HIGH PENETRATION PV VISUALIZATION TASK

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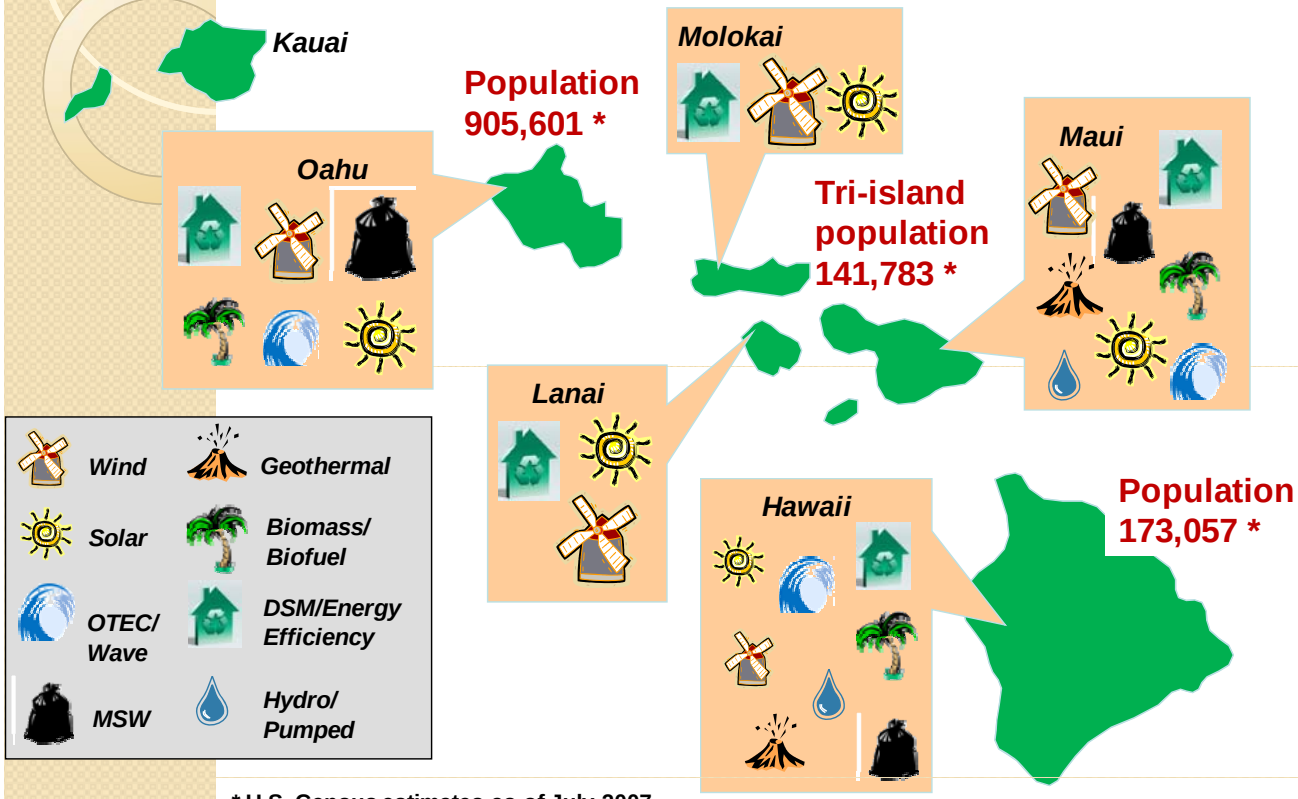
Hawaiian Electric Company
Maui Electric Company
Hawaii Electric Light Company

Overview

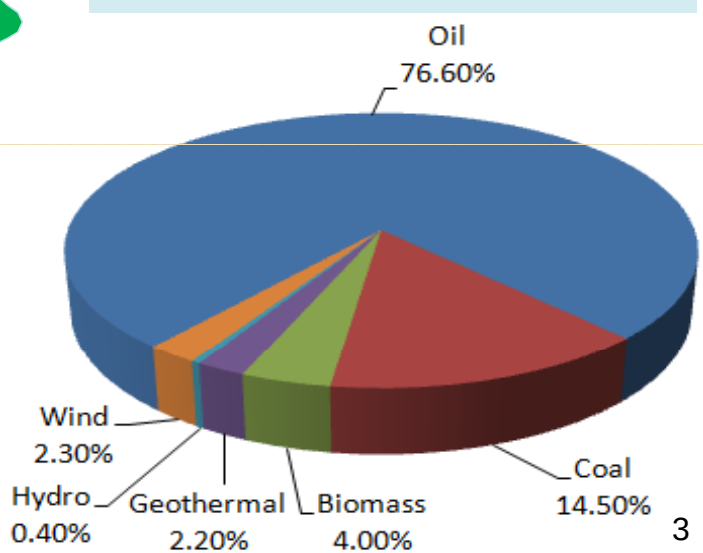
- Motivation
- Figuring out what and where to collect data
- Making sense of the data
- Visual Tools to aid decision making
- Next Steps & Benefits
- Q&A

Where are we Today?



