

# JAMAICA'S RENEWABLE EXPERIENCE

**Lincoy Small - Director, System Operations Division, JPS**



# JPS – BACKGROUND

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**WHO WE ARE:** Jamaica Public Service Company Limited (JPS) is an integrated electric utility company and the sole distributor of electricity in Jamaica.

## OWNERSHIP:

- 80% Majority Owned by Marubeni & Korea East West Power (EWP)
- Government of Jamaica & Minority Shareholders own remaining shares

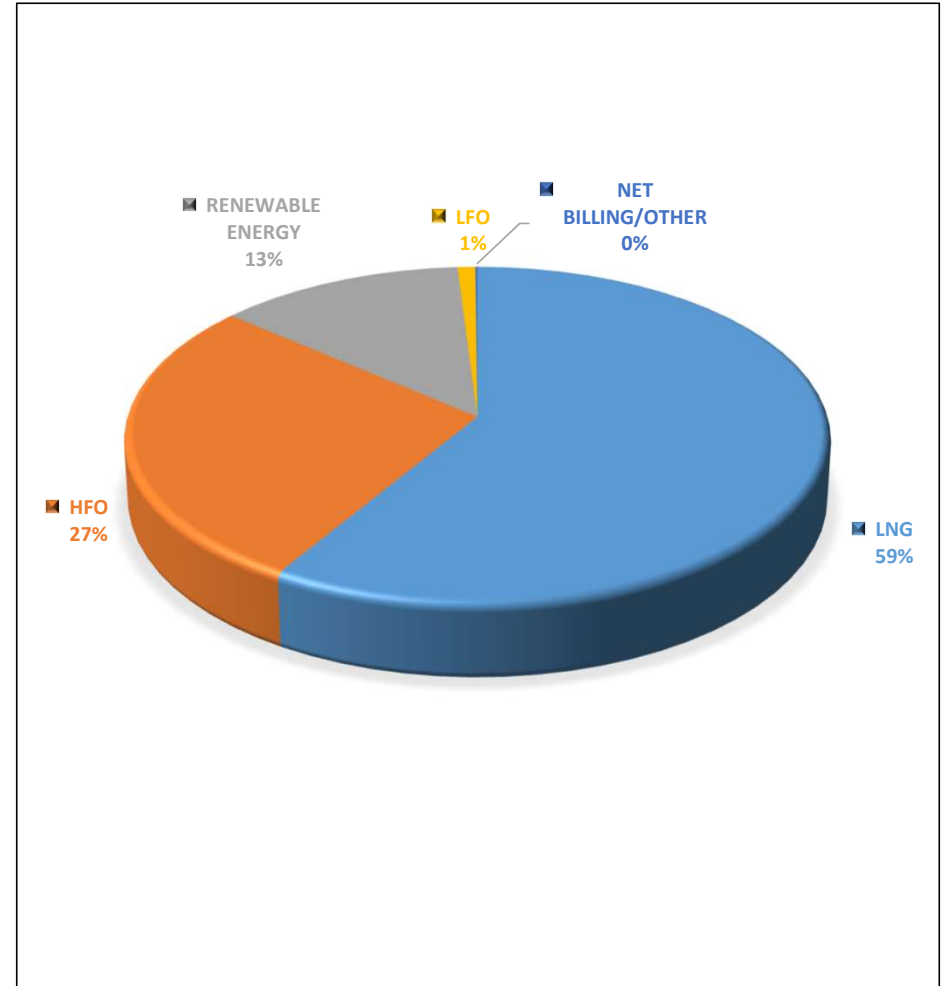
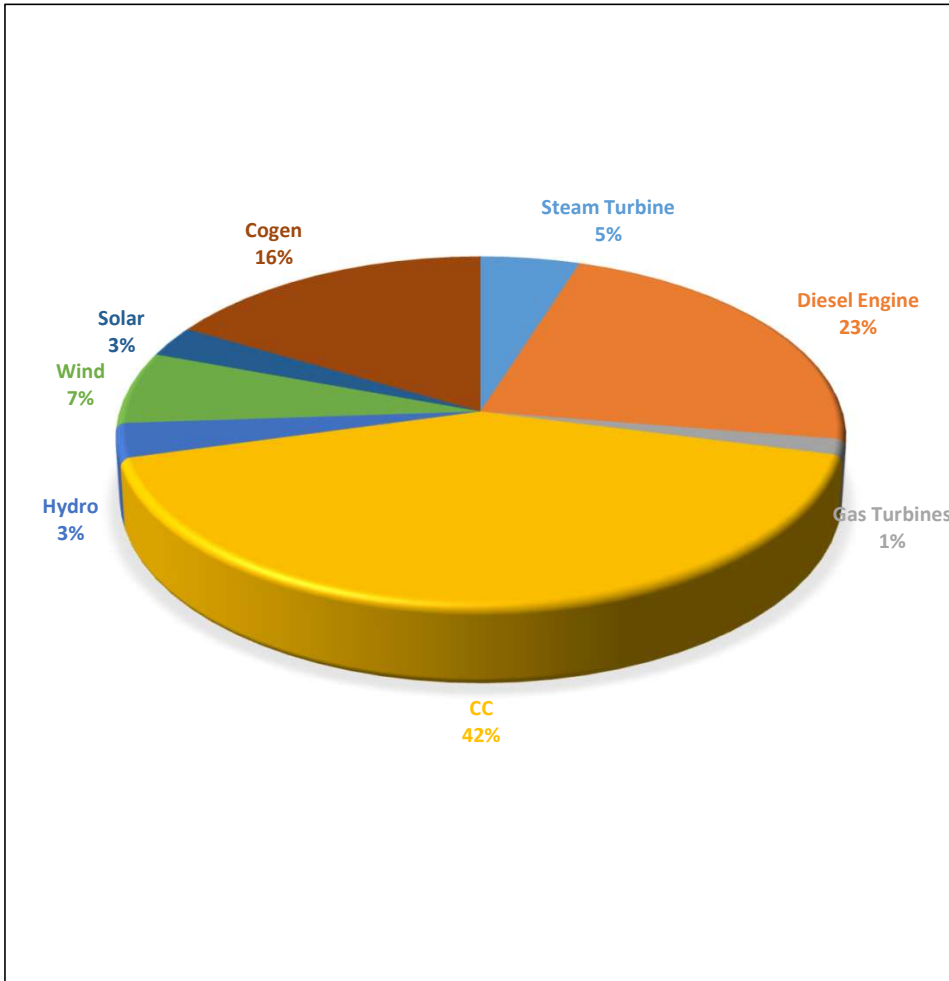
## POWER GENERATION:

- JPS owns & operates 4 power stations, 9 hydro plants, and 1 wind farm
- Thermal: Diesel Engines-HFO (289.9MW), Gas Turbines-ADO (151.5MW), Combined Cycle-LNG (308MW)
- Renewables: Hydro (29.1MW), Wind (101.3MW), Solar (57MW). Cogen Thermal- GT LNG (94MW)
- We purchase power from several Independent Power Producers (IPPs)
- Total Installed Capacity: 1030.8 MW (JPS – 337.6 MW /IPPs – 693.2 MW)
- Peak Demand: 666.7 MW (Sept 2017)

## CUSTOMERS:

- We serve more than 650,000 customers (Population: 2.73 million)
- Customer Categories: Residential, Small & Large Commercial, Industrial

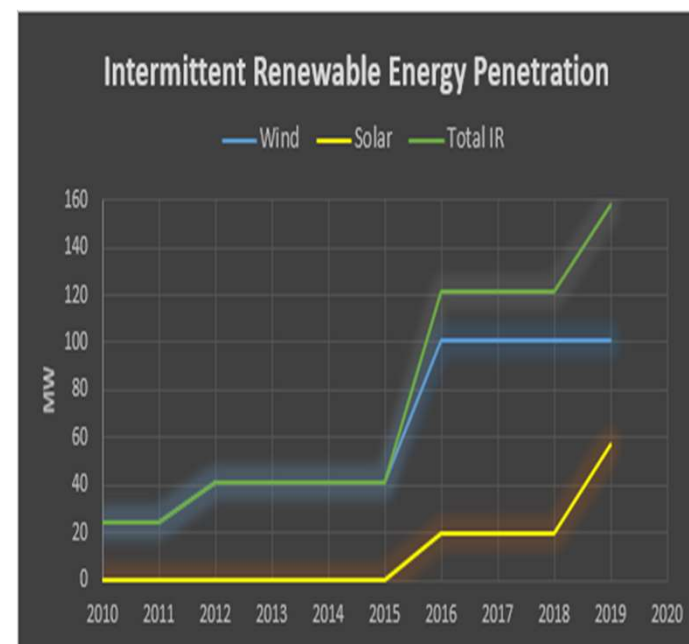
# 2020 ELECTRICITY GENERATION BY TECHNOLOGY & ENERGY SUPPLY



# JAMAICAN INITIAL GRID CHALLENGE DUE TO VRE INTERMITTENCY

## INTERMITTENT RENEWABLE PENETRATION

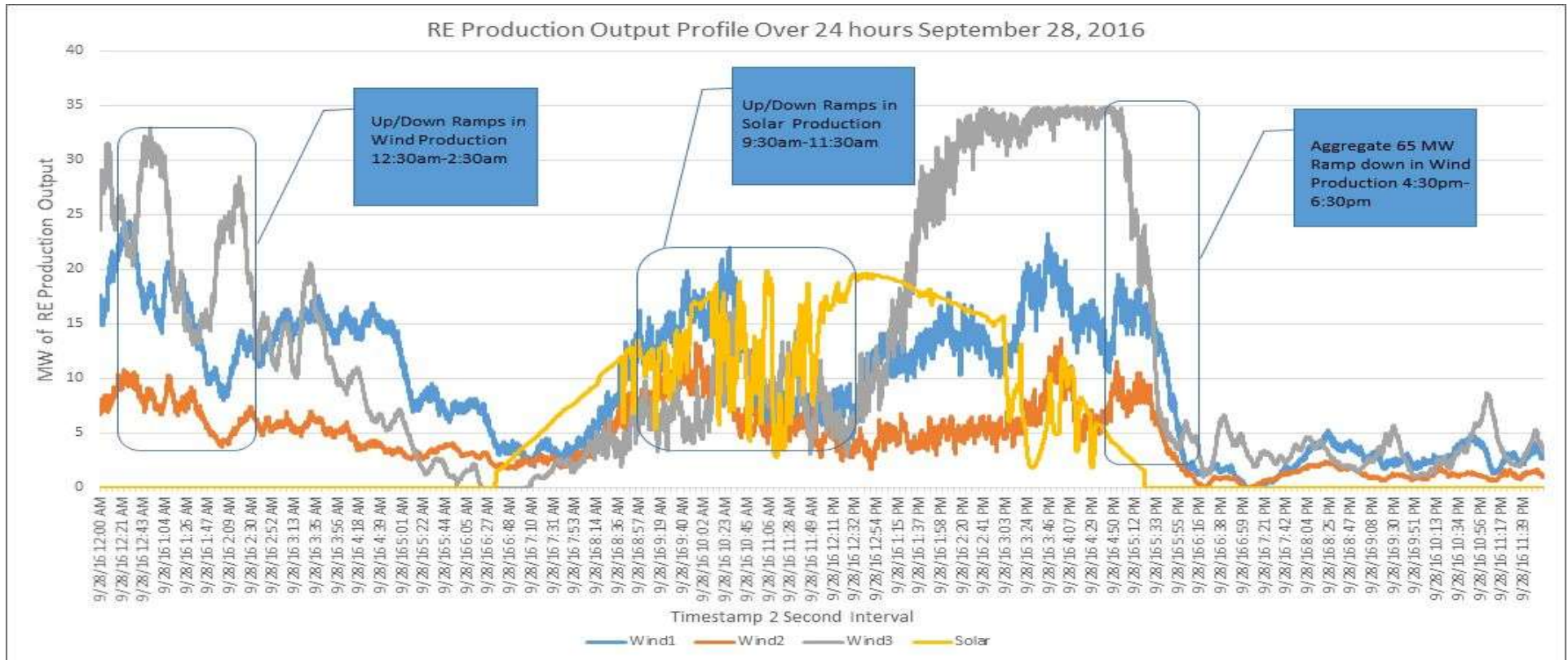
