Evolving Transmission and Distribution System Operations: A Hawai‘i Snapshot

AGENDA

1. Background/Context
2. DER Philosophy Progression
3. Grid Modernization Strategy
4. How if all fits:
    1. Related Utility Programs
    2. Leveraging Customer-sited Resources
        1. Distributed Energy Resources (DER)
        2. Demand Response Portfolio
    3. Demand Response Management System (DRMS)
5. Lessons learned

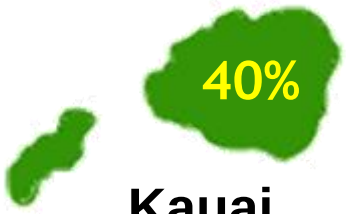
Kauaʻi Island Utility Cooperative

System Peak: 78 MW

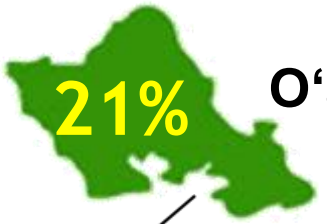
52.6 MW PV / 7 MW Biomass / 9 MW Hydro

(+6.6 MW PV Under Review)

Installed PV: 67% of System Peak



Kauai



Oʻahu

Maui Electric

Maui System Peak: 202 MW

74 MW PV / 72 MW Wind

(+40 MW PV Approved or Under Review)

Installed PV & Wind: 72% of Sys. Peak

Lanaʻi System Peak: 5.1 MW

1.33 MW PV **(27% of Sys. Peak)**

Molokaʻi System Peak: 5.6 MW

2 MW PV **(36% of Sys. Peak)**

Hawaiian Electric

System Peak: 1,206 MW

329 MW PV / 99 MW Wind 69 MW WTE

(+138.5 MW PV & Wind Approved to Install / +88.5 MW PV Under Review)

