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New York ITWG: Hawaii's Pathway to Leveraging Smart Inverters

September 15, 2022 | STEVEN RYMSHA

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Creating a planet
run by the sun.

Today's Agenda

01 | Hosting Capacity & Benchmarking

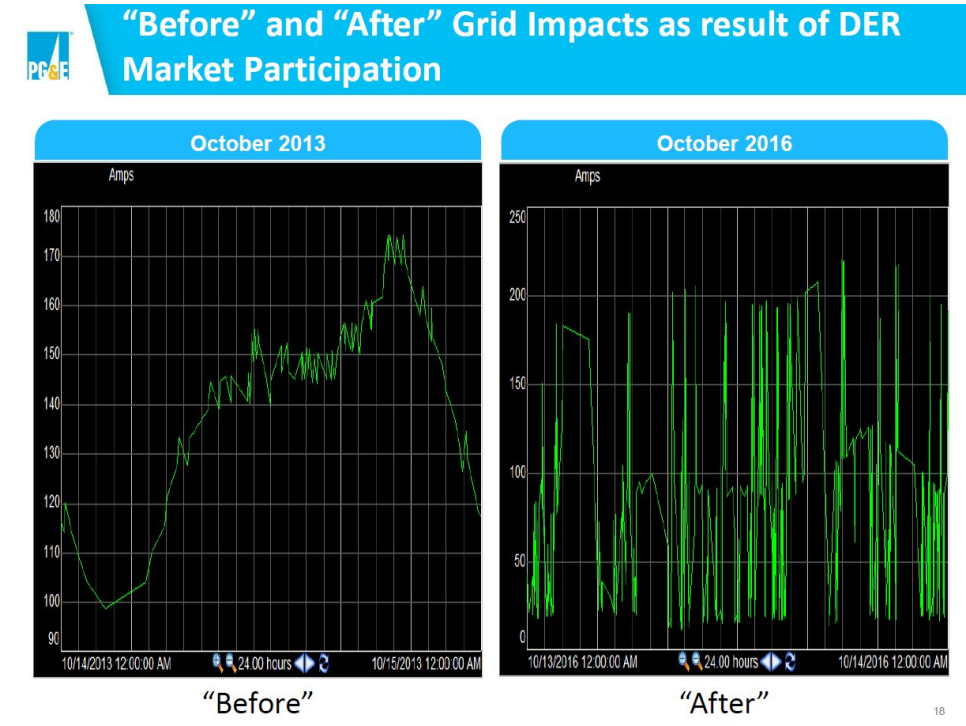
02 | Hawaii's Smart Inverter Learnings

03 | Consumer Pathway for Instant Interconnection

Hosting Capacity Benchmark Calculations

Distribution feeders have sufficient capacity to accommodate dramatic changes in load and generation

Distributed solar is far less impactful compared to a single market participants taking over the distribution feeder, although utility modeling practices likely assume similar extreme variations of aggregate solar resources when modeling the impacts during daylight hours.



Significant variation in load on a distribution feeder from a single large battery facility participating in CAISO.

Hawaiian Electric Policies

Managing Distributed Solar Adoption

- Utility policies evolved ahead of formal interconnection proceedings at the PUC in order to keep up with customer demand, regulatory and political pressure.
- Hosting capacity screens and policies evolved from 10% of peak load to 250% of estimated gross daytime minimum load over a five year period.

2015 — April

Limit increased to **250% estimated gross daytime minimum load.**

2014 — March

Limit increased to **120%; circuit studies completed**.

2013 — September

Limit increased to **100%; De facto moratorium on O'ahu pending circuit studies.**

2012 — October

Limit increased to **75%** for small systems <10kw.

2011 — October

Limit increased to **50% of circuit daytime minimum load .**

2010 — February-April

HECO proposes DG moratorium on neighbor islands, quickly retracts. Circuit penetration limit increased from **10% to 15% of system peak load.**

Hosting Capacity Benchmark Calculations

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- **Estimated/Calculated Gross Daytime Minimum Load**
  - To provide greater clarity on that current state of hosting capacity processes, recommend standardize utility data collection and load allocation based on best practices.
  - National Rural Electric Cooperative Association Photovoltaic System Impact Guide correctly described how proper load allocation and assessment *must correctly allocate calculated gross feeder load for proper assessment.*
- ***"Calculate peak and minimum gross load by adding the existing DER output to the recorded SCADA data. This calculation negates the impact of the existing DER on the load measured at the feeder and substation level so that total, raw load can be properly allocated"***

