

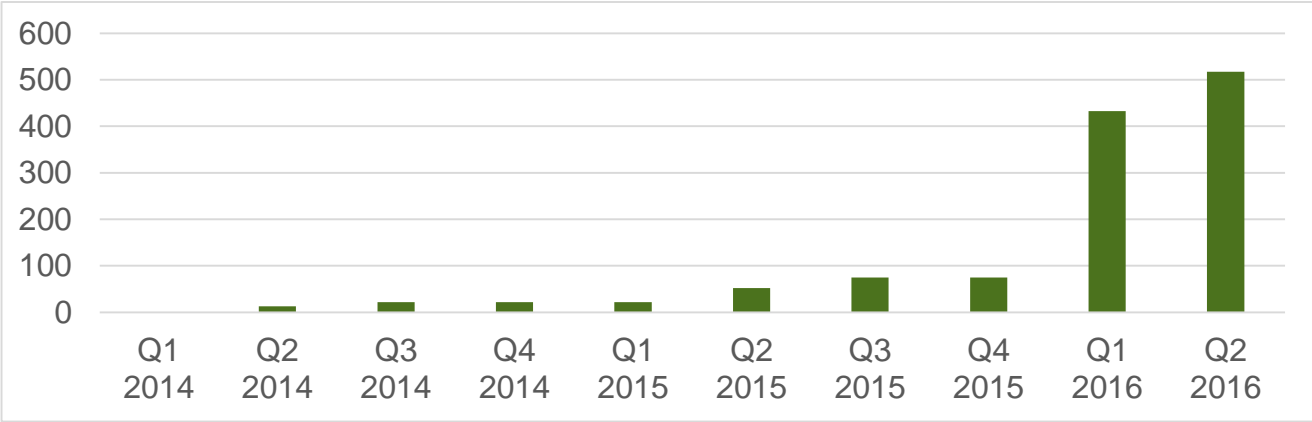


If you love renewables ...

Sir Martin Cortez
Commercial Planning and Regulatory Director

Dramatic growth of Variable Renewable Energy (VRE) in Visayas

SOLAR CAPACITY IN THE VISAYAS (MW)