Typical Dispatch Scenario	Average Day Peak	Average Minimum Load	Installed Capacity (firm & non-firm)
Demand (MW)	580.0	400.0	1030.8
Wind Capacity %	17.4%	25.3%	9.2%
Solar Capacity %	9.9%	14.3%	5.2%
<b>TOTAL CAPACITY PENETRATION %</b>	<b>27.3%</b>	<b>39.6%</b>	<b>14.2%</b>



**VRR > 10% of peak capacity will present challenges for System Operators.**

*Wind Energy and Power Systems Operations: A review of Wind Integration Studies to Date, The Electricity Journal, Vol. 22, Issue 10, 34-43.*

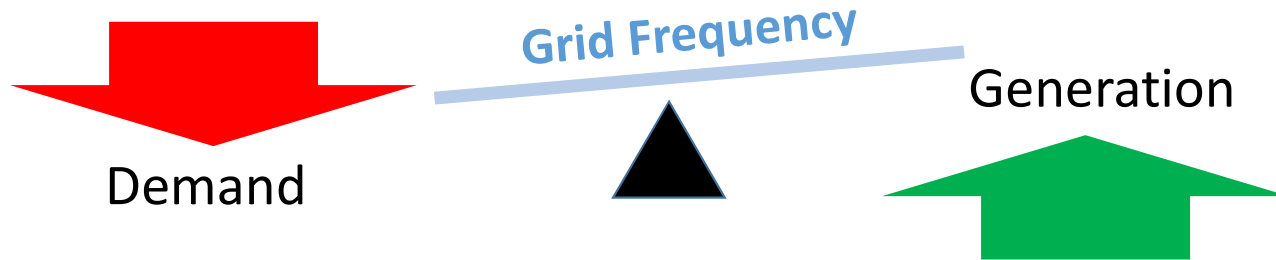
## REAL-TIME SNAPSHOT OF SOLAR & WIND INTERMITTENCY



- Unpredictable and Steep RE Ramps
- Normal Operation at Solar facility, 7.9MW/Min of observed ramp rate.
- Ramping Capability of Thermal Units, 1MW/Min – 5MW/Min

