are working with the grid company to streamline the grid connection process and scale up the deployment pace.
- Some of the concrete steps include:

  a) **Reduced the grid connection process** from 27 to 7 days;

  b) **Established a grid connection checklist** to accelerate application process by consumers;

  c) **Empowering Licensed Electrical Workers (LEWs)** to commission solar installations of certain class, with the submission of relevant test results to SP PowerGrid for verification. With this, the grid company need not witness the commissioning process, in turn reducing coordination costs;

  d) **Developing a one-stop portal for solar PV** to facilitate information sharing with consumers.

#2: Simplifying payment procedures

- We have simplified the procedures for solar generation to receive payments for export to the grid:

Streamlining the market registration process

- Small consumers can receive payments from the billing & metering agent through a direct credit adjustment to their electricity bills, and need not undergo the full market registration. This will be implemented in Q1 2015.

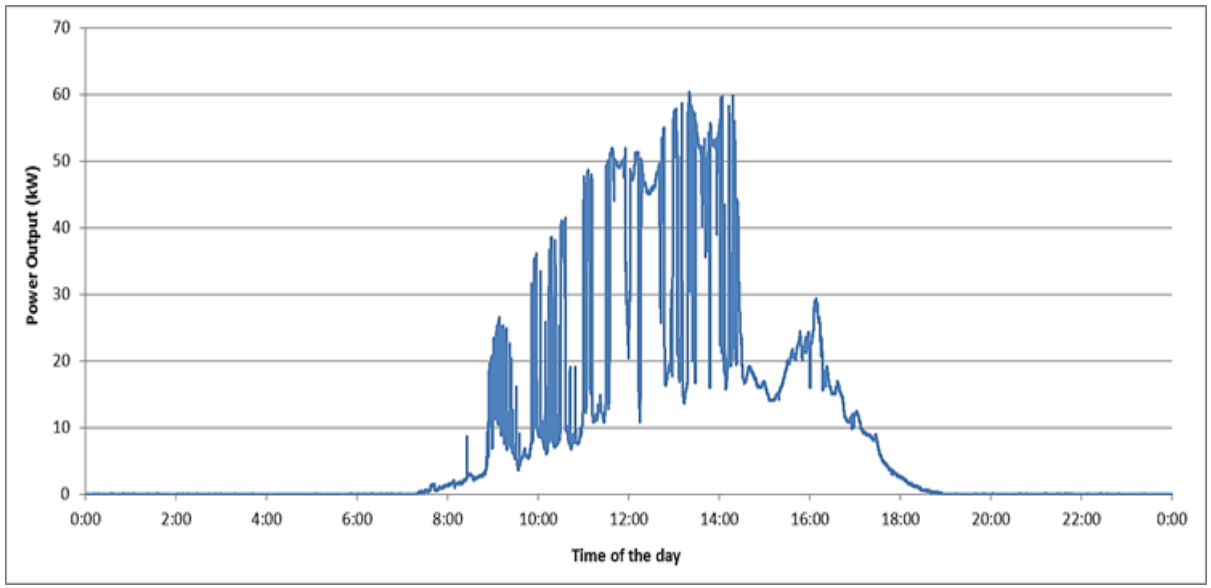
Allowing "net settlement"

- Consumers with solar generation will enjoy **"net settlement".** This means that consumers will pay for their net withdrawal of electricity from the grid or receive payment for excess electricity exported to the grid.

#3: Managing Intermittency – "Dynamic Pathway Approach"

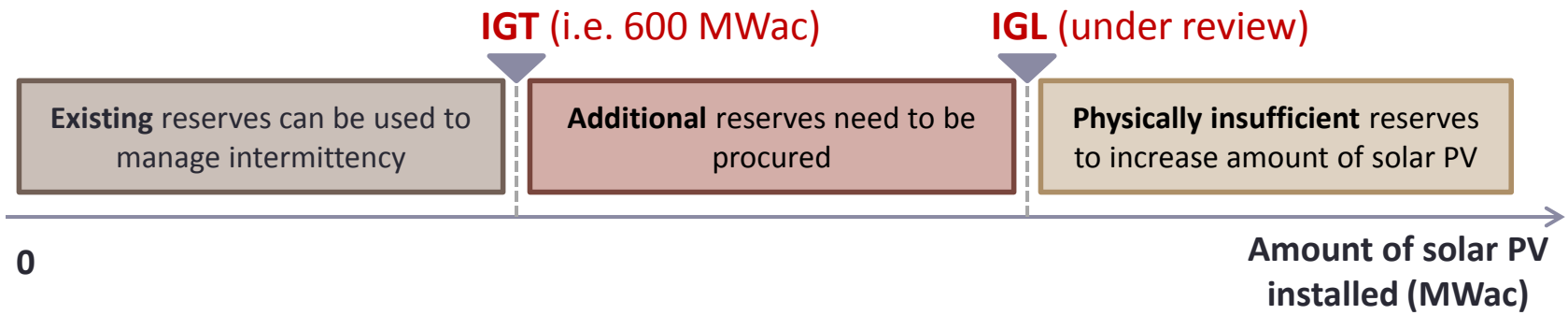
- Solar PV is **intermittent** in nature and the power output **fluctuates** due to changes in weather conditions, cloud cover & shadows.
- Reserves capacity is needed for back-up, to ensure system security, grid stability, and power quality.