LOCATION OF VARIABLE RENEWABLE PROJECTS

● SOLAR NEGROS- 350MW

- SOLEQ
- SACASOL IA, IB, II, III and IV
- SACASUN
- CITICORE

● LEYTE- 105MW

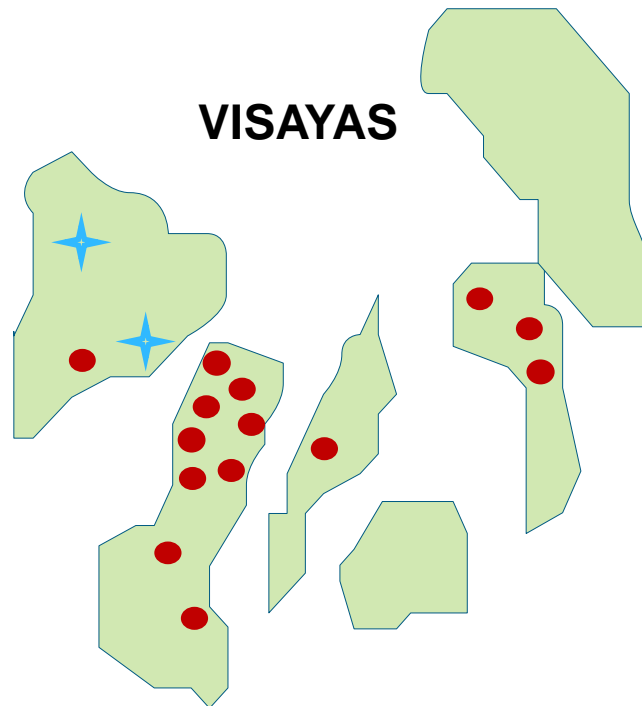
- BILIRAN
- SEPALCO
- SOLEQ

● CEBU- 60MW

- SUNASIA

● PANAY- 5MW

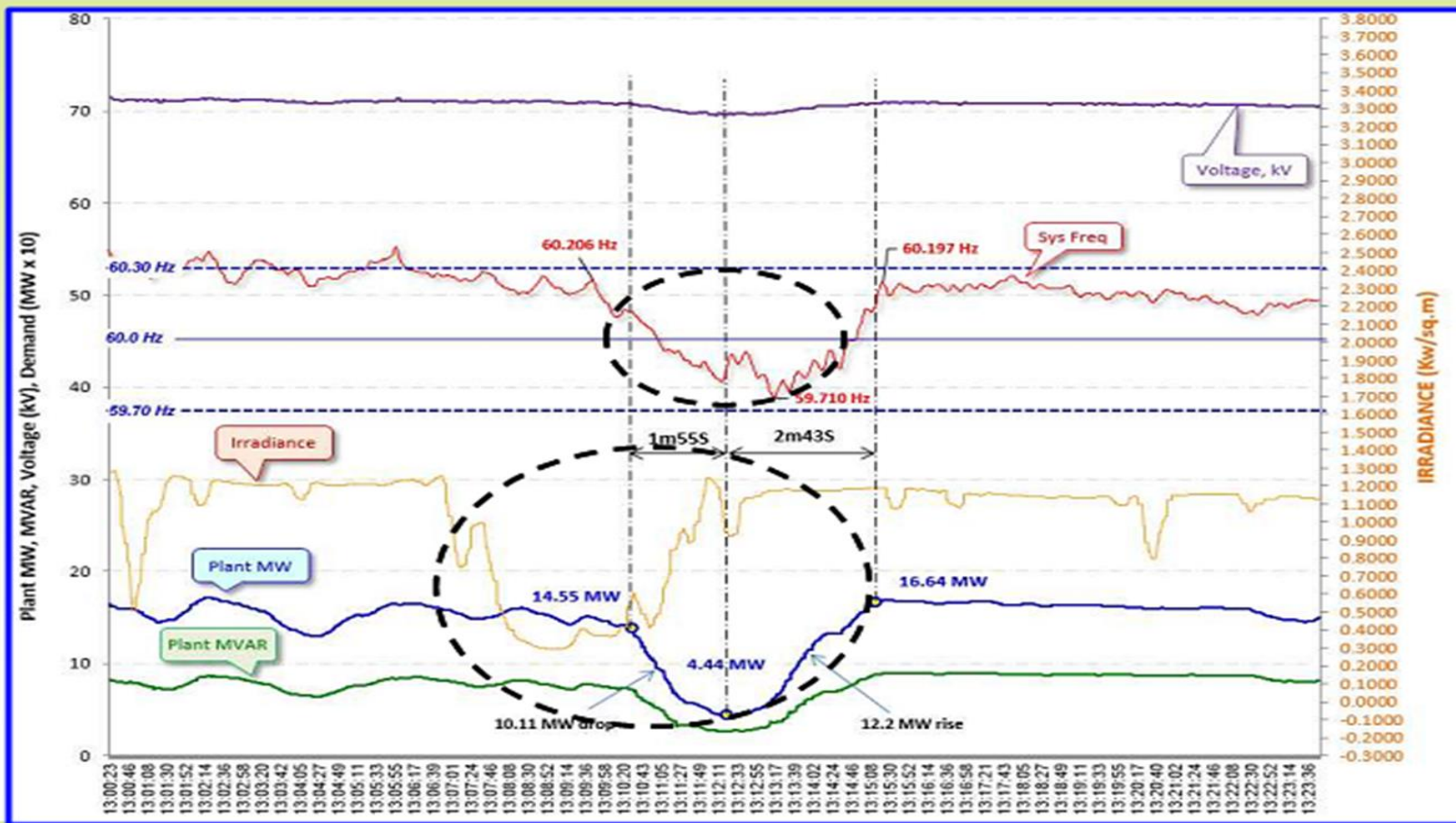
- COSMO



- ### ★ WIND
- AKLAN- 36MW
 - PETROWIND
 - GUIMARAS- 54MW
 - TAREC

But VREs have a profound effect on the system stability

SACASOL Operation - Parameter Response Chart August 23, 2014 (Sat)



Challenges we face in embracing renewables

Maximizing
VRE capacity

Making VRE
“grid-friendly”



Where do we
go from here?