* U.S. Census estimates as of July 2007

- RPS – 40% renewables from electricity, 70% total (includes transportation) by 2030
- Energy efficiency standard of 30% by 2030 (3,400 GWh)
- HECO – 17%, HELCO – 42%, MECO – 26%



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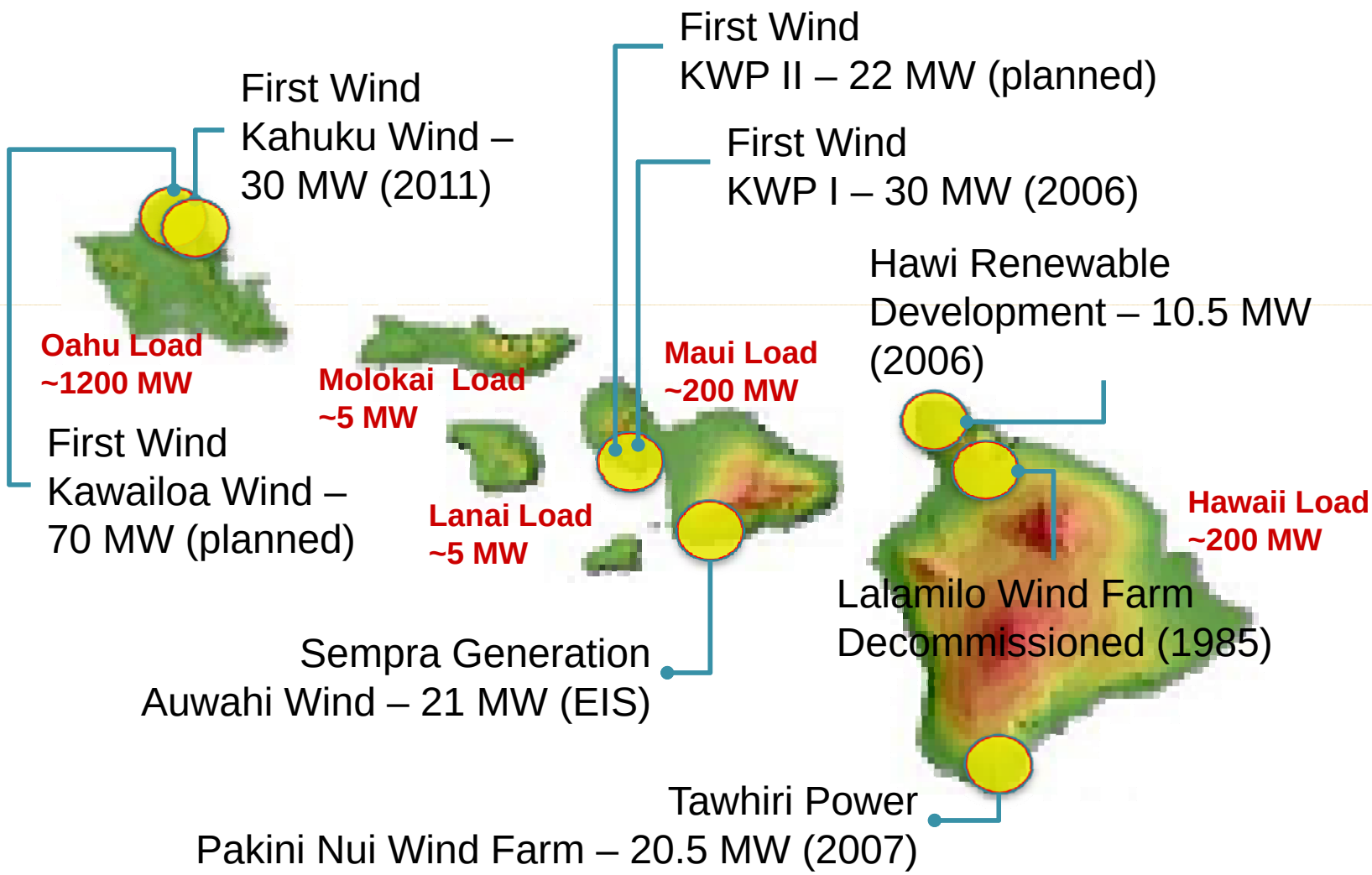
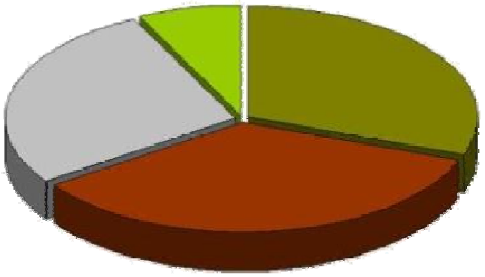
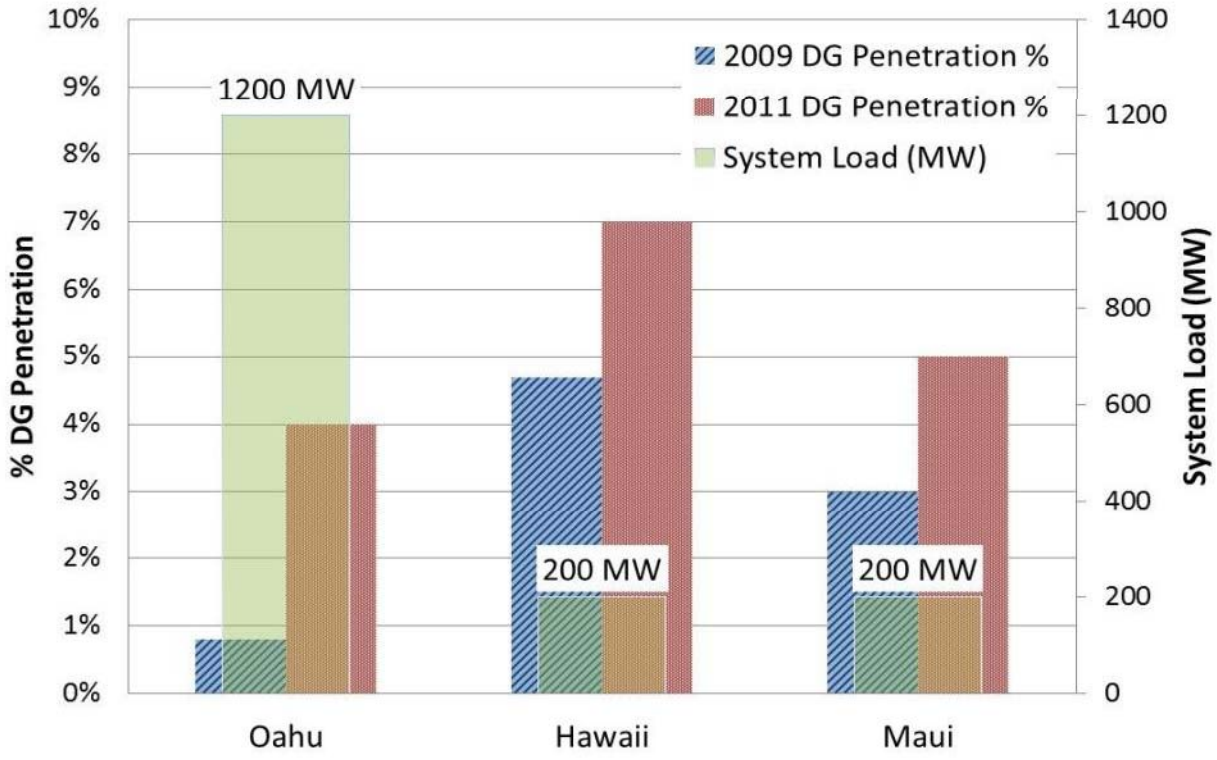
Island Loads & Wind Sites