Installed PV & Wind: 35% of System Peak

Molokaʻi

Lanaʻi

Maui

Hawaiʻi Electric Light

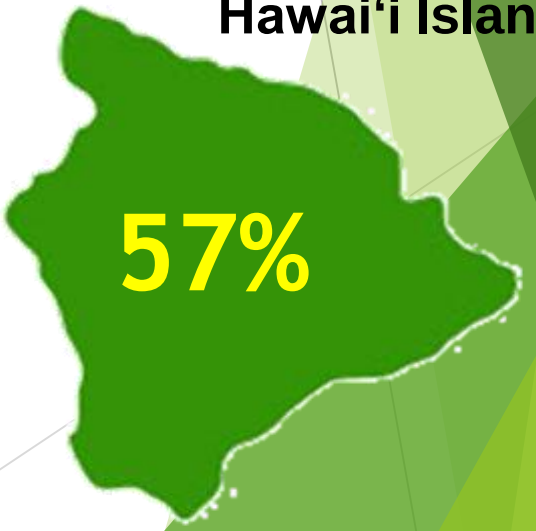
System Peak: 192 MW

75 MW PV / 30 MW Wind /

38 MW Geothermal / 16 MW Hydro

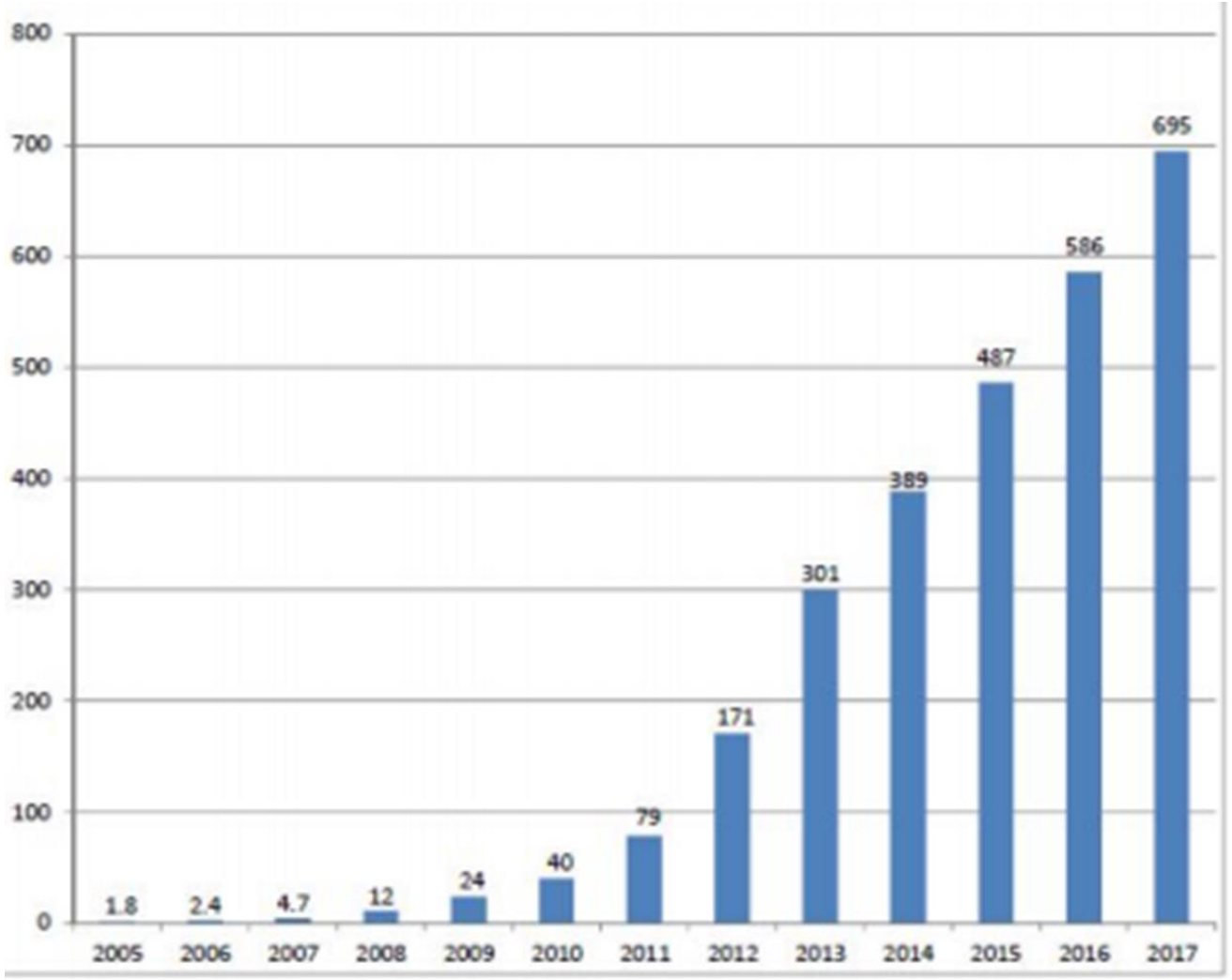
(+31 MW PV Approved or Under Review)