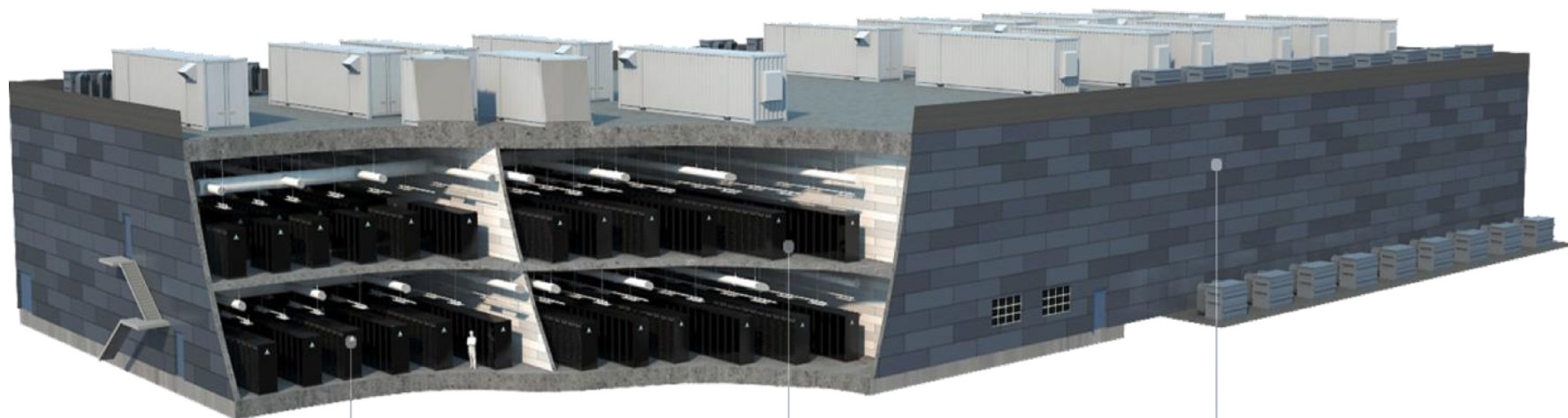
Innovate!

Batteries on the grid? Yes!



Advancion™

Advanced alternative and complement to transmission, generation, and distribution.



DEPENDABLE

COST COMPETITIVE

SMART

Advancion consists of modular arrays of thousands of lithium ion batteries, integrated together and controlled by a proprietary software system.

Battery Energy Storage Will Make Power Grids More Flexible and Resilient

“Energy storage is among the best means to ensure we can reliably integrate renewable energy resources into the grid”
– Jon Wellinghoff, Chairman, U.S. Federal Energy Regulatory Commission

Proven

- ✓ Established technology with proven components and software control system.
- ✓ AES alone operates ~150 MW, with 300 MW more in construction / advanced development

Fast & Precise

- ✓ Instantaneous Response: <1 second to full capacity discharge (or charge)
- ✓ Extremely precise in responding to grid events or requirements.