Hawaii's Smart Inverter Learnings

Early Smart Inverter Certification Challenges

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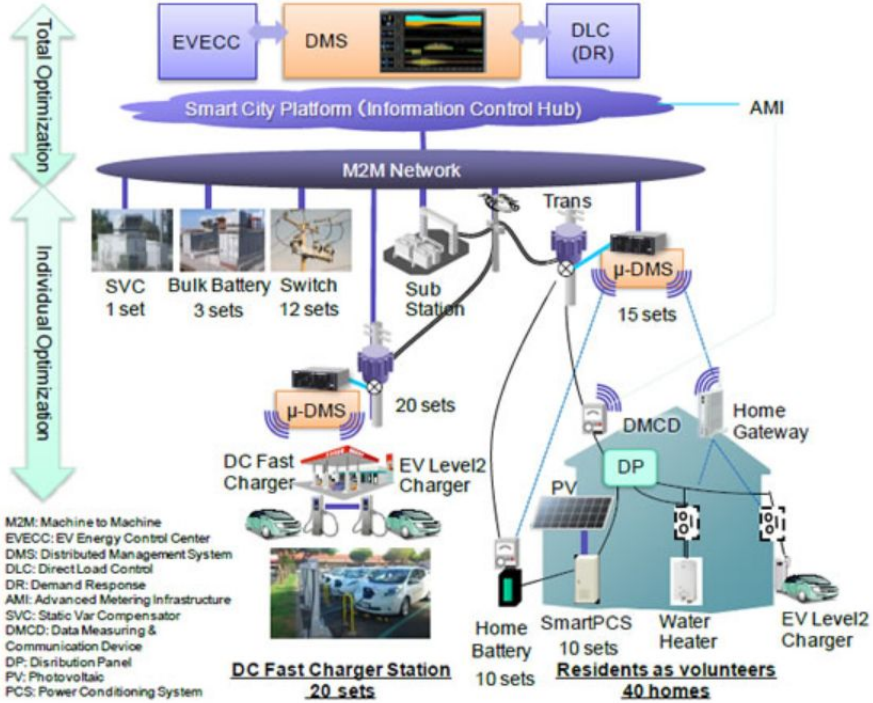
- 2011 and 2016: Smart Community Project called JUMPSmartMaui. Maui, Hawaii, U.S.
- A smart community constructed by Hawaiian and Japanese stakeholders.
- **Objective**: effective utilization of renewable energy that had been penetrating on a larger scale and grid edge management.

Image of Demonstration Site



Customer Service Hosting capacity:

Avoiding Service Upgrades with Smart Inverters: Hawaiian Electric Collaboration with NREL

- Hawaiian Electric has historically used a technical subscreen of **166% of the service transformer rating** in relation to aggregate export capacity.
- Today, based on learnings from NREL's VROS study, **customers on "saturated" service connections can elect to activate volt/watt within the inverter to avoid paying for utility service upgrade as long as the service transformer is not overloaded.**
- In the event of excessive curtailment, the utility is required to resolve.

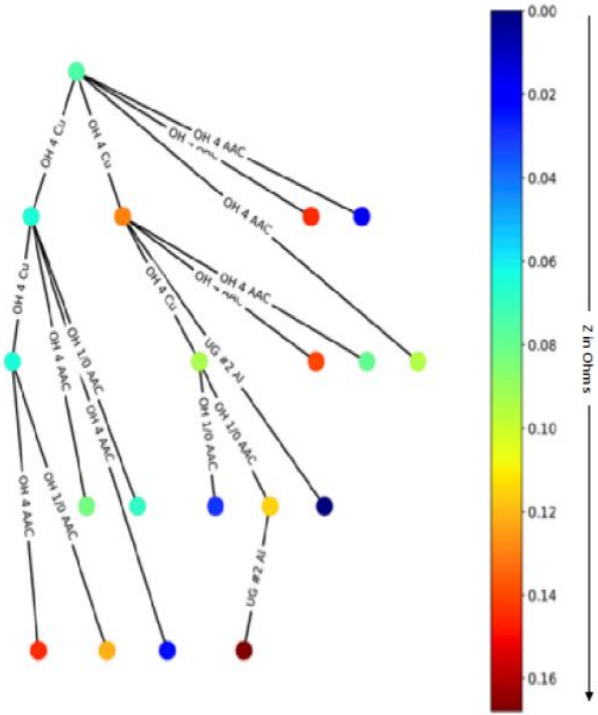


Figure 12. Secondary design for highest curtailed customer (dark red dot) in the M34 feeder