## JPS UNDER-FREQUENCY (UF) LOAD SHEDDING

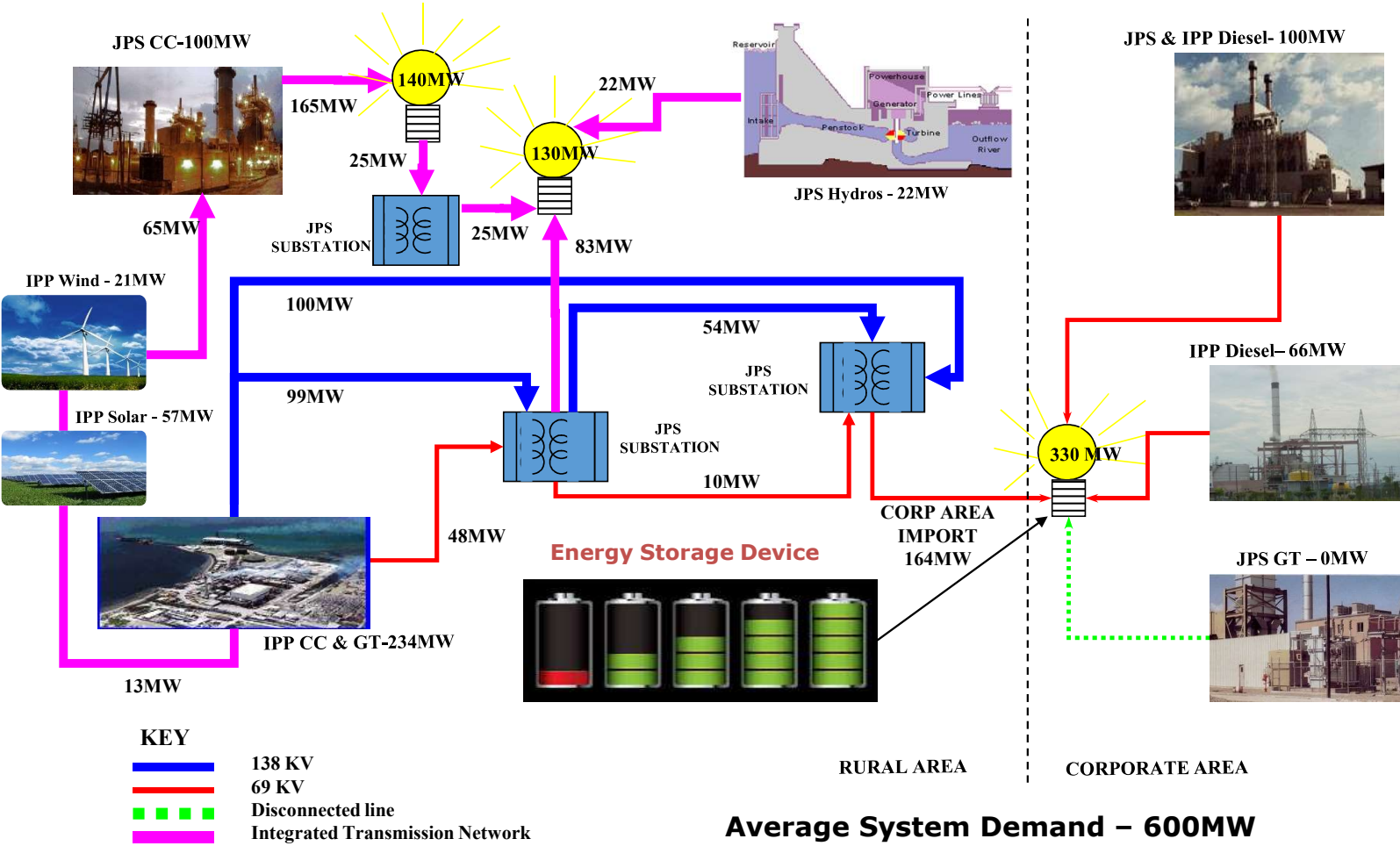
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Stage	Frequency Set-point (Hz)	Potential # of Cust. Affected (Each Stage)
0	49.35	61,708
1	49.20	33,855
2	48.90	63,756
3	48.50	40,065
4	48.10	34,417

- JPS UF load shedding is automatically operated when the shortfall in generation results in the system frequency degrading below the above UF set points

# TRANSMISSION SYSTEM



- **Transmission System**
  - Voltages - 138kV & 69kV
  - Total Length - 1184 km
- **Distribution System**
  - Voltages - 12kV, 13.8kV & 24kV
  - Total Length – 11,000 km
- **Substations**
  - Voltages - 12kV to 138kV
  - Total Number – 43
- **Ancillary Services**
  - Bulk Capacitor Banks
    - Voltage Support
  - Hybrid Energy Storage System
    - Frequency, Voltage, Spinning Reserve
  - Quick Starting Gas Turbines
    - Operating Reserve

## **MAJOR GRID ISSUES - 2016**

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**Increase in the automatic load shedding since commissioning of 80.3MW of RE in 2016**