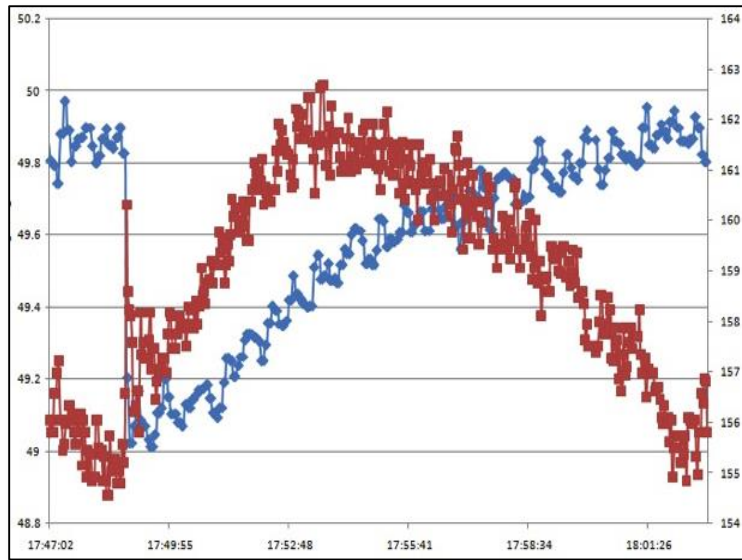
Flexible & Modular

- ✓ Can be a generator and a load, giving it significant flexibility over a conventional power plant
- ✓ Can be sized to fit the exact requirement and augmented as required.

Easily Sited

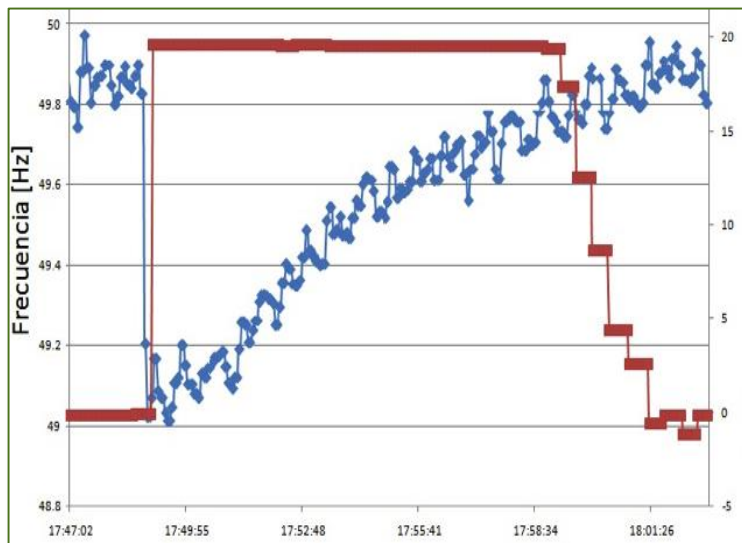
- ✓ Not tied to a fuel source (e.g. hydro), so can be placed anywhere the need is
- ✓ No emissions = no “NIMBY” phenomenon

How fast is fast? BES can respond precisely to grid events in the blink of an eye