Estimating Curtailment / NWA Impact Volt-Watt

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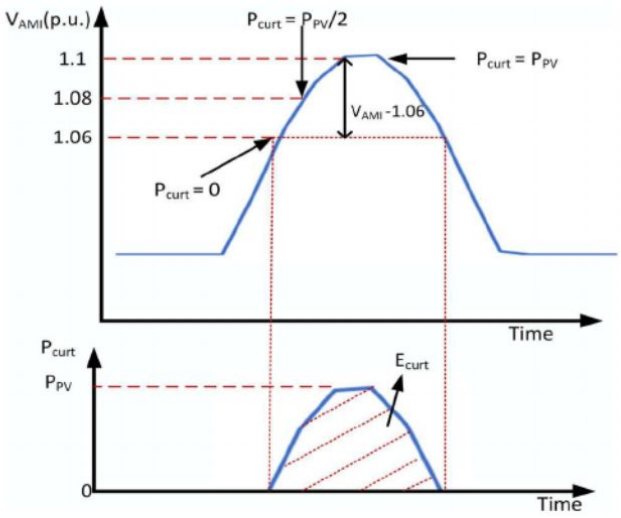
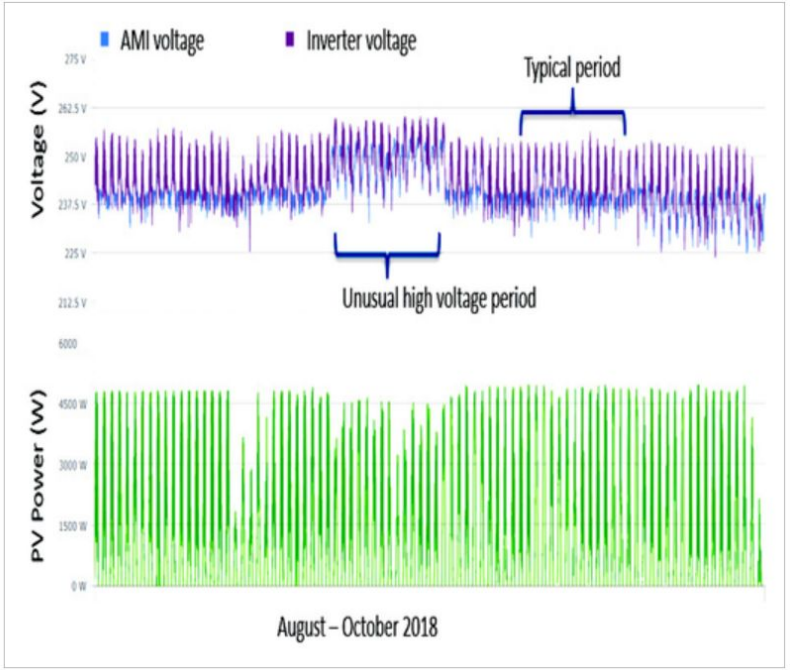


Fig. 3 *Conceptual illustration of estimated curtailment as a function of AMI voltage for a hypothetical day in which the voltage peaks at 1.1 p.u. (which is much higher than seen in field data and outside of tariff rules, but useful for illustrative purposes)*



Hawaii's Consumer Pathway for Instant Interconnection

Prior Example of Hawaii Customer Options Notice

We understand this is disappointing to you, but incorrectly installed systems can result in unacceptable voltage fluctuations that can damage appliances and electronics in your home as well as that of your neighbors'. Without adequate protective measures in place, stray voltage from unsafe installations present a significant risk to the safety of our line workers and to the public in general.

As a result, you now have the following options to carefully consider:

1. **Proceed with an Interconnection Requirements Study (IRS) for your ISE application.**
2. **Proceed with activating Advanced Inverter Grid Support Functions.**
3. **Proceed with ISE Application without daytime export.**
4. **Apply for and install a Customer Self-Supply system.**
5. **Withdraw your ISE interconnection application.**

Each option is described in detail below. You have **90 days** from the date shown on the letter to inform us of your decision and to provide the corresponding requirements related to your choice.

