SEAMS for SHINES

The Right Combination: Solar, Storage, and Demand Response Webinar Series

February 26, 2021

Hawaiian Electric
Maui Electric
Hawai'i Electric Light

SunShot
U.S. Department of Energy

Agenda

- SEAMS for SHINES Background
- SEAMS for SHINES project update
  - Phase 1 – OpenADR Integration
    - Background and Architecture of Phase 1
    - Screenshot of results
    - ConnectDER and UL Forecasting – Mikel Shakarjian
    - Lessons Learned from Phase 1
  - Phase 2 – IEEE 2030.5 Integration
    - IEEE 2030.5 Background/California Rule 21/KITU Systems – Gordon Lum
    - Architecture of Phase 2
    - Demonstration
    - Lessons Learned from Phase 2

SEAMS for SHINES Background

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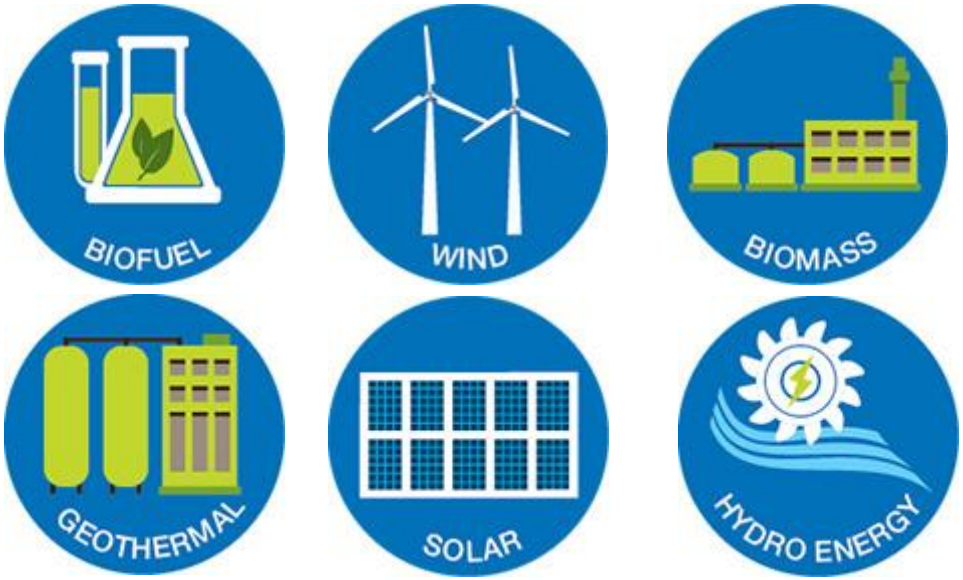
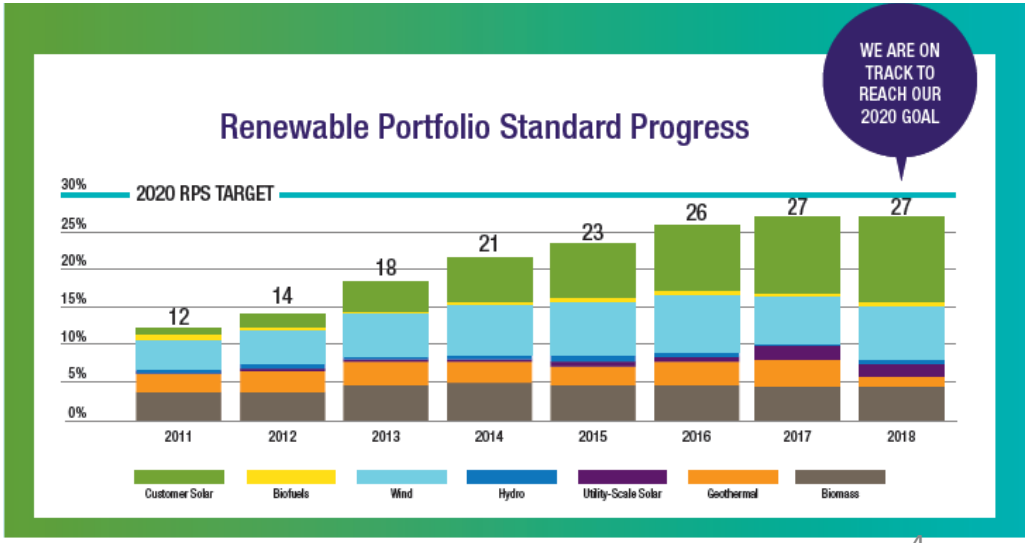
Why? – Changing Utility Landscape

- Declining Load
- Uncertain Costs
- More Customer Options
- Aggressive Policies & Regulations

Hawaii was the first state in the US to go 100% RPS





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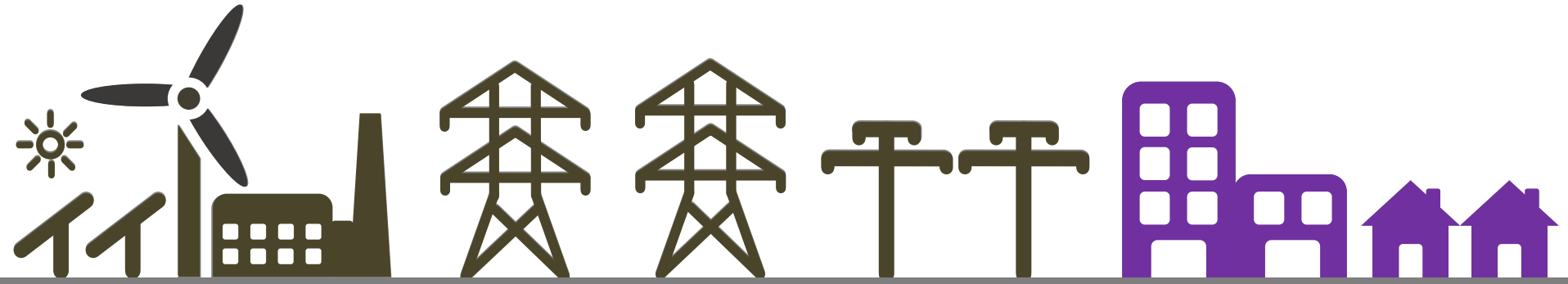
CLOSING THE GAP WITH SEAMS