THERMAL UNITS' RESPONSE

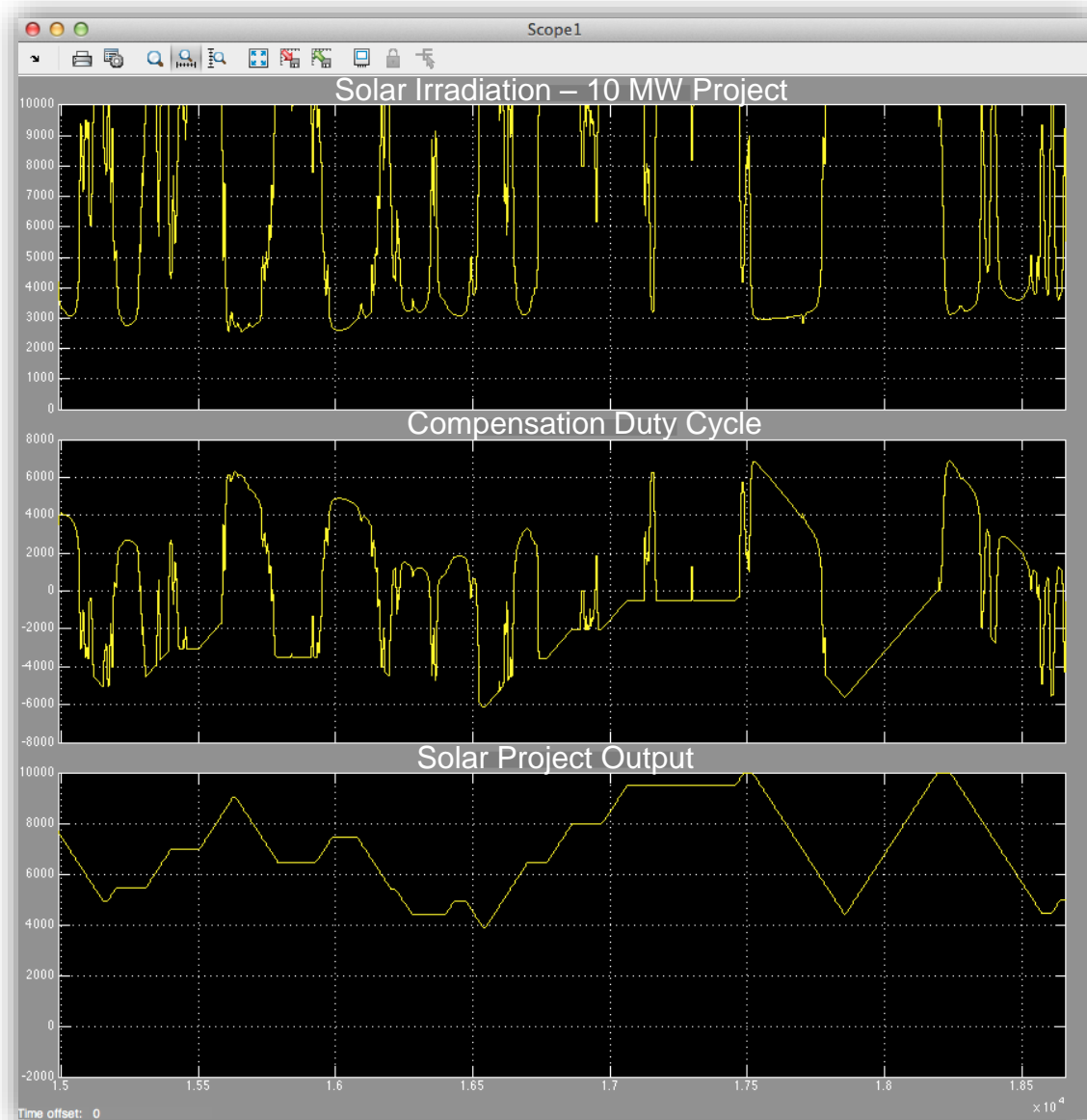
- 4MW burst, then output drops off
- Oscillating, unsteady ramp up
- Takes over 4 minutes to provide 7MW output increase



BES RESPONSE

- Automatic response
- Immediate output increase from 0MW to 20MW
- Output sustained until stability restored