DG Growth in Hawaii



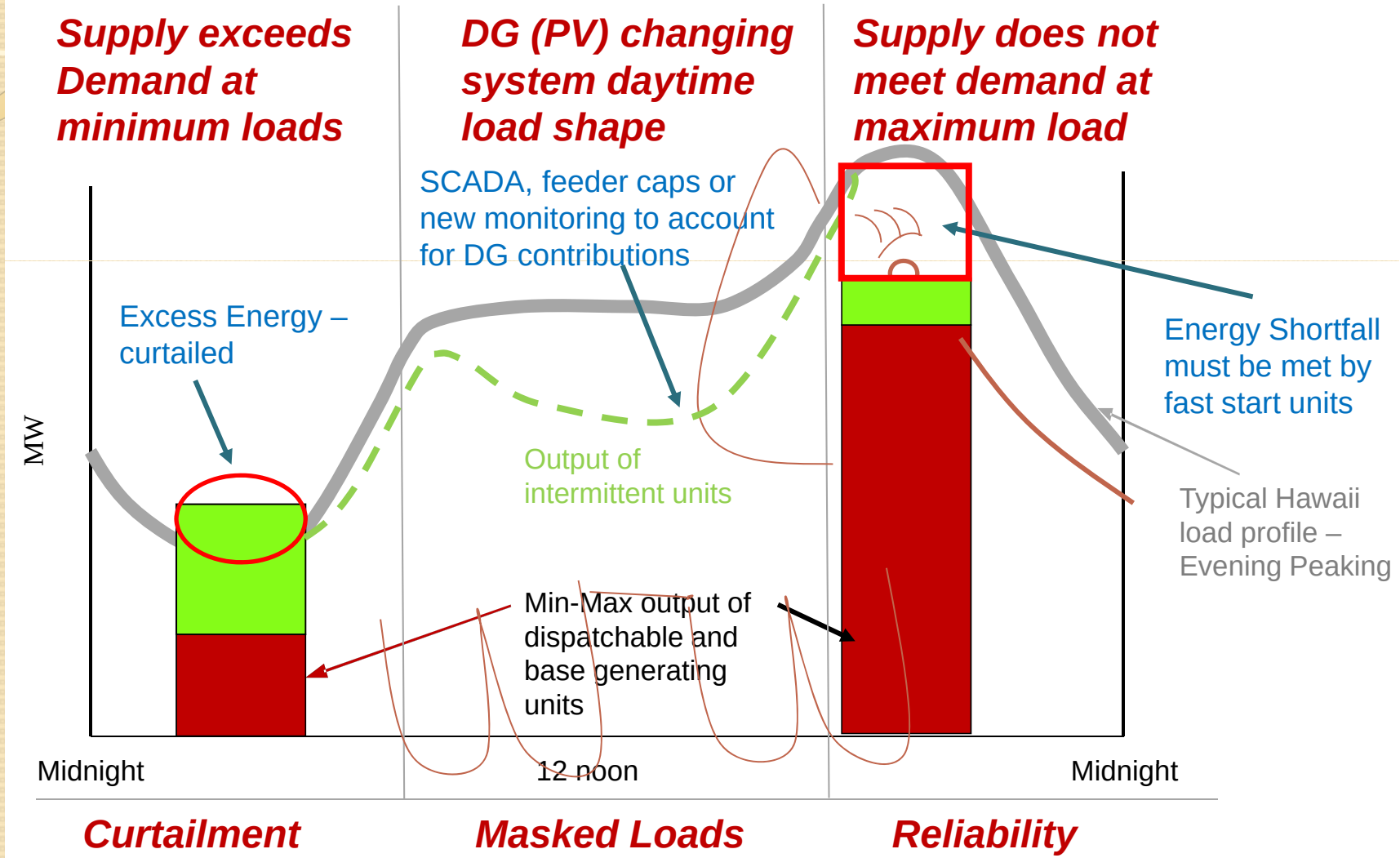
JET FUEL	34%
ELECTRICITY	32%
GASOLINE/ MARINE FUEL	27%
OTHER	7%



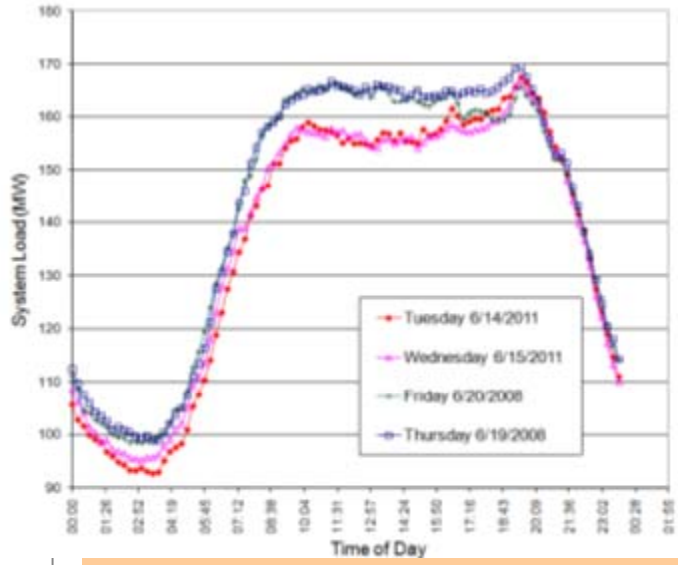
Summary of Distribution Level Penetration on Major Islands
* DG Penetration = Installed DG MW / Max Feeder Load 2010 data