Distributed & Customer Options

Conventional Power Flow Direction

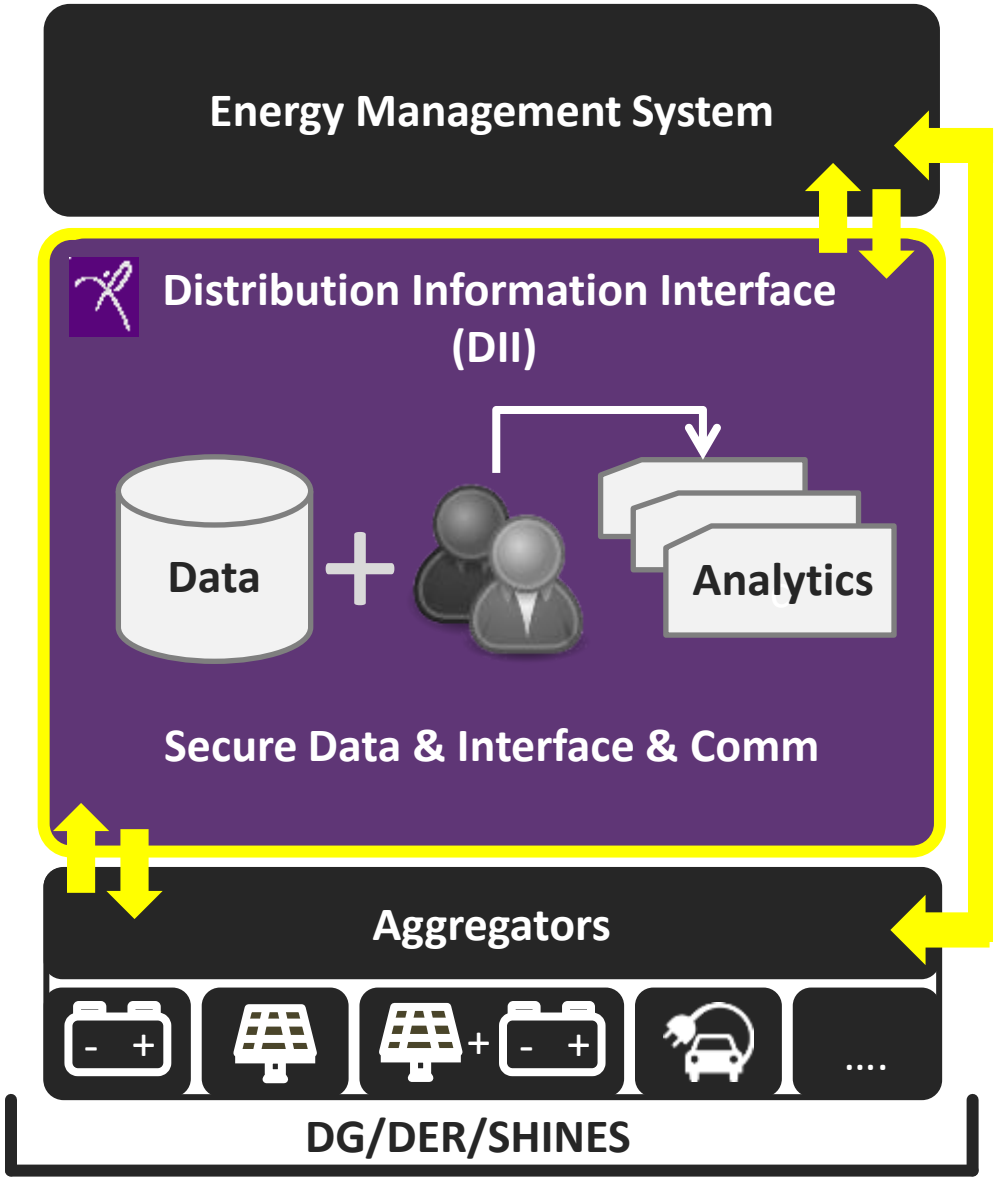
Utility System Control

Customer Control

Improving the Utility to Customer Interface

THE GAP

Communication, monitoring, and data analysis infrastructure for "SEEING & MANAGING" distributed generation (DG) and variable distributed energy resources (VDER)



EMS PLATFORMS

GE/Alstom

Siemens

SECURE DATA INTERFACE

In2lytics/Referentia

RENEWABLE PRODUCTION FORECAST

AWS Truepower

SHINES TECHNOLOGIES

Stem

Apparent

Gridco

Others

MODELING & ECONOMIC EVALUATIONS

DNV GL

System to Edge Architecture & Management Systems for SHINES

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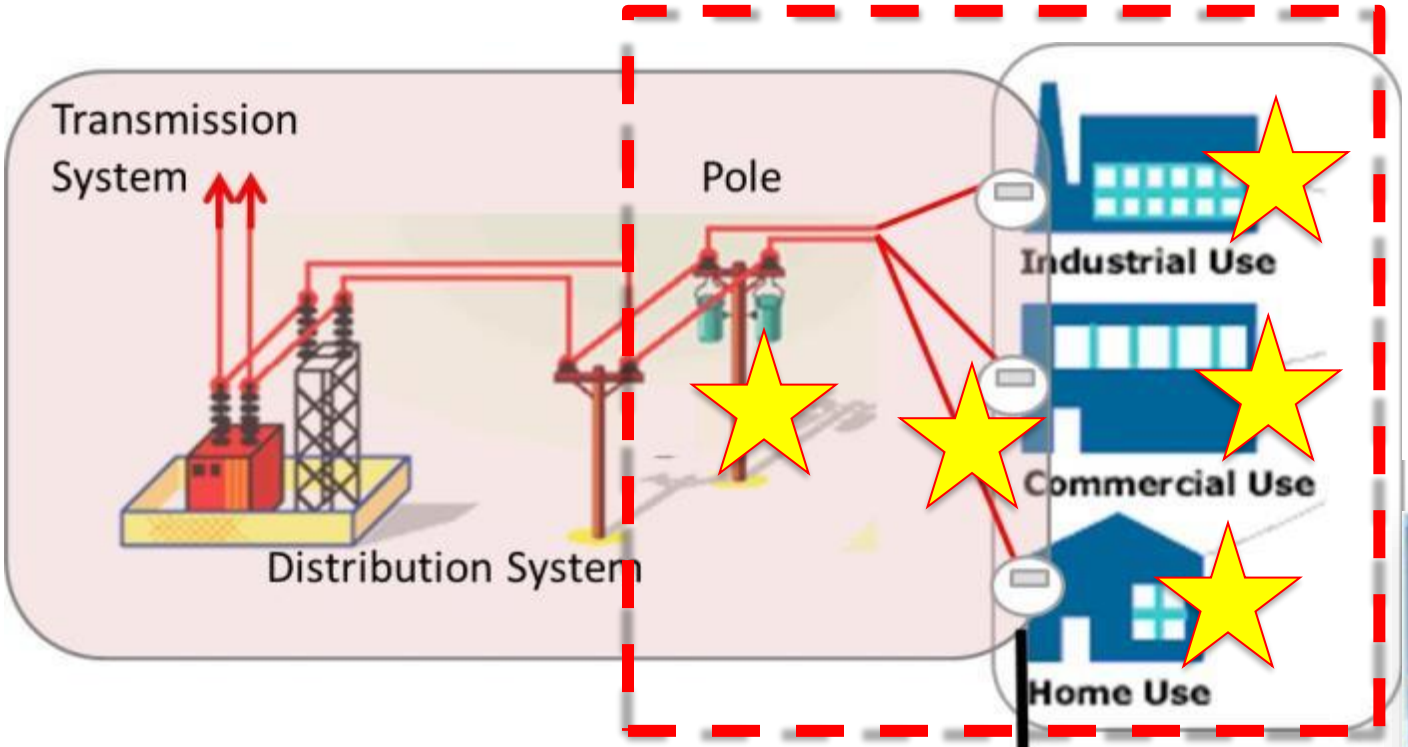
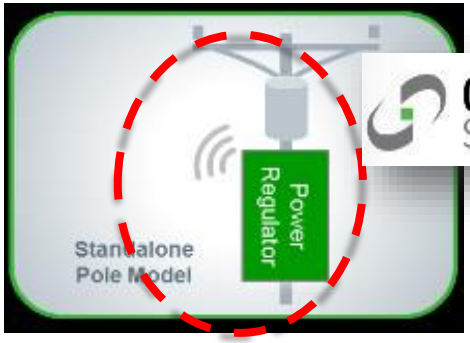
Approach: *Leverage Smart Technologies & Intelligence to Jumpstart Desired Edge-of-Network Capabilities*





GRIDCO SYSTEMS

UTILITY SIDE

CUSTOMER SIDE

peoplepower

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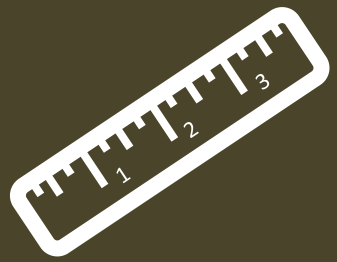
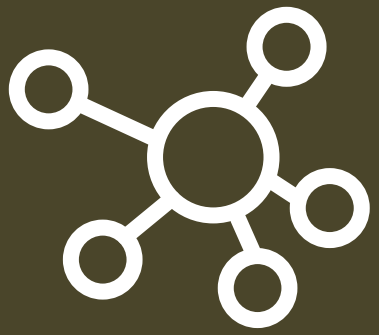
Project Objectives