**Generating units unable to respond to ramp rate to support intermittent RE**

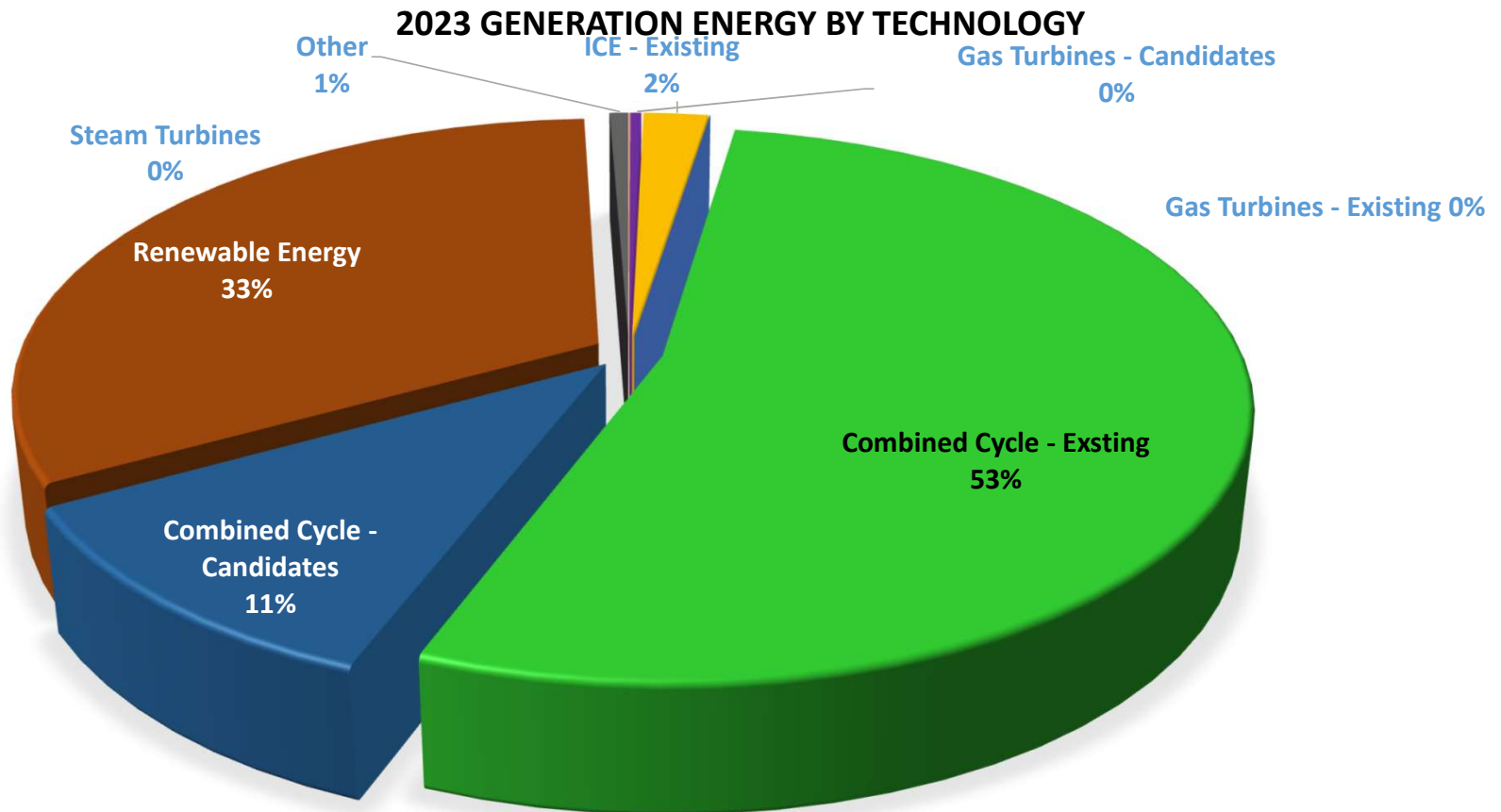
**Reduction in thermal generation efficiency & increase in generation cost and wear on generating units due to increase in cycling & ramping activities**

**Increased dispatch of more expensive generating units that have faster start-up capabilities & higher ramp rates**

**Voltage/VAR management concerns**



## The Evolving Electricity Sector – JAMAICA'S IRP IMPLEMENTATION PLAN



# JPS' Implemented Solutions to Combat Renewable Intermittency Challenges

## JAMAICA/JPS SOLUTIONS TO COUNTER VRE INTERMITTENCY

1. Improve situational awareness tools for System Operators

2. Optimization/Replacement of Existing Generating Fleet

3. Implementing Energy Storage Technologies

4. Utilizing Renewable Resource Forecasting Tools

# BENEFITS OF RE WIND & SOLAR FORECASTING ON DISPATCH

## Intra-day Dispatch (Real Time Operations)

Determine real time spinning reserve levels and reserve ramp rate requirements

## Day ahead Dispatch (Short Term Operations)

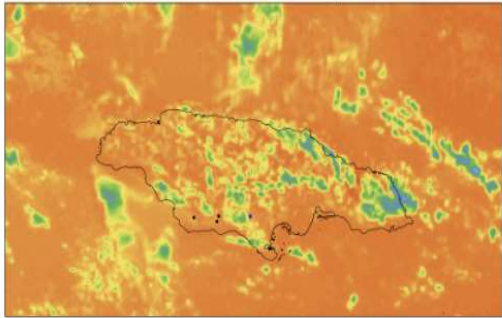
Determine operating reserve requirements

## Weekly Dispatch (Medium Term Operations)

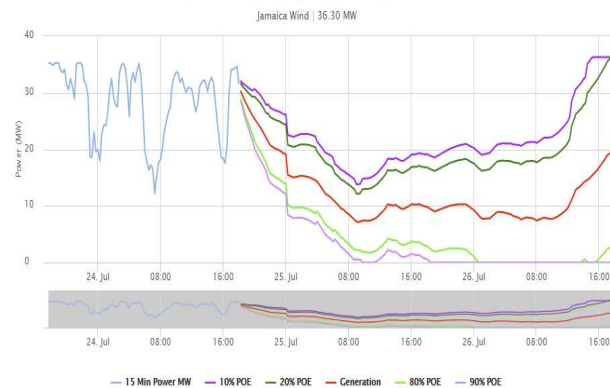
Assist with generator outage scheduling (firming or making intermittent renewable capacity predictable) as well as transmission power flow scheduling & outage scheduling