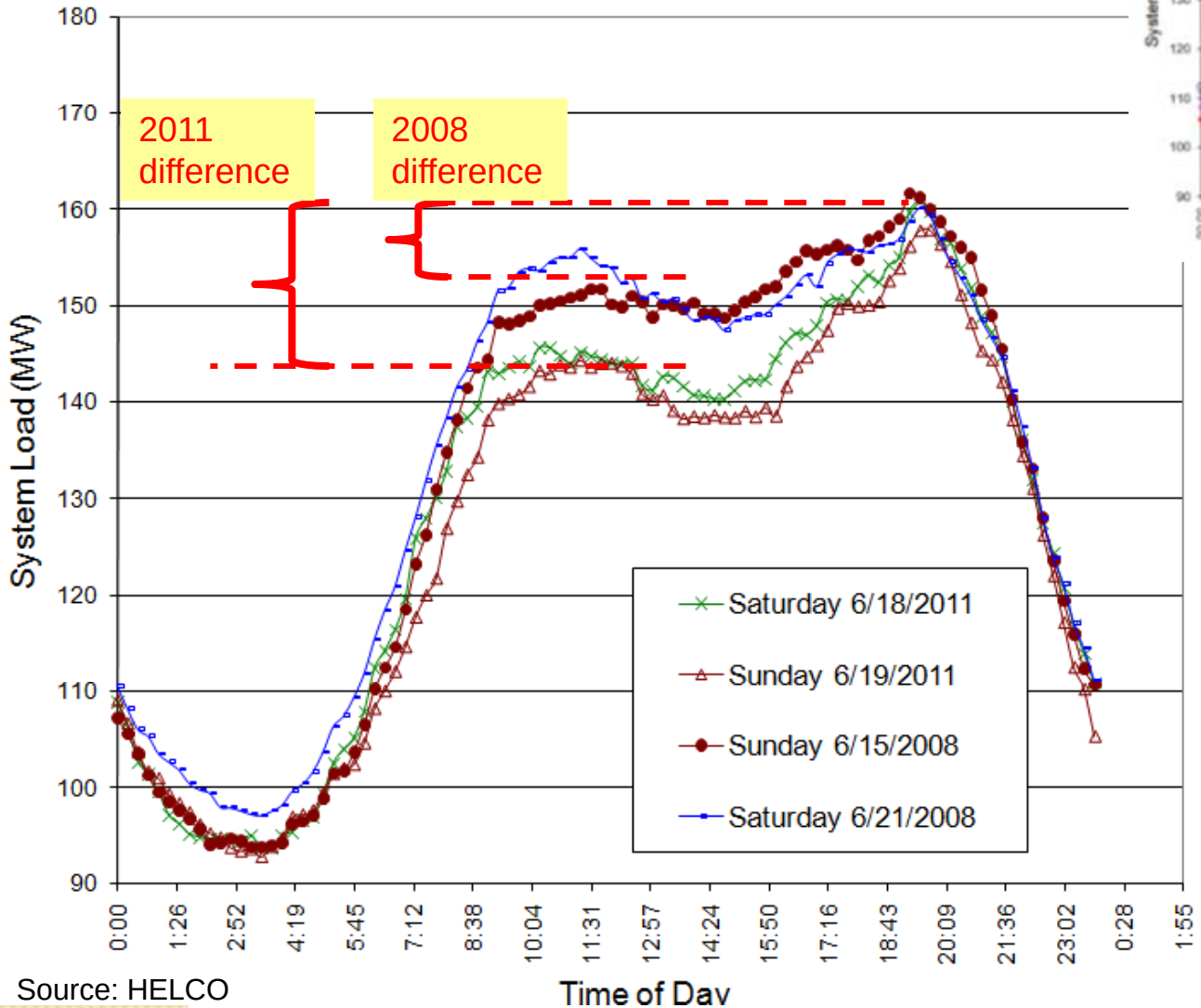
- RPS – 40% renewables from electricity, 70% total (includes transportation) by 2030
- Energy efficiency standard of 30% by 2030 (3,400 GWh)
- HECO – 17%, HELCO – 42%, MECO – 26%

System Issues Being Encountered



Comparison of 2008 and 2011 Weekend (light system load)