GAIN CONFIDENCE & EXPERIENCE
leveraging commercially available behind the meter intelligent VDER technologies with control

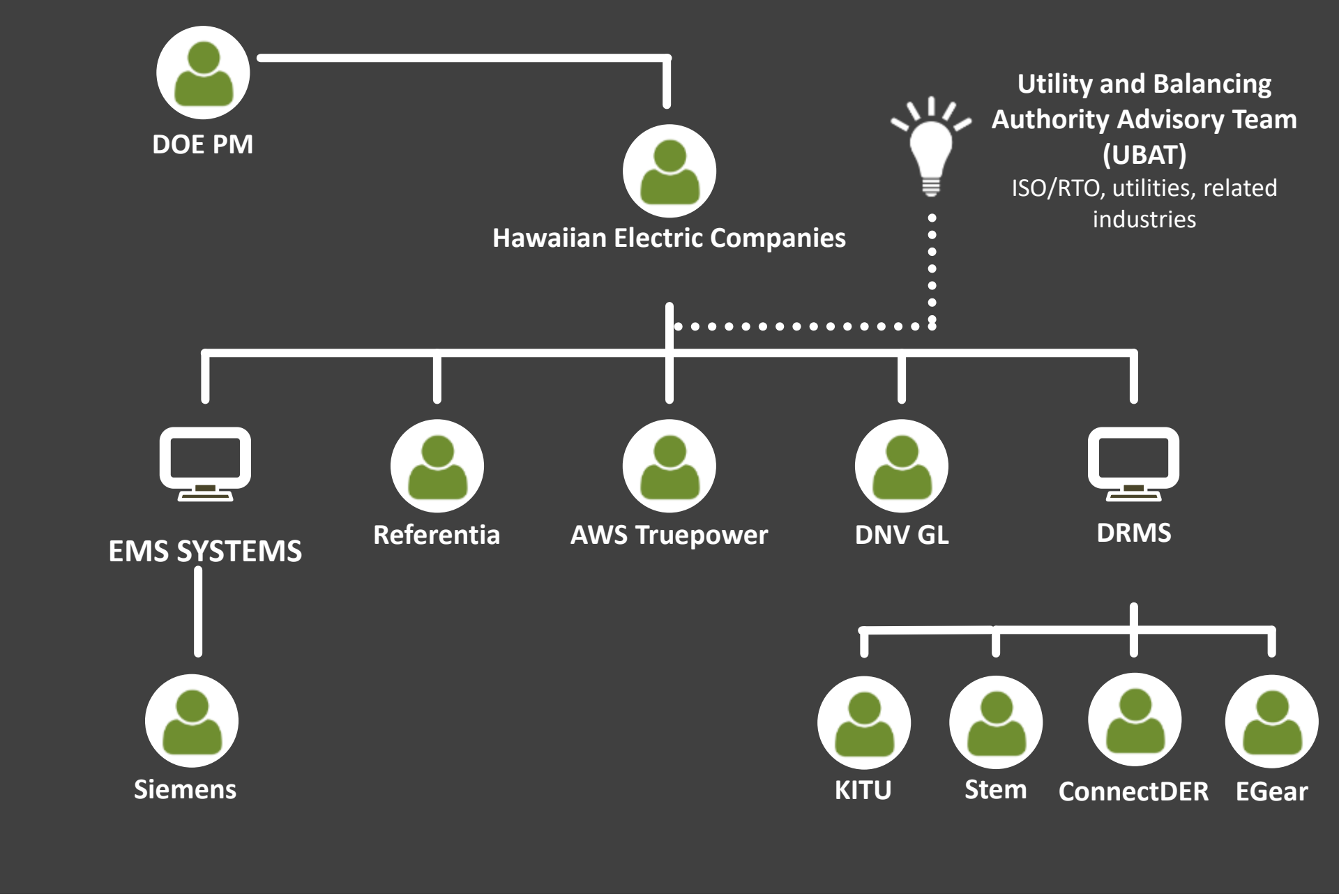


INFORM & DEVELOP CONSISTENT AND PRACTICAL STANDARDS & PROCEDURES
for grid interactive plug-n-play (CIM, communication protocols, data architecture & analytics)



EVALUATE DATA REQUIREMENTS AND INTEGRATE CONTROLS
into familiar utility operating environments

COLLABORATIVELY ENGAGE
and gain experience (utility, vendors, customers)



Ending Project Team

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Maui Electric
Hawai'i Electric Light

SEAMS for SHINES Project Update

Phase 1

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2 Phases of Integration

Phase 1

- Open ADR Protocol – Siemens DEMS Lite
  - Resource Forecast to EMS
  - Invoke control commands from DEMS Lite
  - STEM
  - ConnectDER

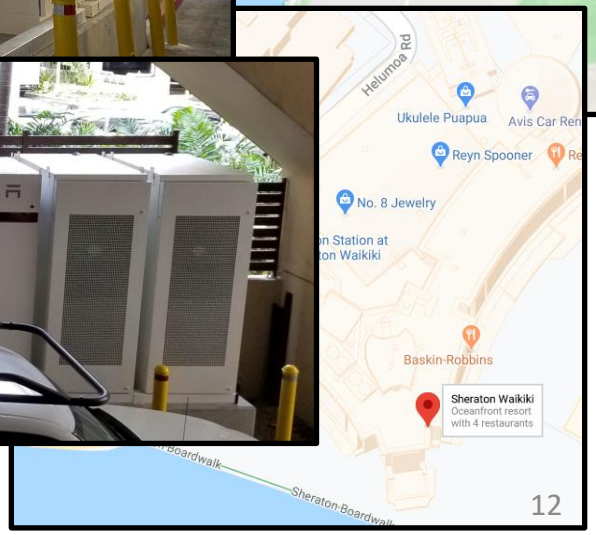
Phase 2

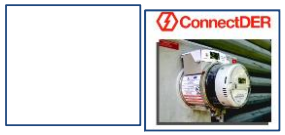
- IEEE 2030.5 – Siemens DEMS Lite
  - 4 functions of commands to individual devices from DEMS Lite
    - Single devices
    - In groups
  - KITU
  - EGear – Smart Inverter Device
  - ConnectDER

Locations of SHINES Technology

ConnectDER Collars

STEM Battery Systems





Proprietary (TBD)

Proprietary (TBD)

Stem

ConnectDER

UL/ AWSTruepower

ConnectDER Forecast

ConnectDER forecast (OpenADR)

ConnectDER Site Data

Stem FastDR Control (OpenADR)

Stem forecast (OpenADR)

DEMS (Lite)

OpenADR (Stem, ConnctDER)

SHINES DB

Pi Extract File (SCADA data, DGPV Estimation)

DGPV forecast (UL)

DGPV forecast (UL)

OpenADR (Stem, ConnectDER)
PI data – SCADA, DGPV estimation
DGPV forecast (UL)

Dev EMS

WebSDK

OSISoft PI

Phase 1 Architecture

RunningTotal - Dreams Dashboard - 0 - Internet Explorer

https://hecodmas.heco.com:8443/dreams/default.do?isTopWindow=true&uid=89423

SIEMENS

Grid Status

Current Status

FREQUENCY	60.01	Hz
System Load	685.87	MW

Weather

71°F

FUTURE

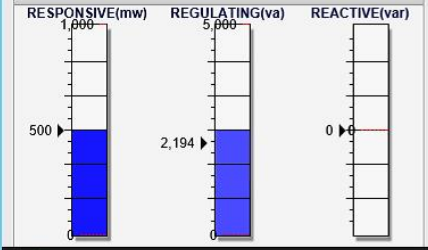
Humidity	76%
Wind speed	8 mph
Wind direction	455 deg.
Sun Radiation	973 W/m²