- Increase the ability to plan more generation outages (higher operating reserves)
- Improve the ability to perform additional OPF and SCOPF by integrating more predictable output from intermittent renewable facilities

Est. Irradiance (W/M<sup>2</sup>) Updated: 2019-07-24 10:45 COT



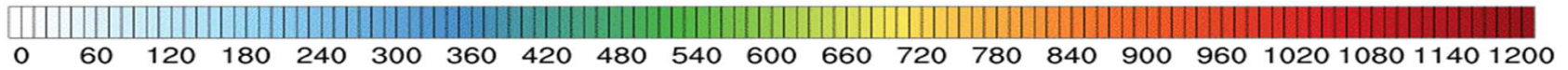
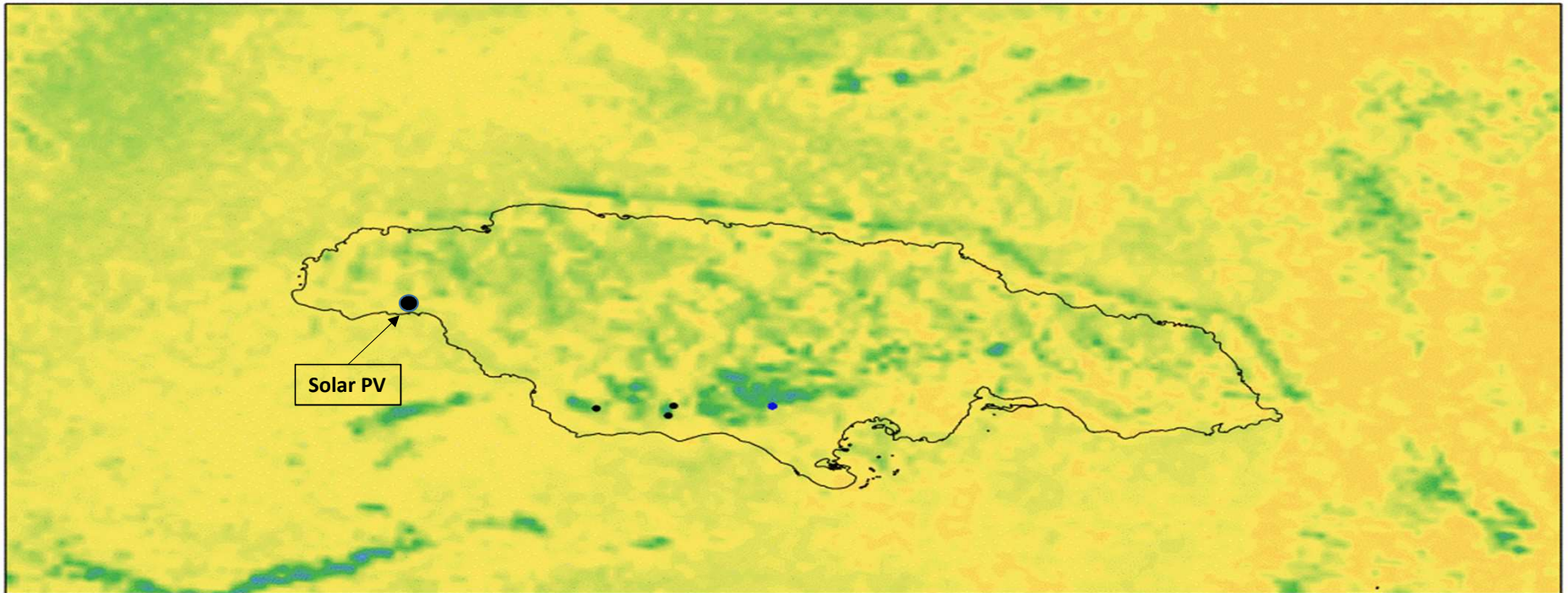
15-Min Day-Ahead Forecast  
Forecast Issued: Wed, Jul 24, 2019 18:00 EST



# IRRADIANCE ANIMATED MAP

Est. Irradiance (W/M<sup>2</sup>)