Hawaiian Electric Quick Connect Program

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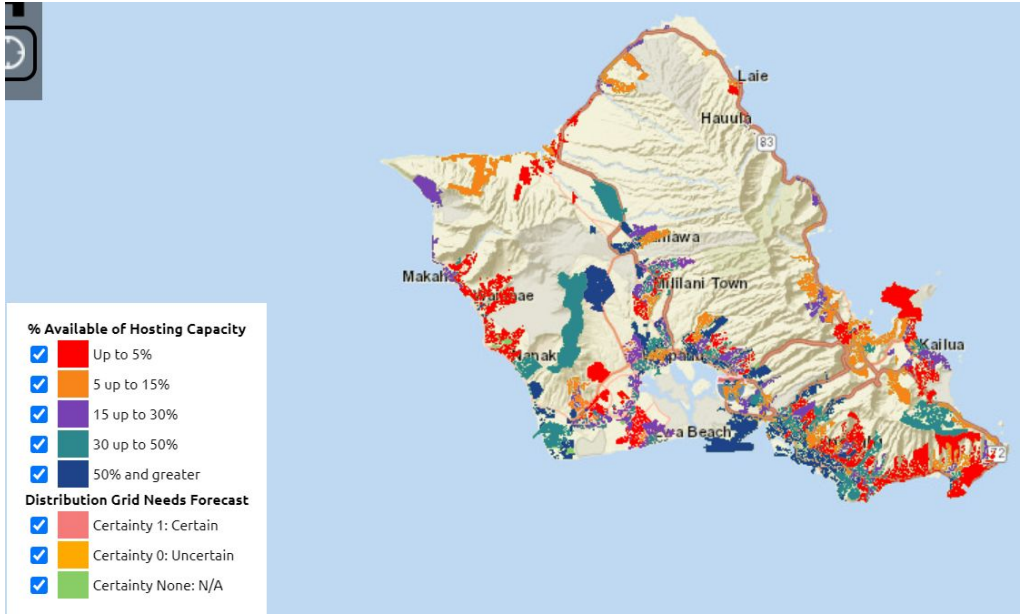

Quick Connect: Systems 100 kW or less, may energize once a meter is installed, electrical inspection is closed, and Volt-Watt is activated.

- In **March 2021**, the **Quick Connect** program was expanded to **all** circuits, including those with 30% or less circuit hosting capacity.
- Where there is **greater than or equal to 30% circuit hosting capacity** and the circuit is not 2.4 kV or 4 kV, **projects 25 kW or less can be installed, energized, and export** prior to receiving conditional approval from the utility.
- Where **less than 30% circuit hosting capacity** remains, customers can install and energize their systems prior to application submittal as long as the **systems operate in a non-export mode** until conditional approval is granted by the utility.
- One of the conditions to utilize the Quick Connect process is for the customer to **activate Volt-Watt so that the Companies can mitigate high-voltage risk** in allowing customers to “install first, get approval later.”

Smart Inverter Instant Interconnection Framework

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- Create a great customer experience through instant Interconnection processes and alternative Interconnection upgrade solution framework designed to address customer device operational response ensuring distribution primary and secondary conductors are not overloaded and voltage remains within compliance.
- Smart inverter settings provide functional grid response as an Interconnection infrastructure deferral safety function.
- In very rare cases initiate DSO infrastructure upgrades when customer interconnected device operation are unreasonably curtailed. This may require an investigation of alternative NWA or a traditional distribution solution. New functional DSO Interconnection role to determine best solution to address existing distribution system infrastructure limitation based on smart inverter voltage response of customers grid edge devices.

Volt-Watt Stipulation (August 19, 2021) & Order

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BEFORE THE PUBLIC UTILITIES COMMISSION

OF THE STATE OF HAWAI'I

In the Matter of	)	
	)	
PUBLIC UTILITIES COMMISSION	)	DOCKET NO. 2019-0323
	)	
Instituting a Proceeding to Investigate Distributed Energy Resource Policies Pertaining to the Hawaiian Electric Companies.	)	

STIPULATION FOR PROPOSED REVISIONS TO TARIFF RULE 14H VOLT-WATT FUNCTION

Volt-Watt Stipulation: Excerpts

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- Because Volt-Watt control, in combination with Volt-VAR, "autonomously adjust inverter output based on local conditions without requiring communication with any other devices, **they are good candidates for non-wire alternatives to increase PV hosting capacity when the limiting factor is voltage constraints in a transformer secondary service with very large numbers of PV systems."**

- Moreover, one would expect the economics to support the non-wires alternative of such system-wide activation of Volt-Watt in combination with Volt-VAR, **rather than funding the costs for additional voltage studies and traditional upgrades, which ultimately result in increased costs to customers**.