Renewable Forecast

POE Value : 50 % Date : 03/05/2019 15:15:00 GMT

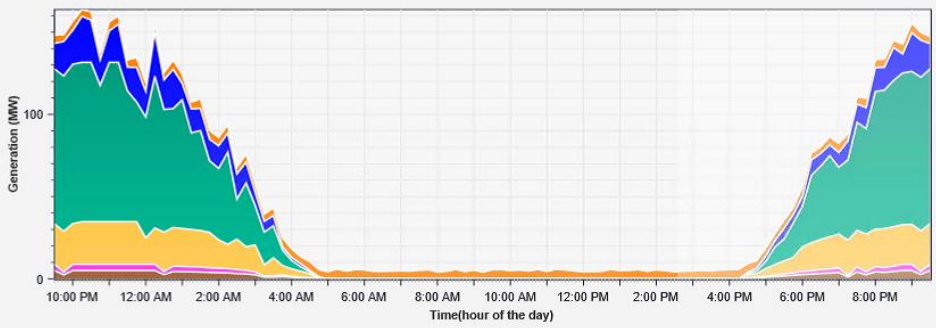
REGION	MW 0 Hour	MW +1 Hour	MW +2 Hour
NORTH	0.00	0.00	1.02
EAST	0.00	0.00	3.85
SOUTH	0.00	0.00	10.74
WEST	0.00	0.00	1.36
CENTRAL	0.00	0.00	6.30
OAHU	0.00	0.00	23.27

Reserve Placeholder

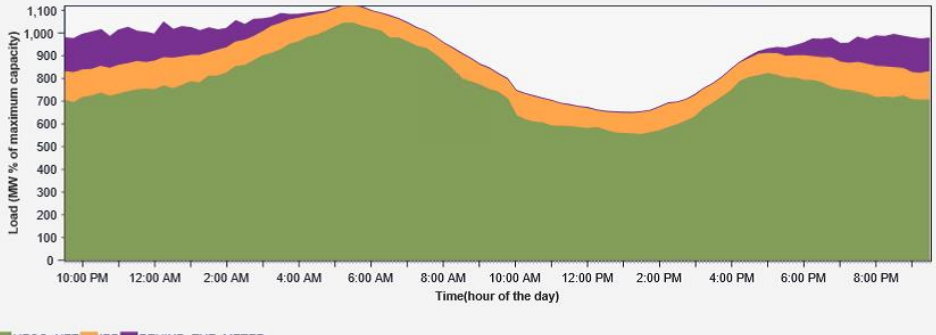


Available Distributed Resources

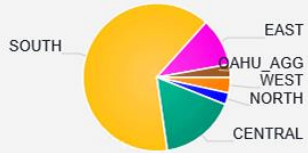
Move pointer on this Chart to set selection for Generation details chart.



Gross Load Distribution



Generation Details



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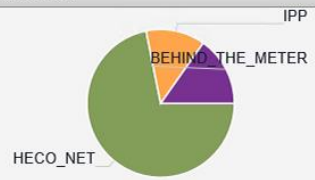
Load Details



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Emissions and cost

Current Generation Mix (In MW)

CONNECTED

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Hawai'i Electric Light

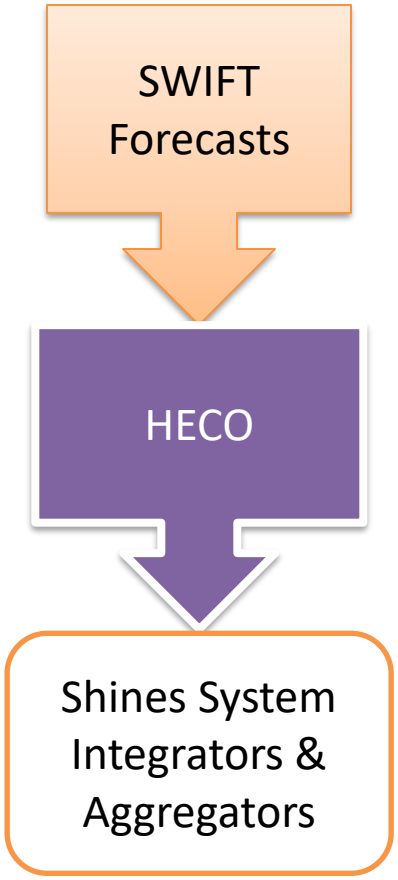
Solar Power Forecasts: Site-Level and Regional BTM Generation

SWIFT- "Solar and Wind Integrated Forecast Tool"

- Utility-scale wind, solar and *distributed generation PV Solar (DGPV or BTM)* probabilistic forecasts
- Modified solar forecasts to meet project needs
- HECO received and disseminated their forecast data

For SHINES

- Forecast targets
- Forecast frequency
- Data format for each end-user
- File naming conventions
- Data transfer protocols
- Data archiving and deletion
- Data throughput timing tests



DGPV Generation Forecasts Oahu

5 DGPV Forecast Regions on Oahu

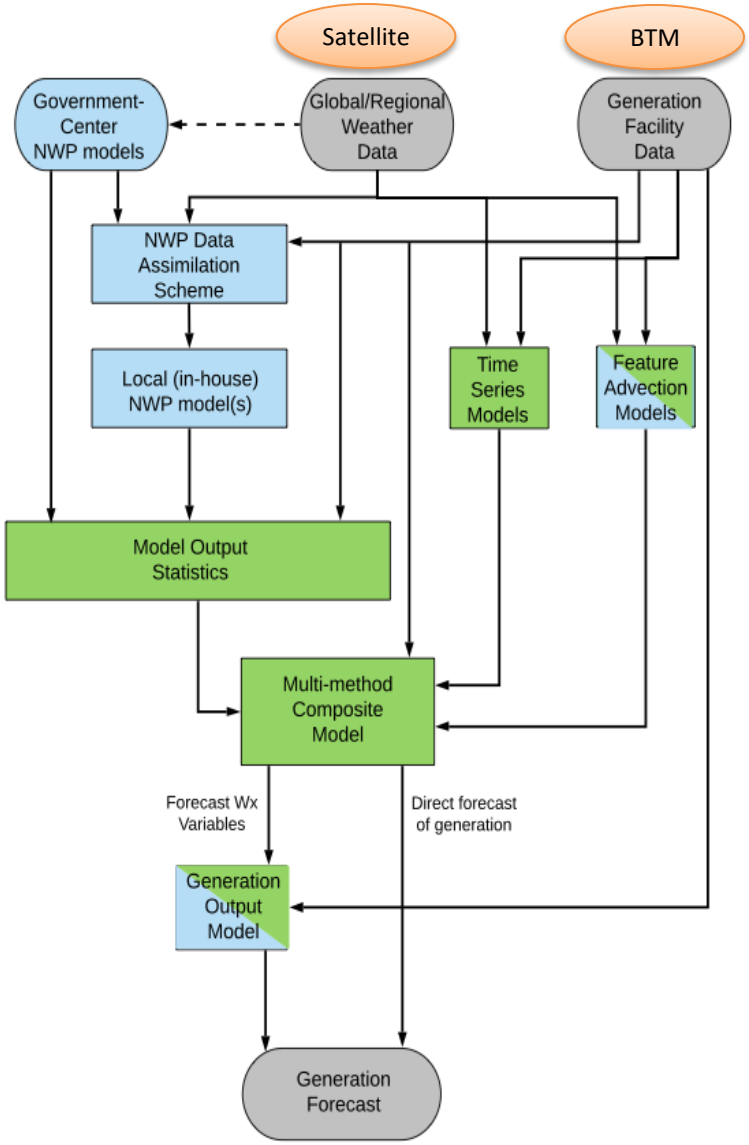
- Regions defined by System Operations
- Modeled using DGPV kW capacity by substation within each region
- Created new forecast file type for Shines integration of the 15-min, 0-6 hr forecast

Updated new forecast frequency

- Desire to utilize higher frequency forecast information in operations
- UL created 5-minute solar forecasts using GOES-17 data
- Combined trend information from 5-minute feed with advanced machine learning methods to generate the very short-term forecasts.