Stabilizing Solar Power Output in Puerto Rico



1 Hour Cross Section - Duty Cycle in PR

SOLAR

- Quick jumps between 30% to 100% of capacity

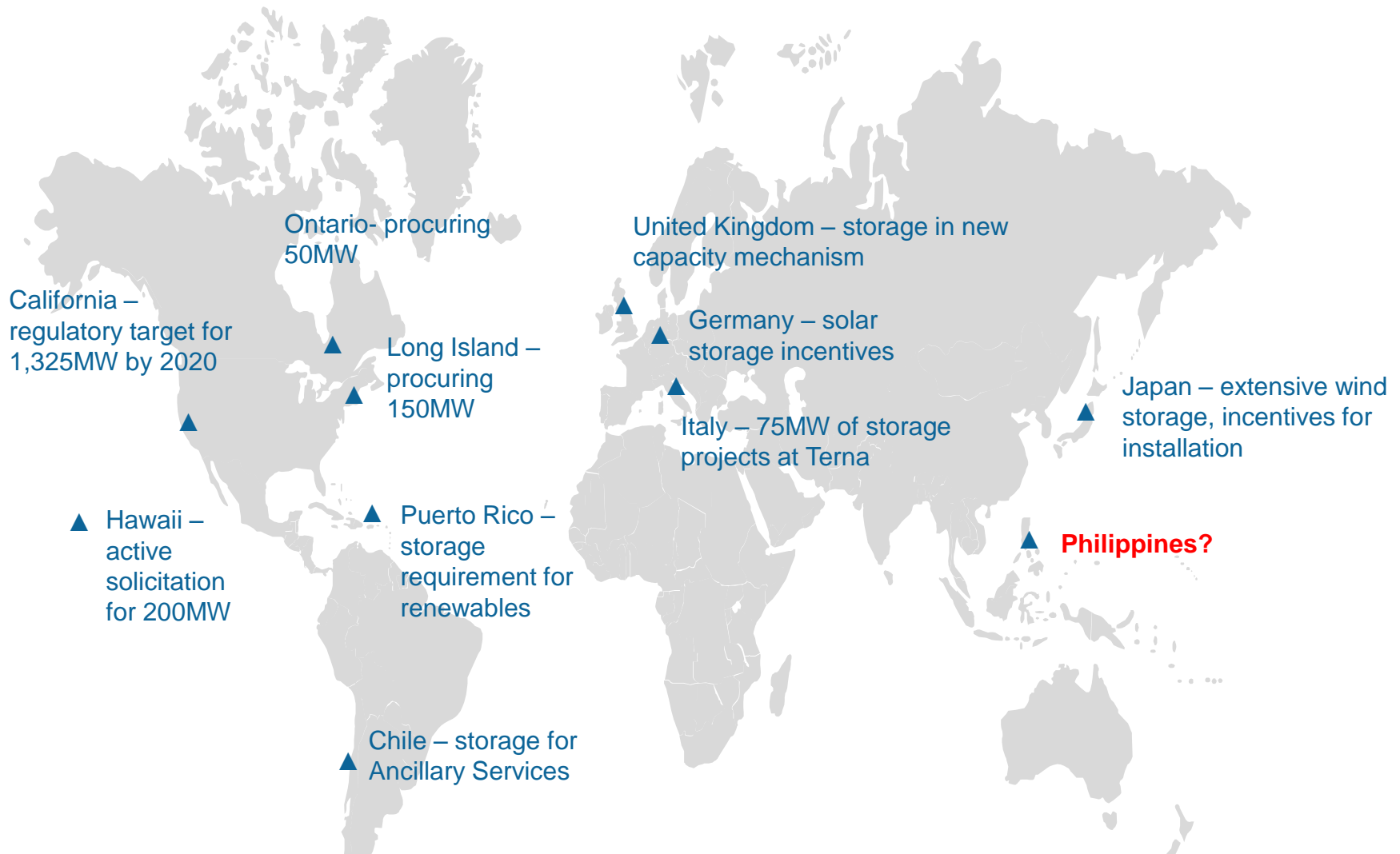
BES

- Mirror image charge and discharge

SOLAR + BES

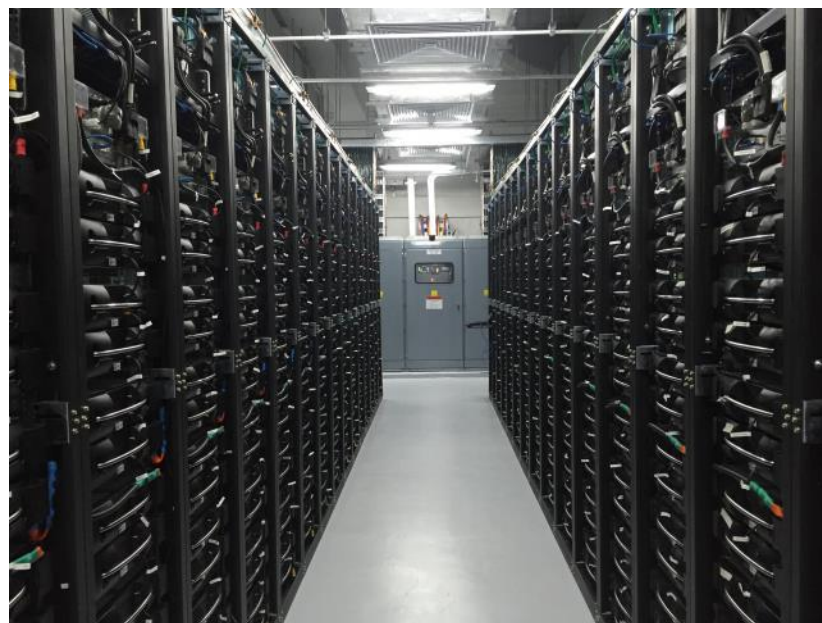
- Slow, modest swings
- Output manageable by grid operator

The world's leading grid operators are procuring BES for system reliability and renewable integration



Strongest initiative from island-based grids and those with high RE penetration targets.