Installed PV & Wind: 55% of System Peak

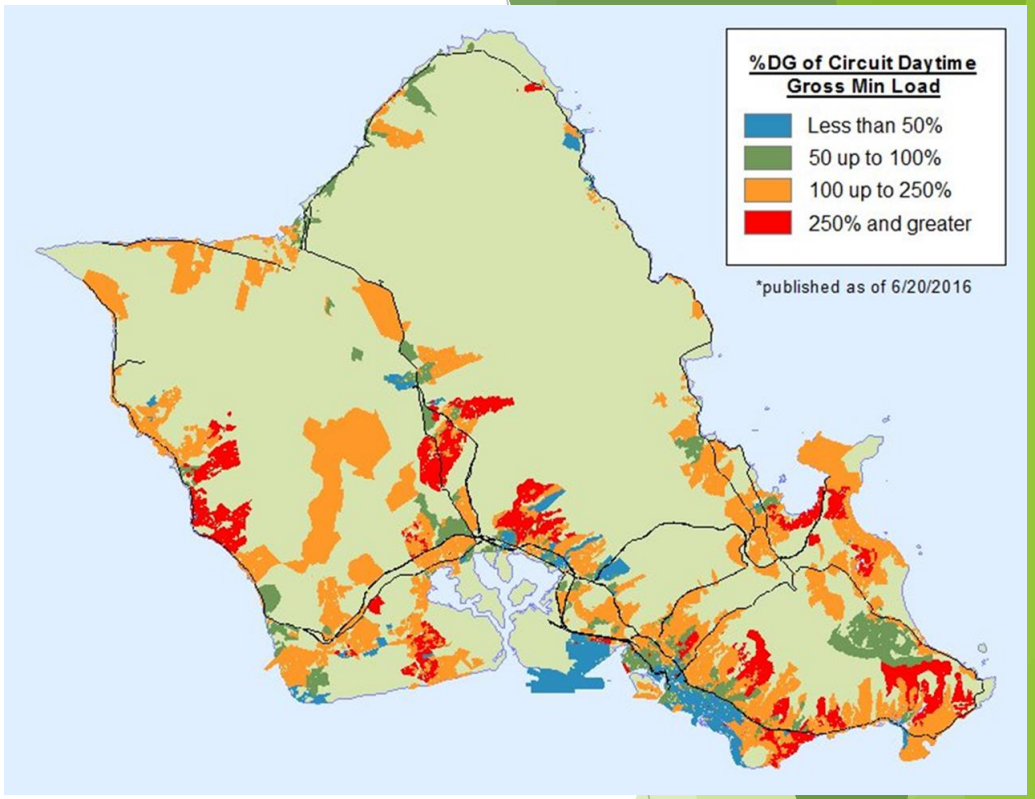


Hawaiʻi Island

EXPONENTIAL DER GROWTH



Cumulative Installed PV in Hawaii, as of Dec. 31, 2017



Over 600 MWs of DG-PV across the Companies' service areas.

DER TECHNICAL CHALLENGES

	STEADY STATE OPERATIONS	CONTINGENCY EVENTS
SYSTEM-LEVEL	Over-generation and increasing variability in generation resulting in: -Curtailment of other renewable generation -Frequency regulation and ramping challenges for central generation	Behavior of aggregate DER fleet may exacerbate grid instability during emergencies: -Need grid-supportive frequency and voltage trip and ride through settings
CIRCUIT-LEVEL	Over-generation resulting in: -Approaching or exceeding distribution system equipment capacity limitations	Behavior of DER systems during circuit-level contingencies may result in: -Unintentional islanding -Temporary load rejection overvoltage