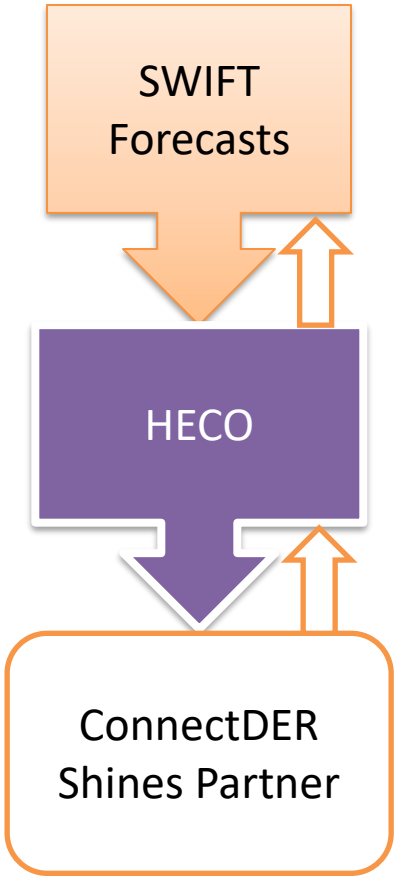
✓ Tested SHINES architecture for data throughput at a very high frequency

✓ Tested ability of forecast provider to ingest satellite data, run model ensemble, create a probabilistic forecast and return results to HECO's middleware in time for operations



Solar Power Forecasts: Site-Level

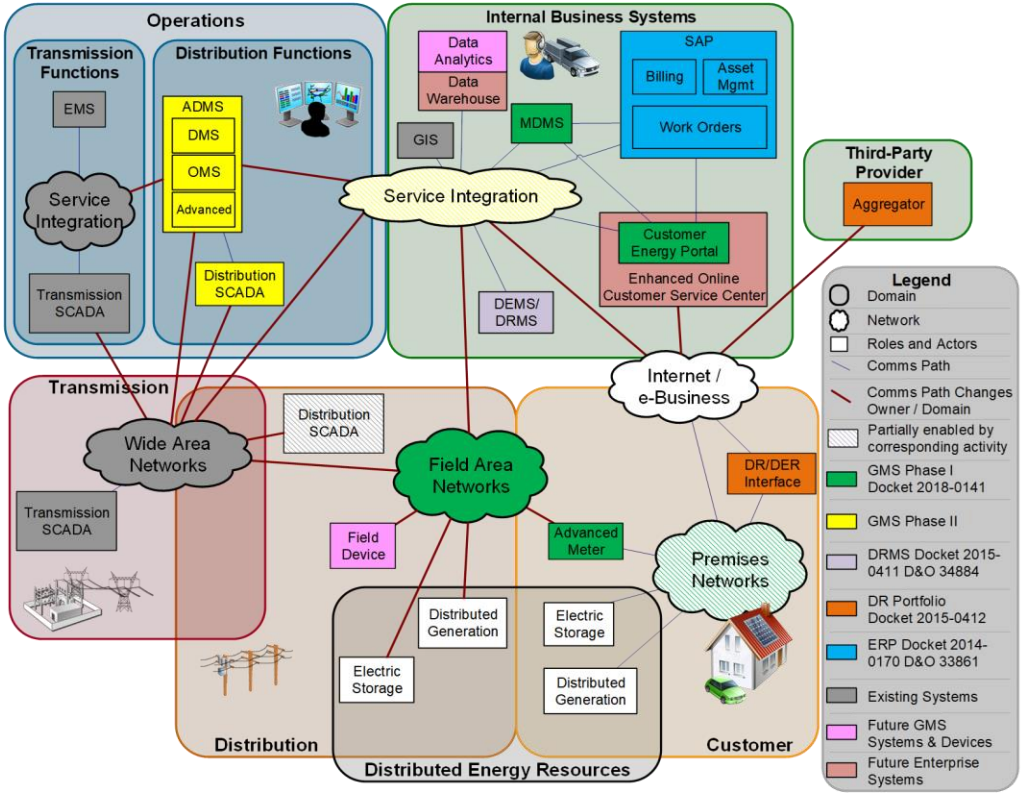
- 6 Sites equipped with ConnectDER collars
  - All sites on Molokai were forecasted as individual point locations
  - Obtained historical generation for use in model training
  - Shines architecture supplied near-real time 1-minute site-level generation data to UL every 15-minutes



- Shines
  - ✓New forecast targets
  - ✓Data format xml
  - ✓File naming conventions
  - ✓Data transfer protocols for confidential information
  - ✓Data archiving and deletion
  - ✓Data throughput timing tests

Lessons Learned From Phase 1

- OpenADR – useful for passing forecast information in aggregate
- Commands can only be sent in aggregate
- Other tools have developed such as DRMS and ADMS
- Dispatchers on neighbor islands have asked for the Forecasting tools to be built into the EMS
  - Wind & Solar



SEAMS for SHINES Project Update

Phase 2

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2 Phases of Integration

Phase 1

- Open ADR Protocol
  - Resource Forecast to EMS
  - Invoke control commands from DEMS Lite
  - STEM
  - ConnectDER

Phase 2

- IEEE 2030.5
  - 4 functions of commands to individual devices from DEMS Lite
    - Single devices
    - In groups
  - KITU
  - EGear
  - ConnectDER

IEEE 2030.5 Webinar for HECO

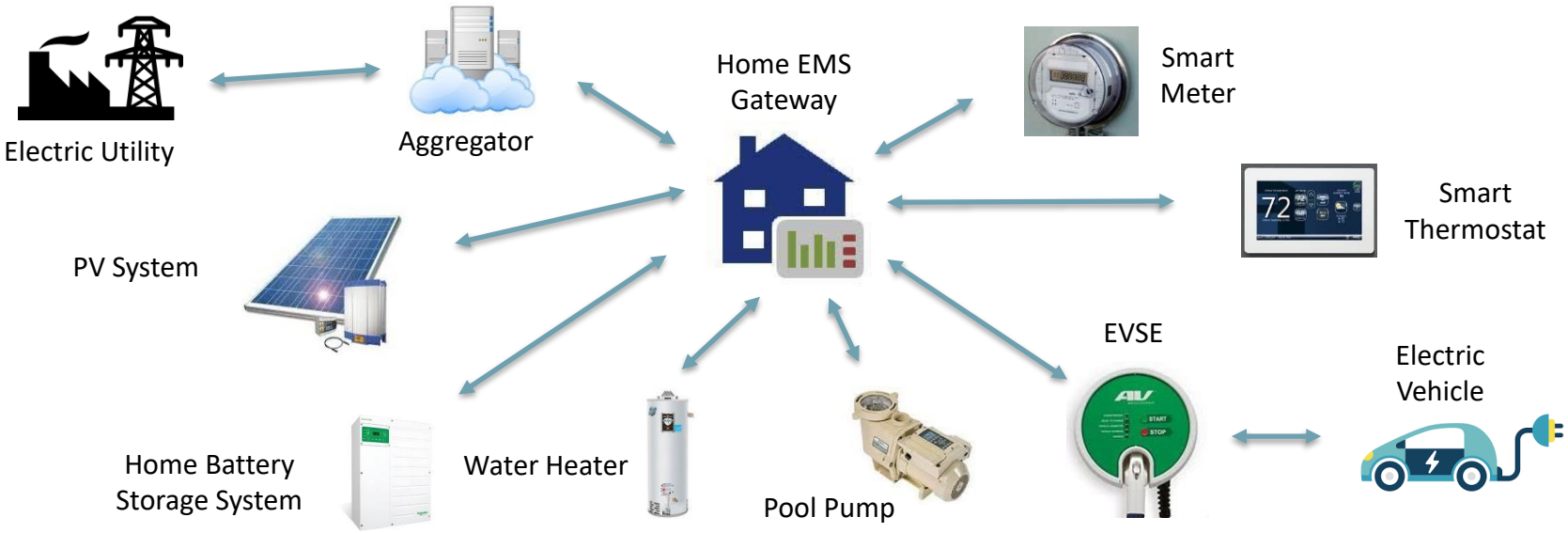
February 26, 2021

Gordon Lum
Chief Technology Officer
KITU Systems

IEEE 2030.5 Purpose

What is IEEE 2030.5 ?