Figure. Example of variability of output from solar PV



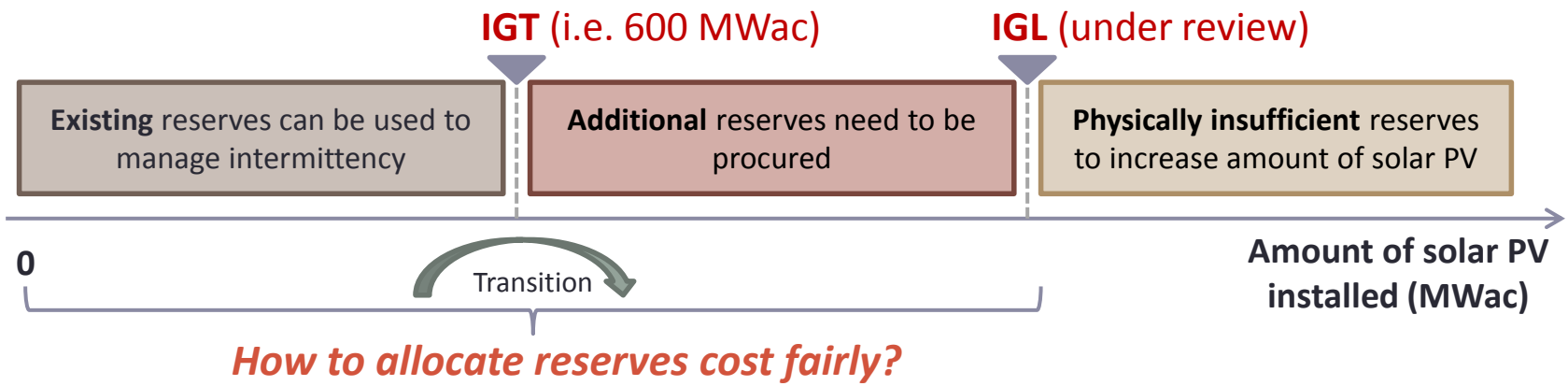
#3: Managing Intermittency – "Dynamic Pathway Approach" (con't)

- To ensure sufficient reserves to manage the intermittency, we have developed the **"dynamic pathway approach"** which allows the amount of reserves to grow in tandem with solar deployment.
- This consists of two thresholds :
  - ✓ **Intermittent Generation Threshold (IGT):** Below IGT, existing reserves will be used to manage the intermittency of solar. Above IGT, additional reserves would need to be procured to manage intermittency.
  - ✓ **Intermittent Generation Limit (IGL)**: This is the total amount of solar generation the power system can support based on the total amount of reserves available.



#3: Managing Intermittency – Allocating costs in an equitable way

- As solar generation requires back up reserves to manage its intermittency, it is important that the **cost of providing the reserves is allocated in a fair manner**.
- We are studying reserves charging frameworks to account for intermittency, whilst ensuring that the regime is fair to all generators and consumers, including future solar owners.



#3: Managing Intermittency – Solar forecasting and Energy Storage

Solar Forecasting

- Solar forecasting will be important tool for managing intermittency and determining the reserves requirements to cater for real-time weather fluctuations and solar output.

- For a start, EMA is collecting solar PV and weather data and exploring working with agencies like A*STAR I2R, Experimental Power Grid Centre (EPGC), Solar Energy Research Institute of Singapore to develop forecasting capabilities.

Energy Storage

- We are also keen to build capabilities and solutions in grid-scale energy storage for tropical conditions to deal with intermittency and to facilitate the deployment of solar energy.

Moving forward

- We support solar deployment, and have been taking proactive steps to maximise the deployment potential in Singapore.
- We will continually refine our rules and policies to ensure that the regulatory framework remains relevant as technologies and business models evolve.
- Looking ahead, EMA will be building system-level capabilities solutions to ensure that the power system is ready to manage the increased intermittency as solar deployment accelerates.
- We welcome the sharing of experiences and knowledge in the important area of intermittency management.

THANK YOU