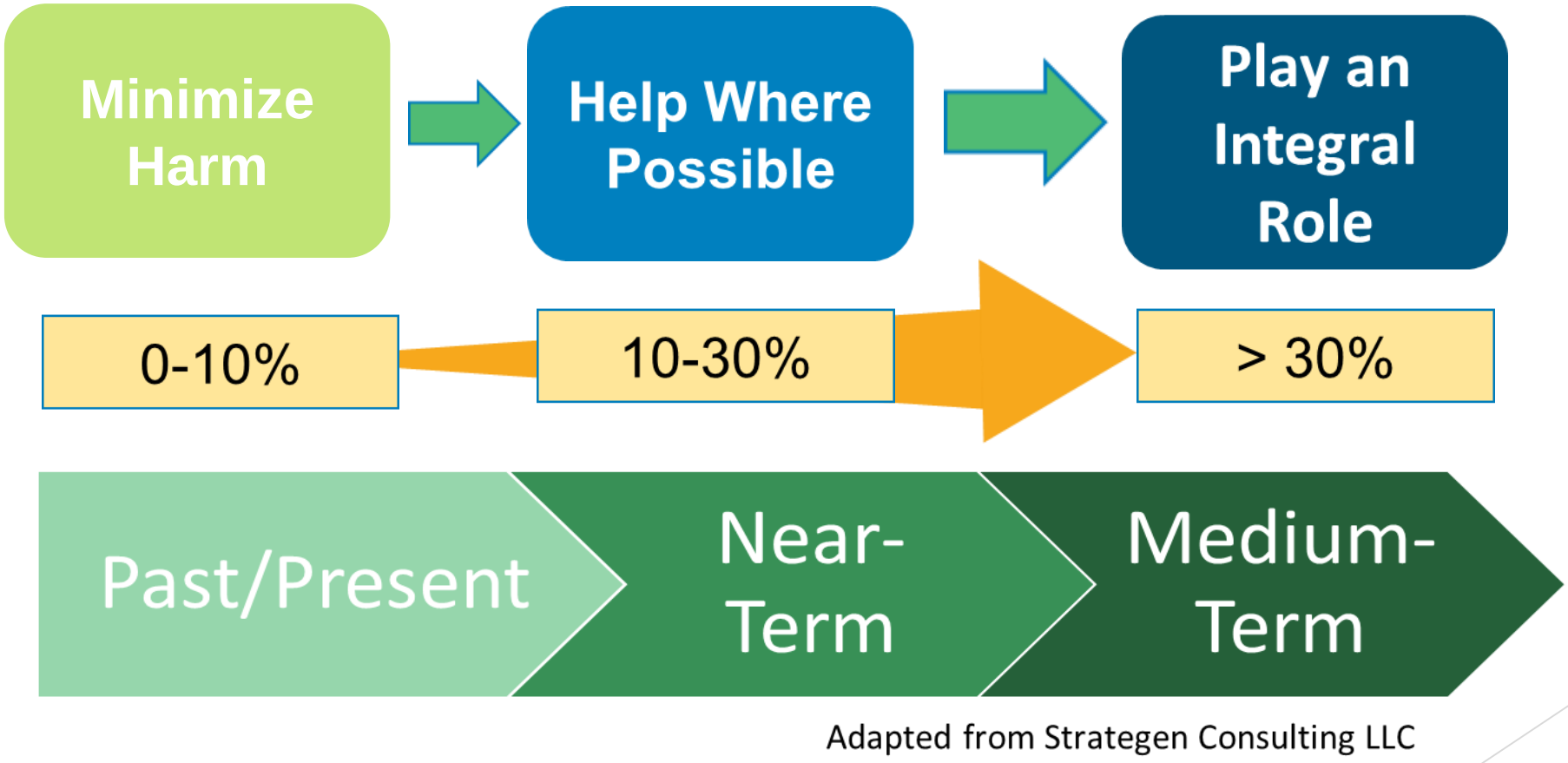
Source: Table 2, page 19, Staff Report and Proposal, Docket No. 2014-0192, March 31, 2015

2014

COMMISSION'S INCLINATIONS ON THE FUTURE OF HAWAII'S ELECTRIC UTILITIES

Creating Modern Transmission and Distribution Grids – *"[The Inclinations] outlines priorities in order to transform each island's transmission and distribution grids into modern, advanced electrical networks that are capable of integrating greater quantities of customer-sited distributed energy resources and expand the array of energy options for customers to manage their energy use."*

DER PHILOSOPHY PROGRESSION



Adapted from Strategen Consulting LLC

Figure 7 "Run" – Illustrating an Envisioned Future State for Technology Supporting the Grid