Innovation in Action



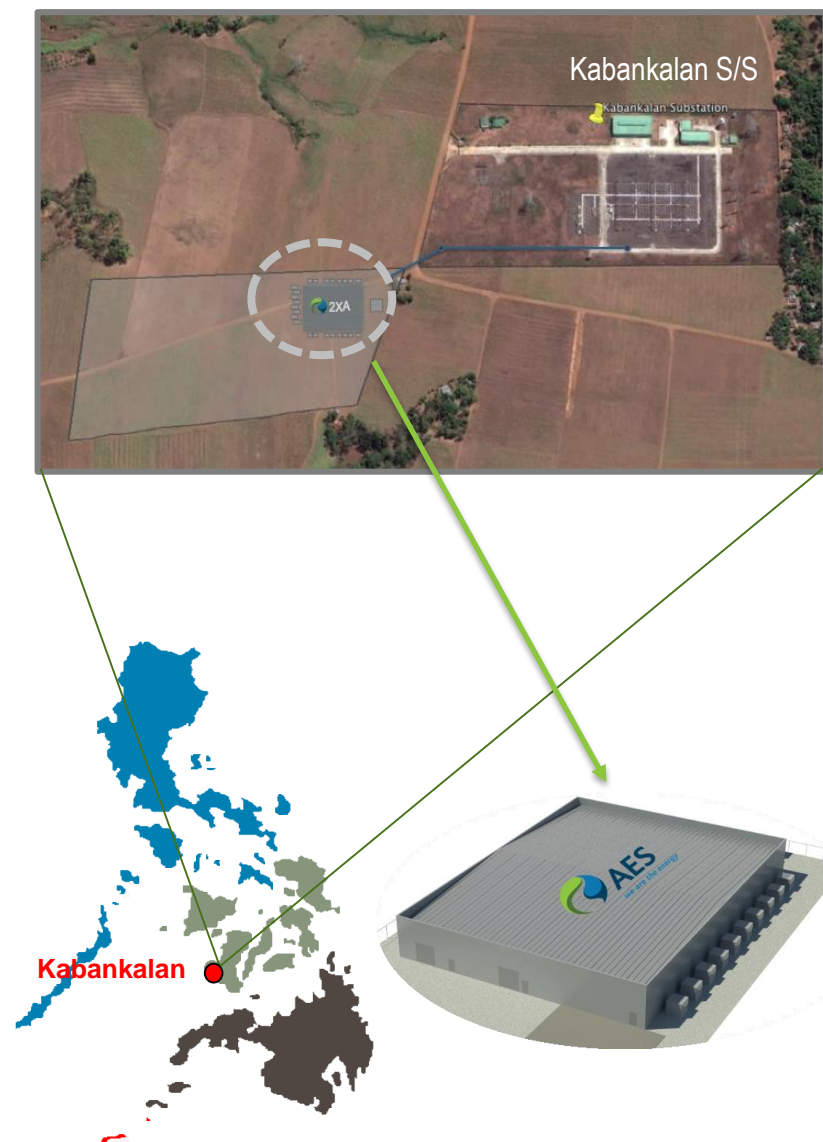
Masinloc Advancion Energy Storage Array

- Fast response frequency regulation for the Luzon grid
- 10 MW interconnected capacity
- Commercial Operations: 2016
- The first grid scale battery energy storage facility in the Philippines – and all of South East Asia

In late stage development

Kabankalan Advancion Energy Storage Array

- 40MW interconnection, 80MW frequency regulation resource
- Tied into Kabankalan substation in Negros Occidental, Visayas
- SIS completed
- All necessary government permits obtained
- COD: 2017





**“If you love renewables...
...you gotta love batteries”**

Thank you

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