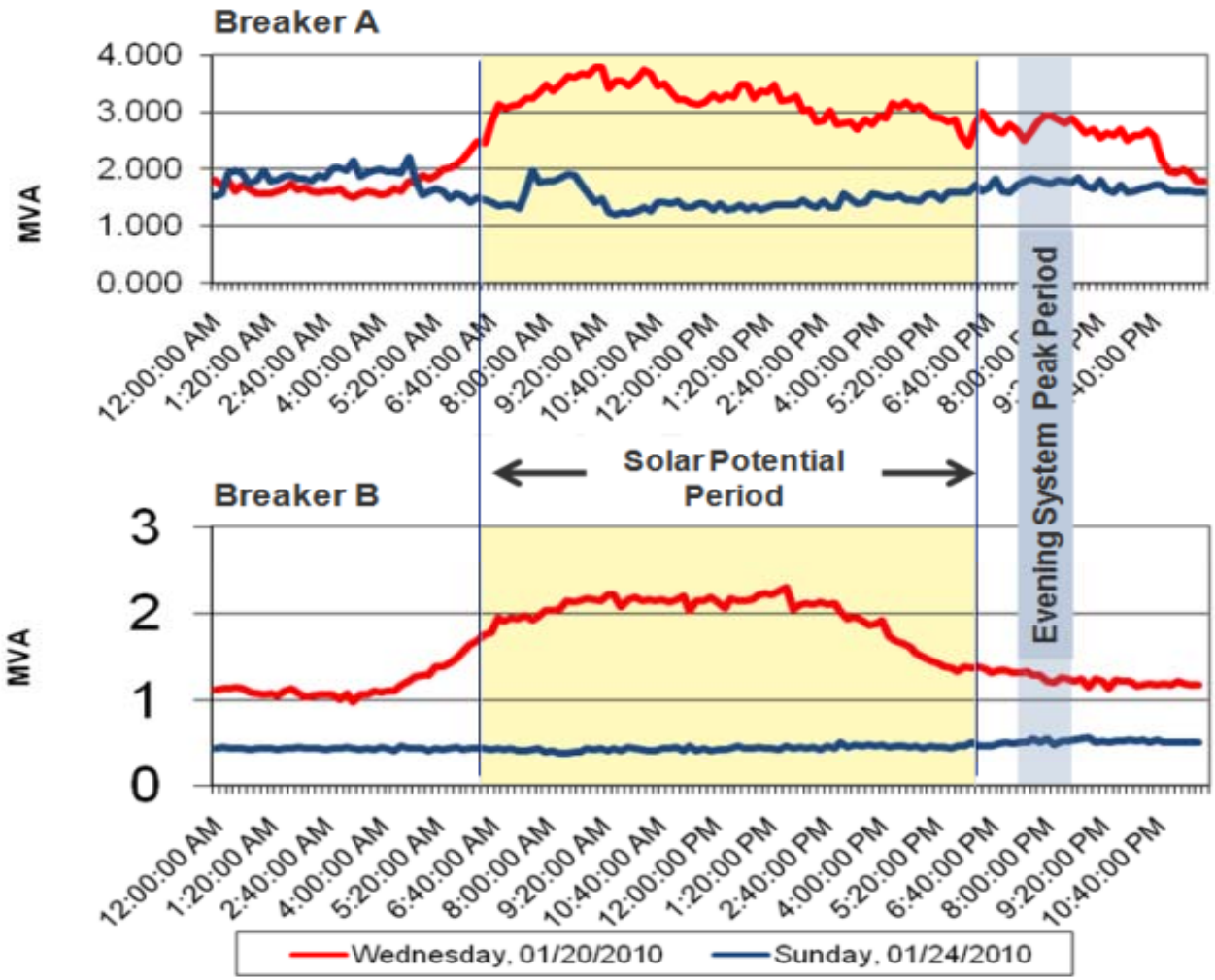




Source: HELCO

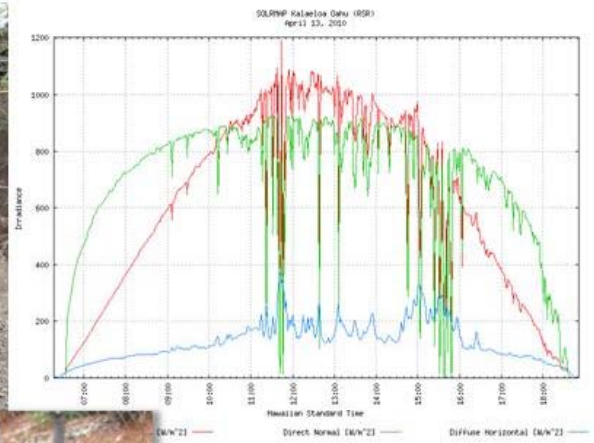
- Weekday comparison: evening peak has not significantly changed between 2008 and 2011 but daytime demand has.
- Weekend comparison (light load day): difference between daytime peak and evening peak has increased.

Local Circuit Impact – light load

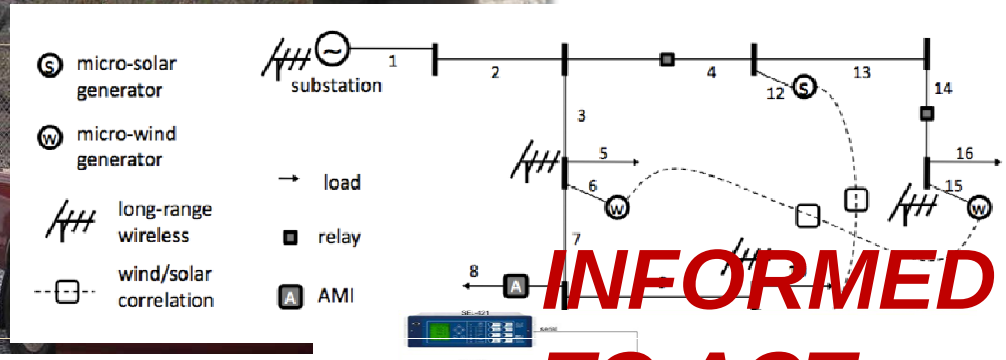


Concerns:

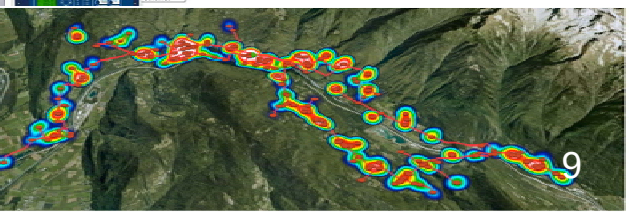
1. The above graphs illustrate the need to assess the feeder loading not only at peak periods but also on the days where the loads are not as high (light load Sundays) – Rule 14H
2. Circuit peaks often not coincident with System peaks