Hawaiian Electric
Maui Electric
Hawai'i Electric Light

Grid Related Investments

- Varentec: ENGO Devices
- Grid 20/20: OptaNode

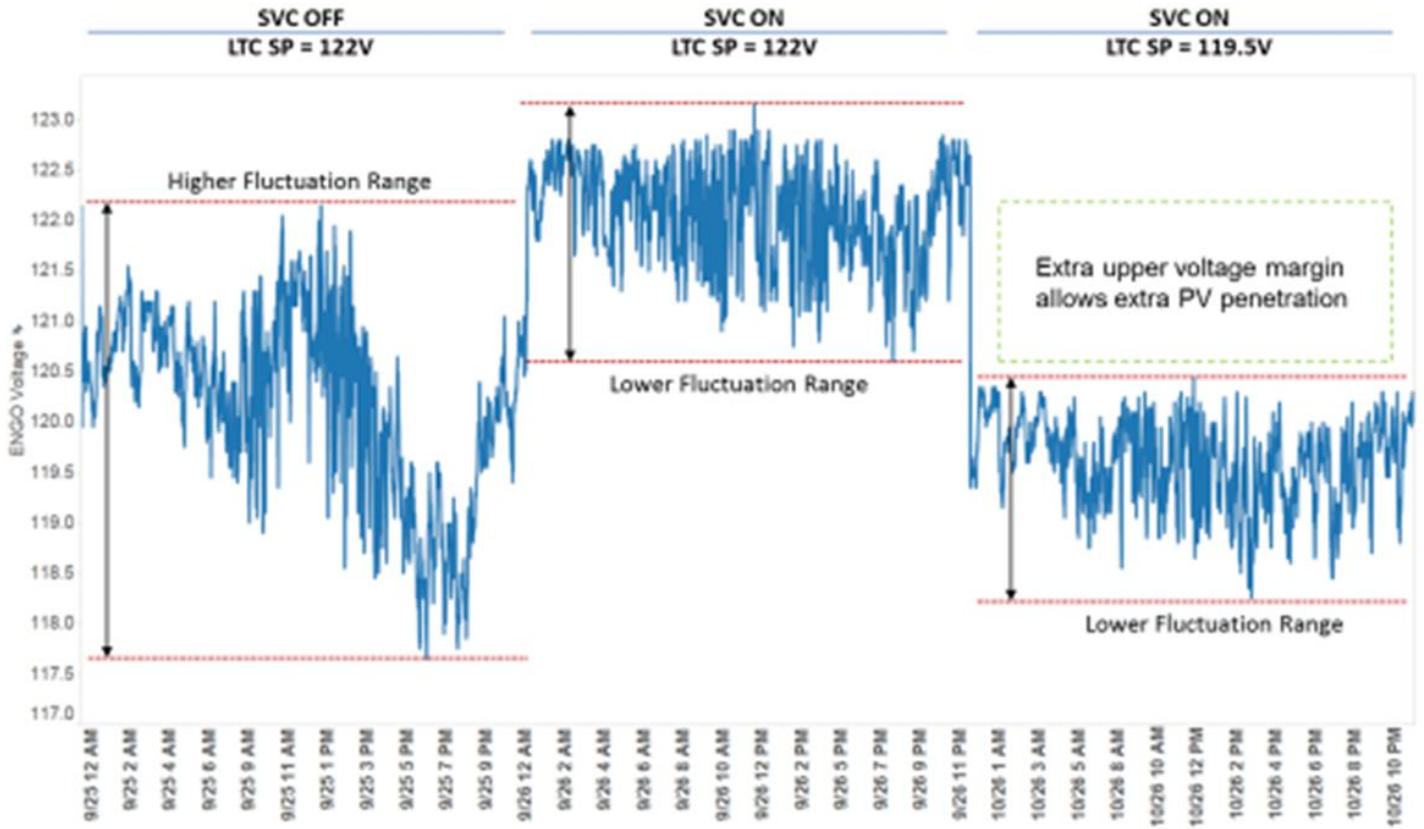
Programs and Tariffs

- CSS
- CGS+
- Smart Export
- Demand Response Portfolio
- Demand Response Management System (DRMS)

GRID RELATED INVESTMENTS

- **Varentec – Grid Optimization Project;**
  - Edge of Network Grid Optimizers (ENGO) Devices to minimize voltage fluctuation and allow for additional rooftop solar capacity. Grid Energy Management System (GEMS) Platform for data analytics.
- **GRID 20/20 – OptaNODE Distribution Transformer Monitor**
  - Provide Planning Engineers with more insight on how much PV circuits can handle before suffering overvoltage and reliability issues (i.e. safety concerns and additional costs for the utility)

Can circuit hosting capacity be improved upon through active voltage regulation?