- **Through the analysis of AMI voltage data**, if a voltage issue is identified as described in subpart (a) below, then the **Companies will evaluate and implement solutions as needed to mitigate the voltage issue to protect the customer from excessive volt-watt curtailment.**

- **Once the need to investigate is triggered, the Hawaiian Electric Companies will investigate** the voltage issue and also utilize the Proposed Method to estimate the amount of curtailment occurring at the system to supplement the voltage data and facilitate transparency for the customer. **Based on the investigation, the Hawaiian Electric Companies will proceed with solutions, including upgrades as needed, to address the high-voltage risk.**

- The **Hawaiian Electric Companies commit to fixing the voltage issue causing the curtailment, including completing any necessary upgrades**, as follows: (1) for an **overhead secondary mitigation, within six (6) months of identifying the voltage issue and triggering the need to investigate;** and (2) for an **underground secondary mitigation, within nine (9) months** of identifying the voltage issue and triggering the need to investigate.

3rd Smart Inverter Function Revision - Approved by Hawaii Commission

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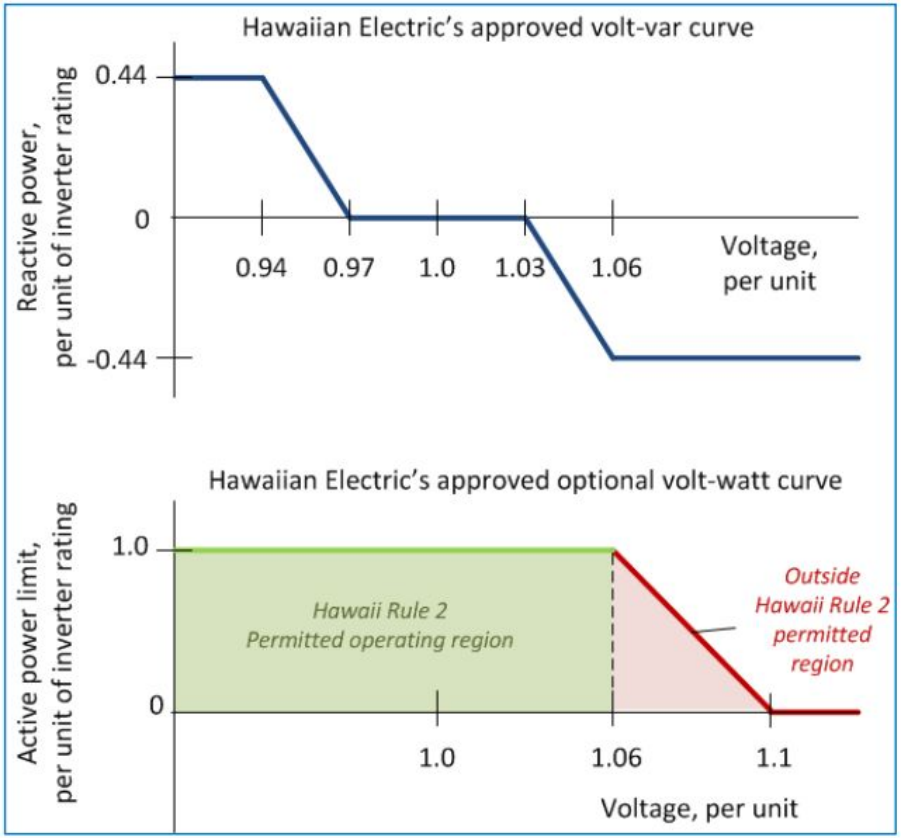
w. Default Activation States for Functions: Unless otherwise provided by the utility, the default activation status for an Advanced Inverter shall be as follows:

- Anti-islanding – Mandatory Activation
- Transient Overvoltage – Mandatory Activation
- Low/High Voltage Ride-Through – Mandatory Activation
- Low/High Frequency Ride-Through – Mandatory Activation
- Frequency-Watt P_{pre} - Mandatory Activation
- Volt-Watt P_{rated} – Mandatory Activation
- Volt-var – Mandatory Activation
- Normal and Soft-Start Ramp Rate – Mandatory Activation
- Fixed power factor – Mandatory Deactivation

These default activation states may be modified by mutual agreement between the utility and Customer-Generator.

Smart Inverter Voltage Support Settings



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