ASSESS,
MODEL &



INFORMED
TO ACT

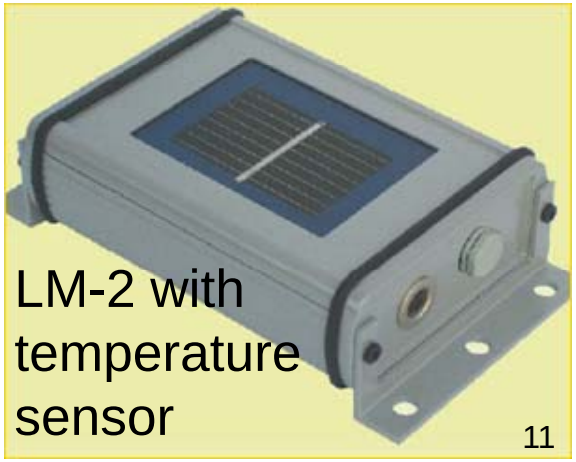


Visualization & Data Supporting Portfolio of Renewable Integration Activities

- Develop Integration Tools & Capabilities
  - Resource characterization, sensor deployments & field monitoring
  - Data management and analysis tools
  - Model enhancements & field validation
  - New visualization & decision aids
  - Operationalize "look-ahead" wind & solar forecasting with ramp event capability
- Integrate & Enhance Processes/Procedures
- Workforce Development and Pipeline
- Outreach & Collaborations
- Support Transformative Efforts

Solar & Feeder Monitoring Instrumentation

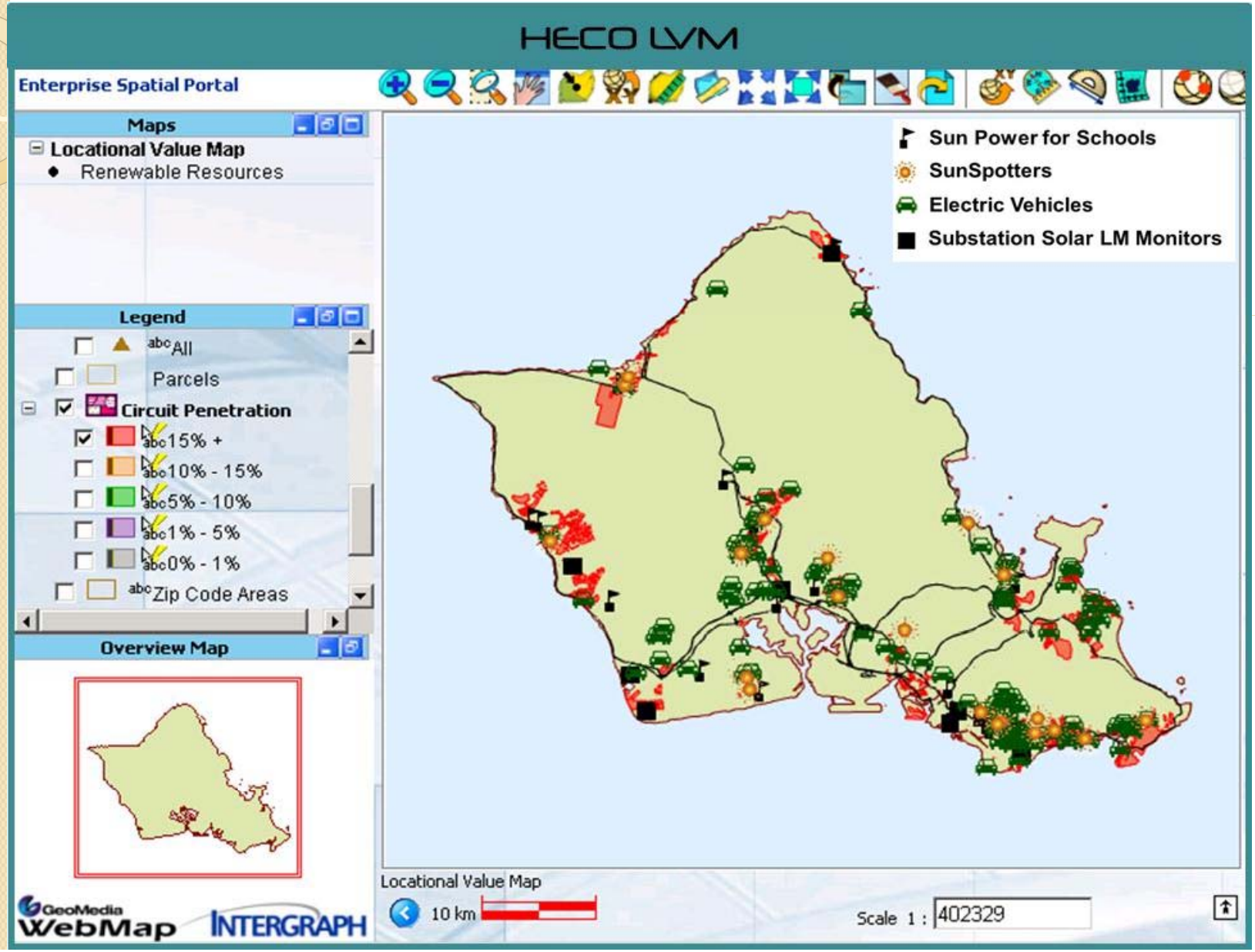
Reference
Met station
at Kaneolani
Elementary