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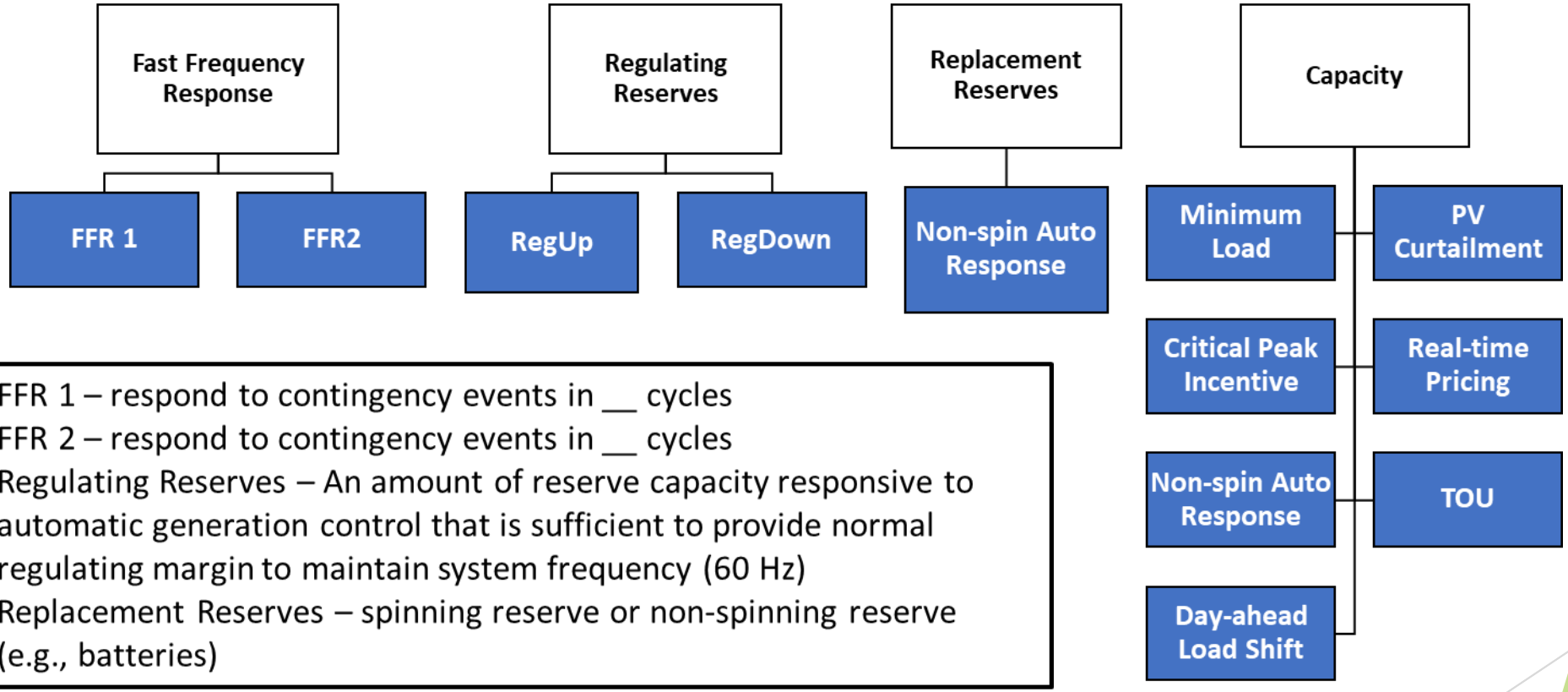
Leveraging and Integrating Customer Sited Resources

- Distributed Energy Resources Programs
  - Customer Self Supply (CSS)
  - Customer Grid Supply + (CGS+)
  - Smart Export
- Demand Response Portfolio
  - Providing other services beyond energy; voltage, capacity, frequency reserve, etc.
- Demand Response Management System
  - “The Brain”

DEMAND RESPONSE PORTFOLIO



FFR 1 – respond to contingency events in __ cycles
FFR 2 – respond to contingency events in __ cycles
Regulating Reserves – An amount of reserve capacity responsive to automatic generation control that is sufficient to provide normal regulating margin to maintain system frequency (60 Hz)
Replacement Reserves – spinning reserve or non-spinning reserve (e.g., batteries)

Demand Response Management System

Within Decision and Order 34884, the Commission noted that the DRMS proposed by the Companies was a ***"critical tool for leveraging customer-sited resources to assist in grid operations and constitutes a key component of a modern electric grid."***

Figure 7 "Run" – Illustrating an Envisioned Future State for Technology Supporting the Grid

Hawaiian Electric
Maui Electric
Hawai'i Electric Light

LESSONS LEARNED

- Coordination
- Risks associated with new technologies
- Strategic Plan

Thank you!

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