Updated: 2019-07-22 09:45 COT



# BENEFITS FROM HYBRID ENERGY STORAGE SYSTEM

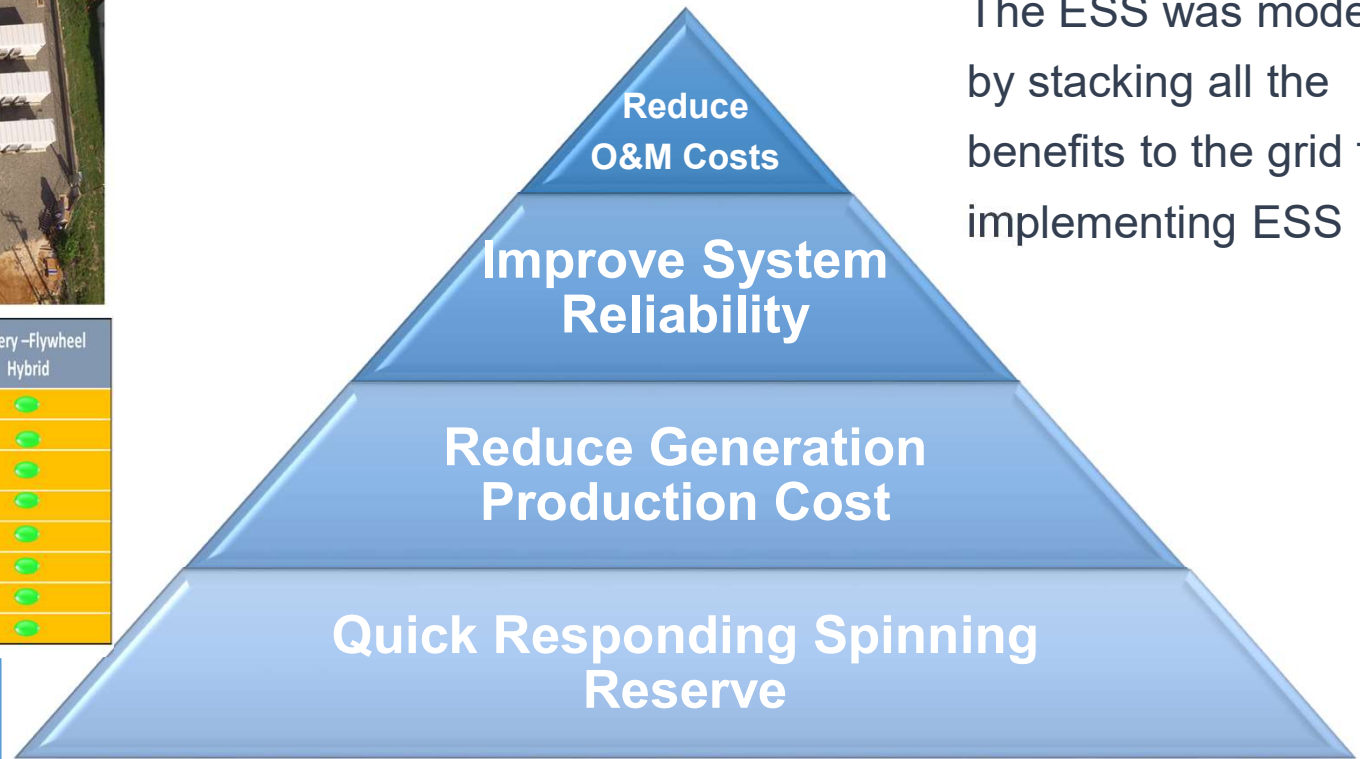


	Li-Ion Battery	Flywheel	Battery-Flywheel Hybrid
	GOOD	MEDIUM	POOR
Power Density	●	●	●
Energy Density	●	●	●
Fast Response	●	●	●
Duty Cycle	●	●	●
DOD W/O Degradation	●	●	●
Efficiency	●	●	●
Maintenance	●	●	●
Years of Service	●	●	●

## Actual Energy Storage Benefits

(Pre Storage 2016-2018 vs Post Storage 2020)

- Outages due to VRE Intermittency
  - 88% Improvement in SAIDI
  - 87% Improvement in SAIFI
- Outages due to Loss of Generation Events (<30MW)
  - 79% Improvement in SAIDI
  - 83% Improvement in SAIFI
- Services during Major Grid Incidents
  - Reduction in restoration time (quick power source)
  - Voltage Support