- An open, international, protocol for Smart Energy communications geared for consumer and residential devices.



IEEE 2030.5 History

IEEE 2030.5-2013 (SEP 2.0)

- *2010-2012*: Initially developed by the ZigBee Alliance as SEP 2.0 (Smart Energy Profile 2.0) as a comprehensive, general-purpose, IP-based protocol for smart energy functions.
- *2012-2014*: Governance turned over to CSEP (Consortium for SEP 2 Interoperability), which consisted of the Wi-Fi Alliance, the ZigBee Alliance, the HomePlug Alliance, and the Bluetooth SIG.
- *2014*: Governance turned over to IEEE and became IEEE 2030.5

IEEE 2030.5-2018

- Primary purpose of this update is to add full support for IEEE 1547: *IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces*

IEEE 2030.5 Protocol Features

Zero Configuration using mDNS/DNS-SD

- Use of multicast DNS (mDNS) for host discovery and DNS-SD for resource discovery
- Can also use standard DNS for host discovery

Internetworking

- Uses of HTTP(S) over TCP/IP
- RESTful HTTP web services architecture
  - Client-Server model
  - Client operations limited to GET, PUT, POST, DELETE
- Uses XML schema based on IEC 61968 (CIM)

Robust Security Model

- Uses TLS 1.2 with a strong cipher suite

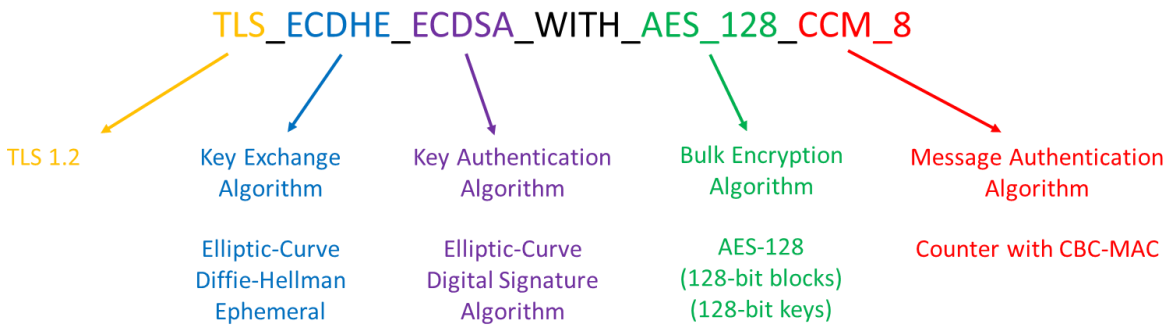
IEEE 2030.5 Smart Energy Functions

IEEE 2030.5 provides direct support for Smart Energy functions

- Demand Response Load Control
- Distributed Energy Resources
- Metering & Meter Mirroring
- Tariff Profile – Pricing
- Energy Flow Reservation
- Messaging
- Billing
- Prepayment

IEEE 2030.5 Cybersecurity Features

- Strong security was a design goal from day one
- Compliant with NSA Suite B recommendations at the SECRET (128 bits security) level.
  - Use Elliptic Curve instead of RSA
  - Have Perfect Forward Secrecy
  - Use AEAD for encryption & message authentication
- Single Cipher Suite for maximal interoperability
  - Provides 128 bits of security which is better than what's required by PCI 2.0
  - Components of the cipher suite compliant with TLS 1.3

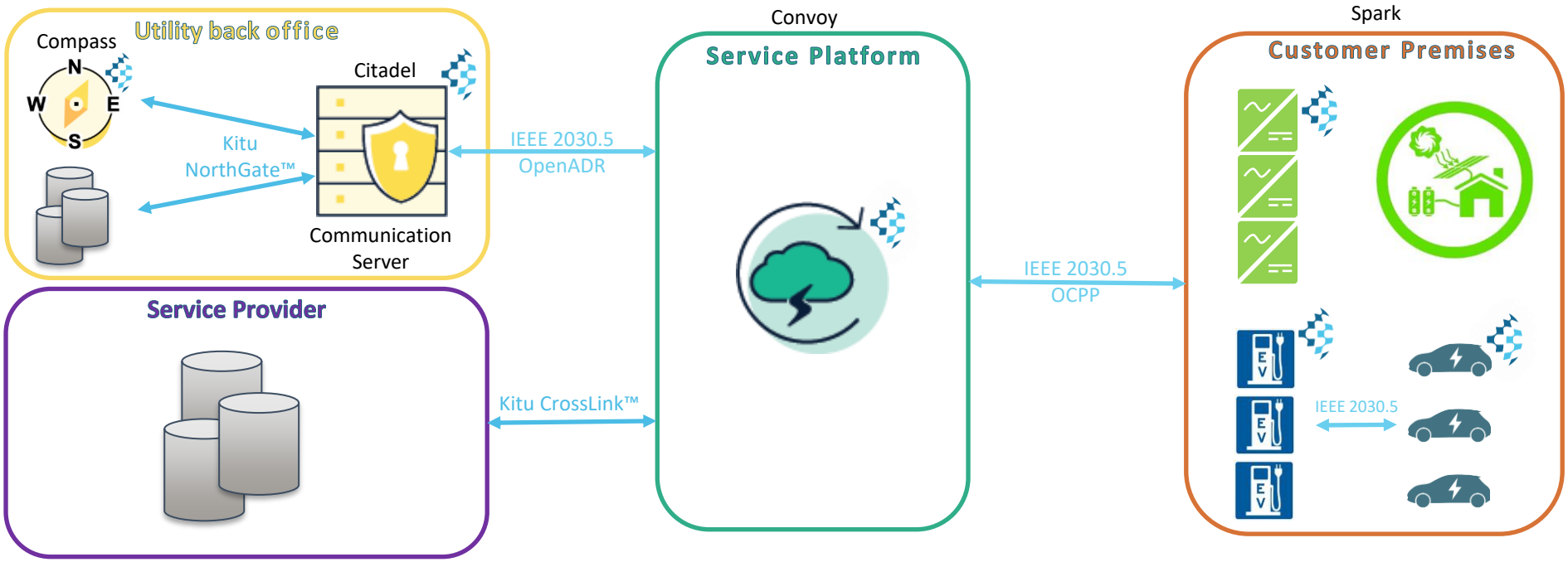


California Rule 21 Phases

- Phase 1: Autonomous Functions
- Phase 2: Communications Requirement (IEEE 2030.5 is the default protocol)
- Phase 3: Advanced Inverter Functions

Phase 1	Phase 3 Functions	
Anti-Islanding Protection	1. Monitor Key DER Data	[March 22, 2020: Attestation]
Low and High Voltage Ride-Thru	2. DER Disconnect/Re-connect	[March 22, 2020: NRTL Test]
Low and High Frequency Ride-Thru	3. Limit Maximum Active Power Mode	[March 22, 2020: NRTL Test]
Dynamic Volt-Var Operation	4. Set Active Power Mode	[Approved National Standard + 12 months]
Ramp Rates	5. Frequency-Watt Mode	[March 22, 2020: Attestation]
Fixed Power Factor	6. Volt-Watt Mode	[March 22, 2020: Attestation]
Soft Start on Reconnect	7. Dynamic Reactive Support	[Approved National Standard + 12 months]
	8. Scheduling Power Values and Modes (Volt-Var, Fixed Power Factor)	[March 22, 2020: Attestation]

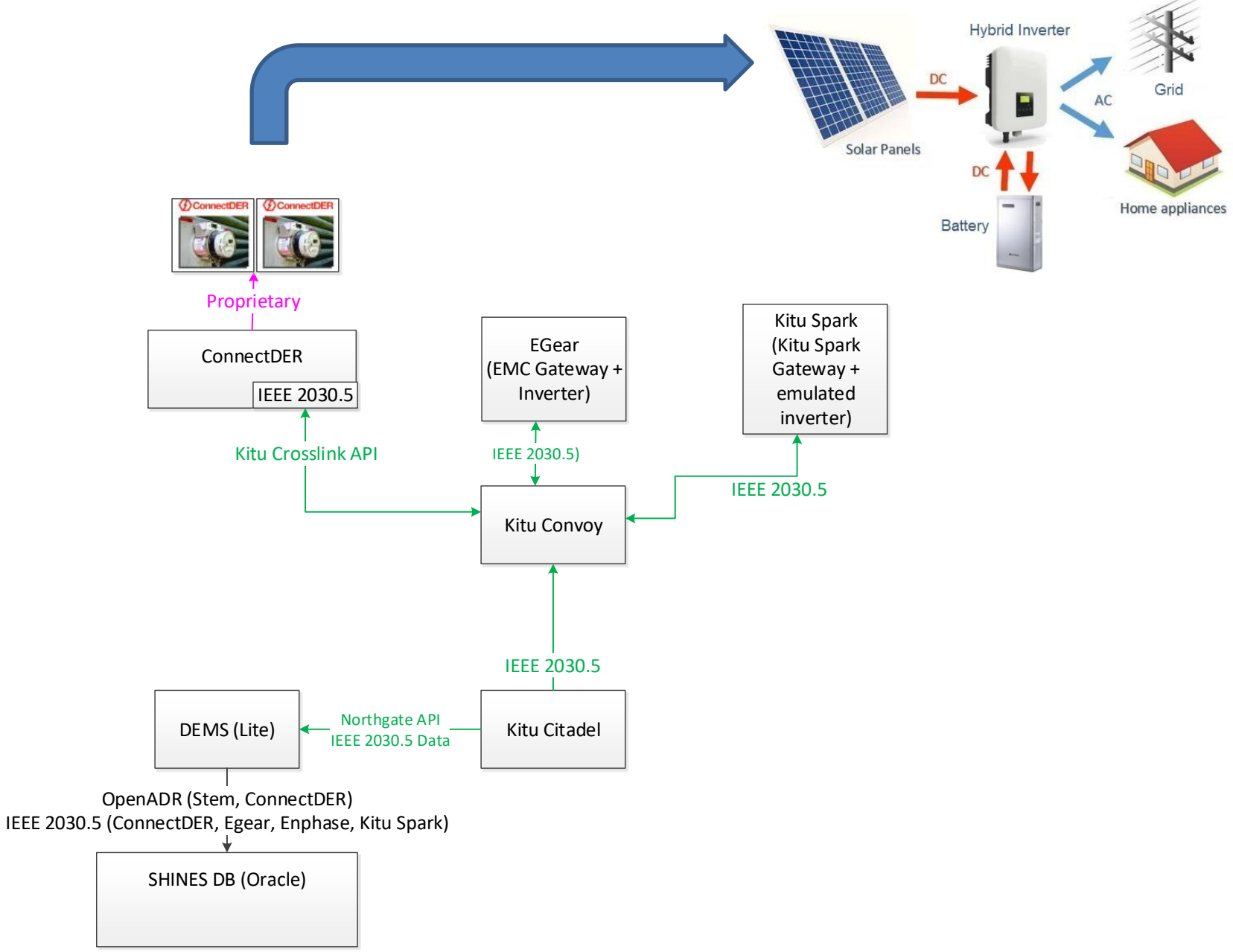
Kitu End-to-End Product Summary



We enable enhanced customer equipment such as electric vehicle chargers and smart inverters to seamlessly interconnect with utilities and other service providers

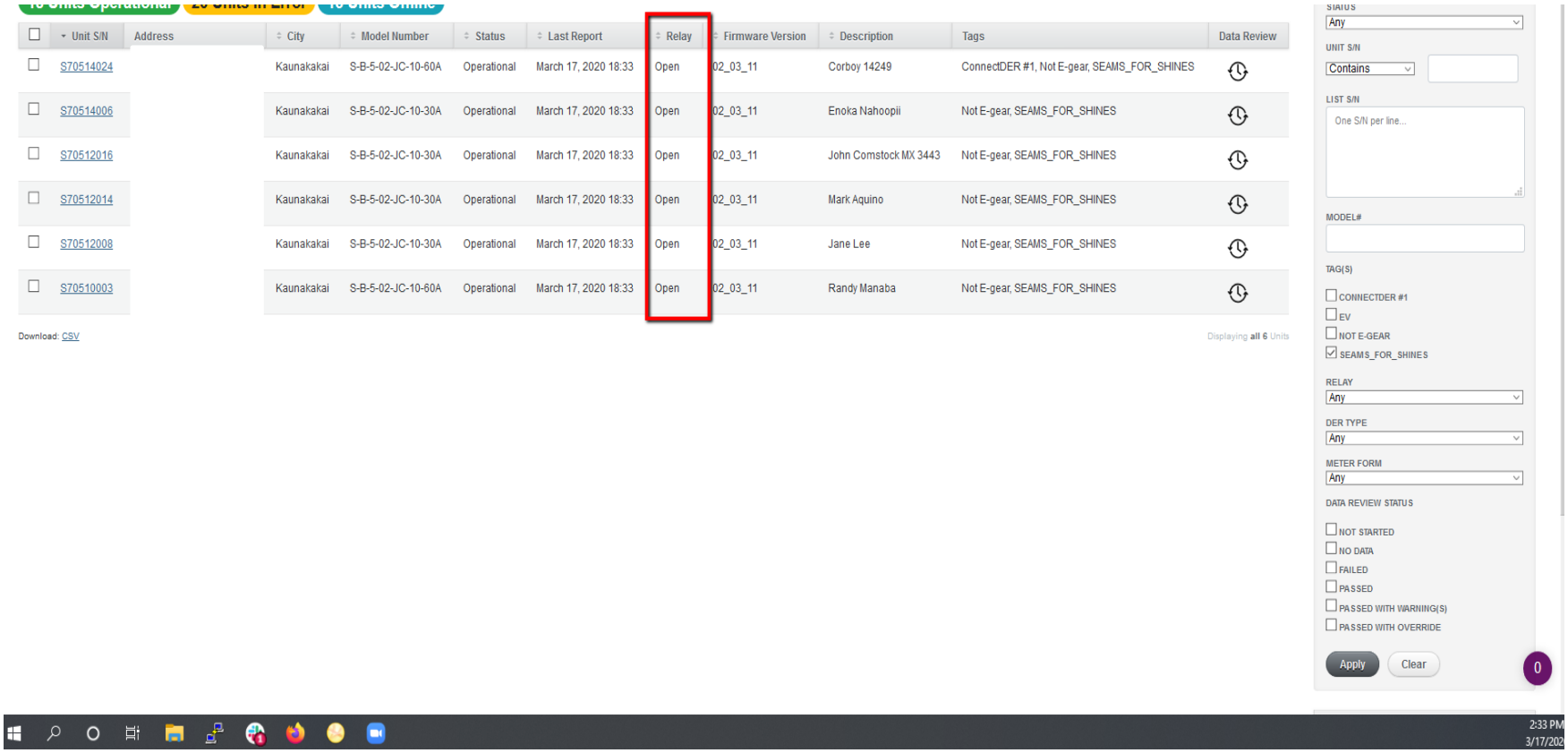
SEAMS for SHINES – 4 Functions

- Function 1 – Monitor Key DER Data
- Function 2 – DER Disconnect/Reconnect Command
- Function 3 – Limit Maximum Active Power Mode
- Function 4 – Set Active Power Mode
- Function 5 – Frequency Watt Mode
- Function 6 – Volt Watt mode
- Function 7 – Dynamic Reactive Support
- Function 8 – Scheduling Power Values and Modes