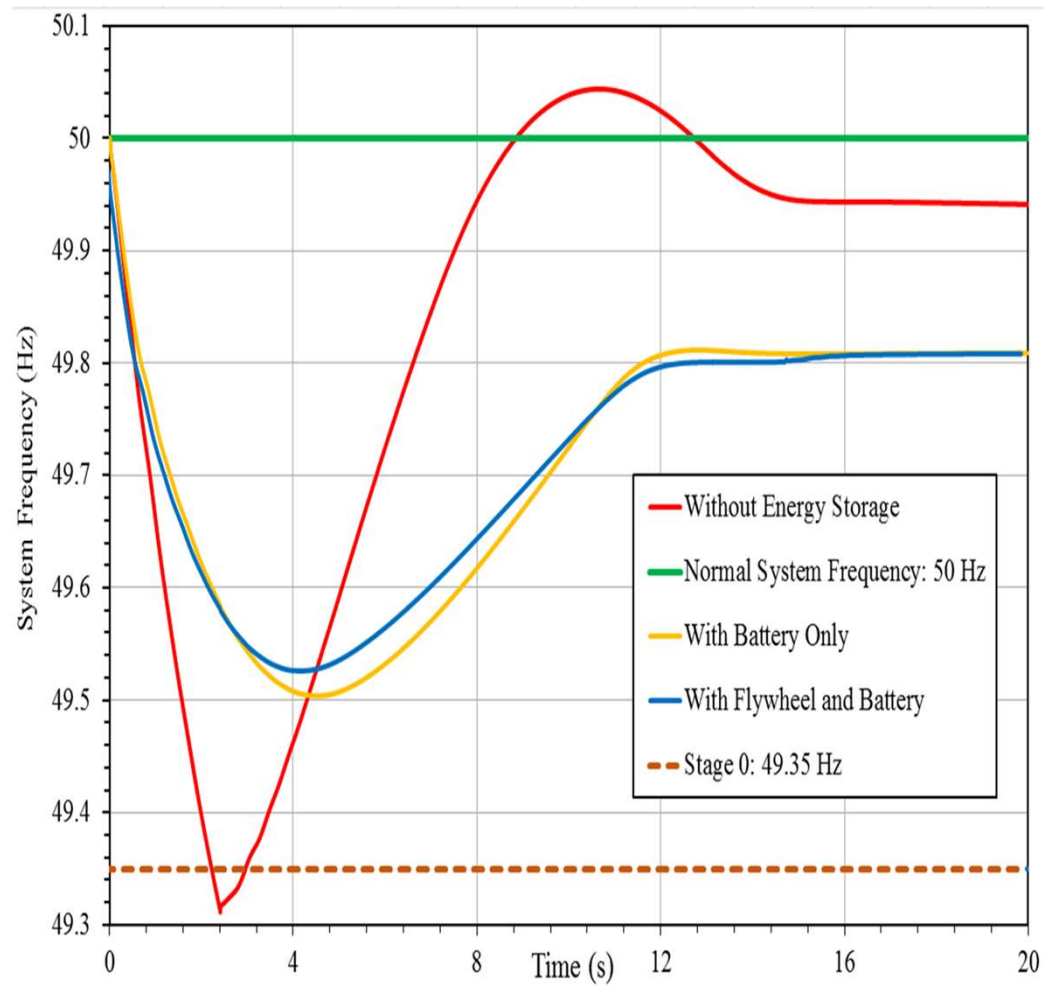
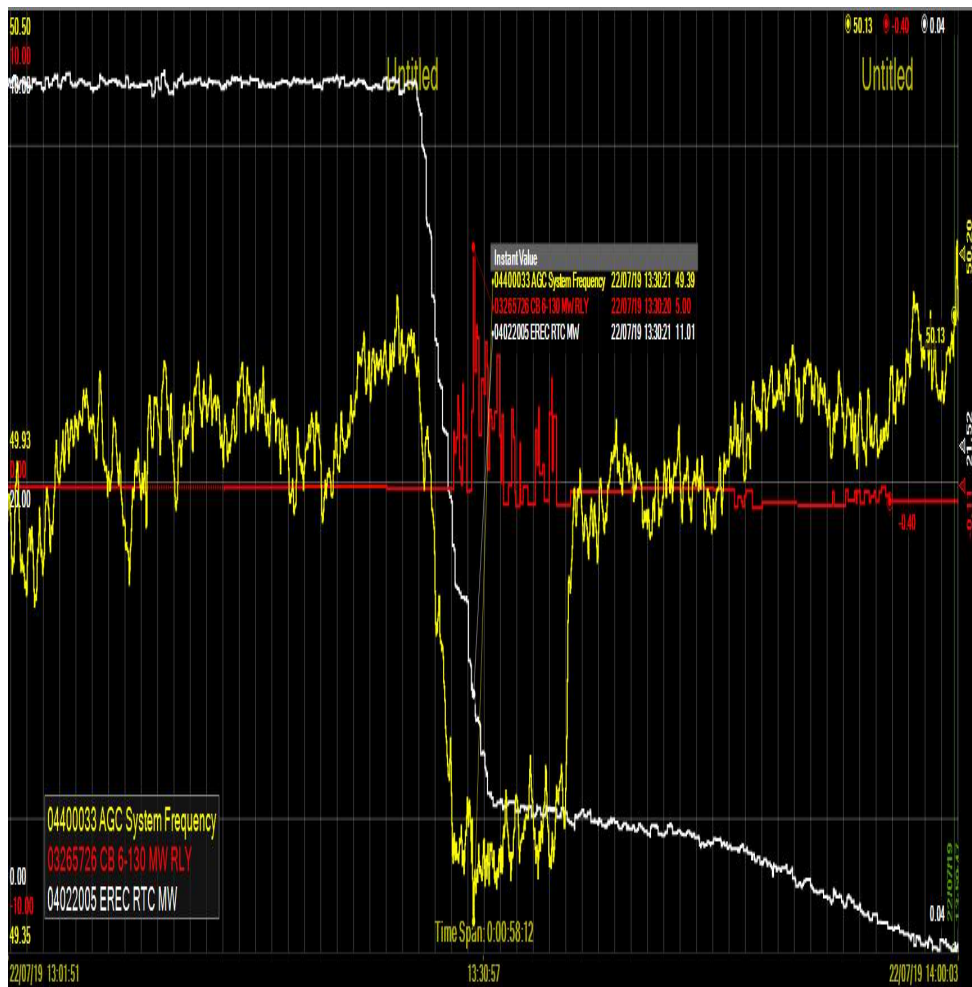


The ESS was modelled by stacking all the benefits to the grid from implementing ESS

## Energy Storage will be implemented to provide:

- Frequency Regulation (RE Intermittency)
- Spinning Reserve Support (Loss of Generation)
- Steady & Transient Voltage response for Generation or T&D contingencies (<100ms)

# ENERGY STORAGE VS SOLAR INTERMITTENCY



***JPS***

System Operations