Phase 2 Architecture

Phase 2 Control of DER Collars



Unit S/N	Address	City	Model Number	Status	Last Report	Relay	Firmware Version	Description	Tags	Data Review
S70514024		Kaunakakai	S-B-5-02-JC-10-60A	Operational	March 17, 2020 18:33	Open	02_03_11	Corboy 14249	ConnectDER #1, Not E-gear, SEAMS_FOR_SHINES	
S70514006		Kaunakakai	S-B-5-02-JC-10-30A	Operational	March 17, 2020 18:33	Open	02_03_11	Enoka Nahoopii	Not E-gear, SEAMS_FOR_SHINES	
S70512016		Kaunakakai	S-B-5-02-JC-10-30A	Operational	March 17, 2020 18:33	Open	02_03_11	John Comstock MX 3443	Not E-gear, SEAMS_FOR_SHINES	
S70512014		Kaunakakai	S-B-5-02-JC-10-30A	Operational	March 17, 2020 18:33	Open	02_03_11	Mark Aquino	Not E-gear, SEAMS_FOR_SHINES	
S70512008		Kaunakakai	S-B-5-02-JC-10-30A	Operational	March 17, 2020 18:33	Open	02_03_11	Jane Lee	Not E-gear, SEAMS_FOR_SHINES	
S70510003		Kaunakakai	S-B-5-02-JC-10-60A	Operational	March 17, 2020 18:33	Open	02_03_11	Randy Manaba	Not E-gear, SEAMS_FOR_SHINES	

Download: CSV

Displaying all 6 Units

STATUS: Any

UNIT S/N: Contains

LIST S/N: One S/N per line...

MODEL#

TAG(S)

- CONNECTDER #1
- EV
- NOT E-GEAR
- SEAMS_FOR_SHINES

RELAY: Any

DER TYPE: Any

METER FORM: Any

DATA REVIEW STATUS

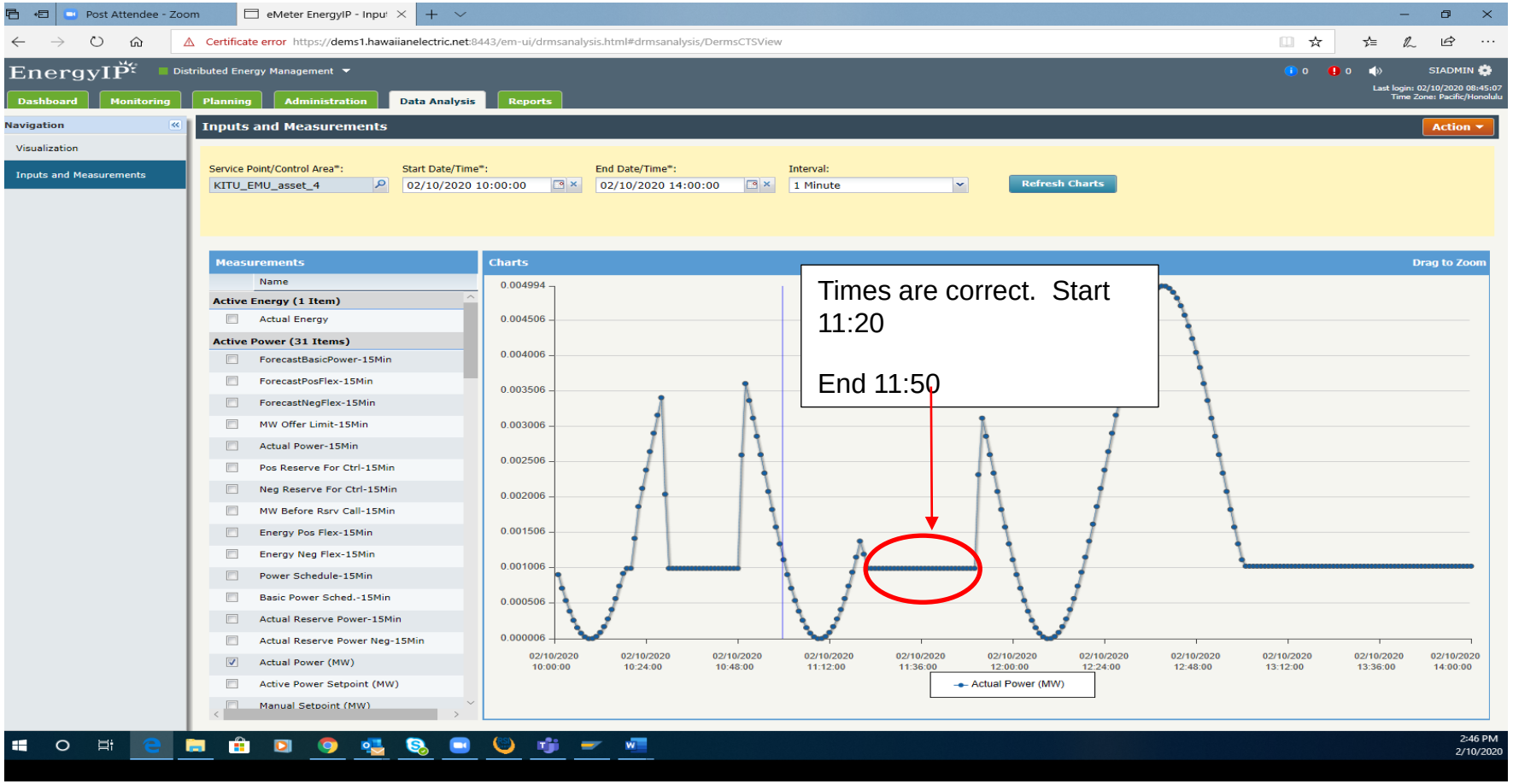
- NOT STARTED
- NO DATA
- FAILED
- PASSED
- PASSED WITH WARNING(S)
- PASSED WITH OVERRIDE

Apply | Clear

0

2:33 PM
3/17/202

Limit Max Power Output



Lessons Learned From Phase 2

- Technical Integration
  - Multiple vendors, multiple geographic locations – attain agreement on common work hours ahead of time
  - One set of master requirements and specification documentation that everyone worked on with 1 party responsible for updating and distributing new version would be helpful
  - Maintaining the same personnel from the beginning to end of the project to allow accumulation of information and strengthening of working relationships would be great

Lessons Learned From Phase 2 (cont)

- Functional
  - Demonstration of controlling 1 device or several devices was accomplished
  - KITU devices and offerings allow for flexibility in configuration
    - Mapping of values
  - A visual user interface is required for the dispatcher
    - Should be a DEMS long term goal, or integration to ADMS or EMS will be required
  - Eliminate the number of clicks to invoke a command

Questions/Comments??

Mahalo for Your Support

For more information please contact:

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Shari.Ishikawa@hawaiianelectric.com

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