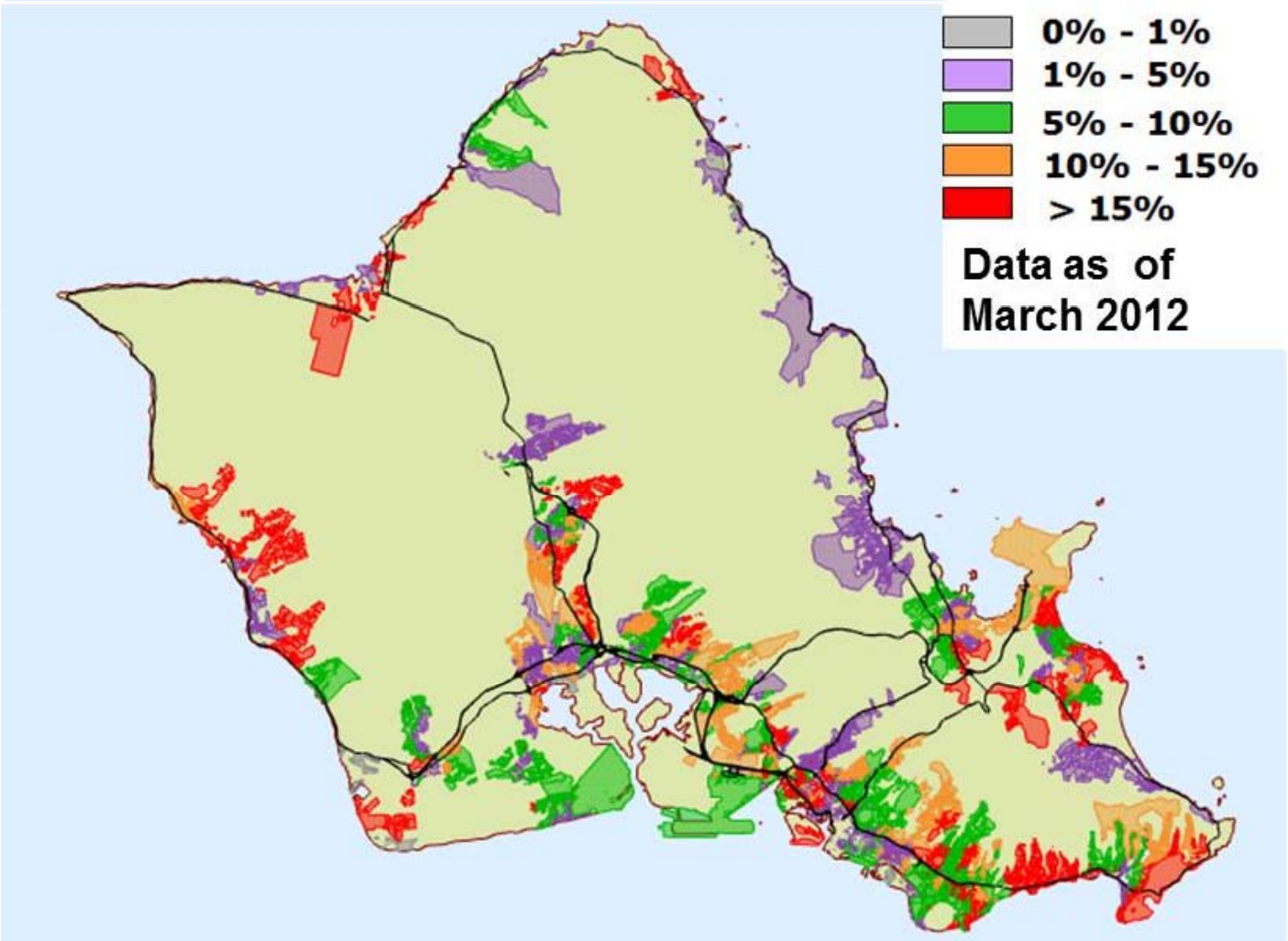
New Data Requirements for Solar Facilities (included in PPA language)

Ex. Collecting PV facility data at site to better track, utilize and plan for large-scale “as-available” renewable generation facilities (Oahu).

GIS-based Tools – Track Monitoring & Emerging Technologies



Using LVM to Track Growth in Distributed PV

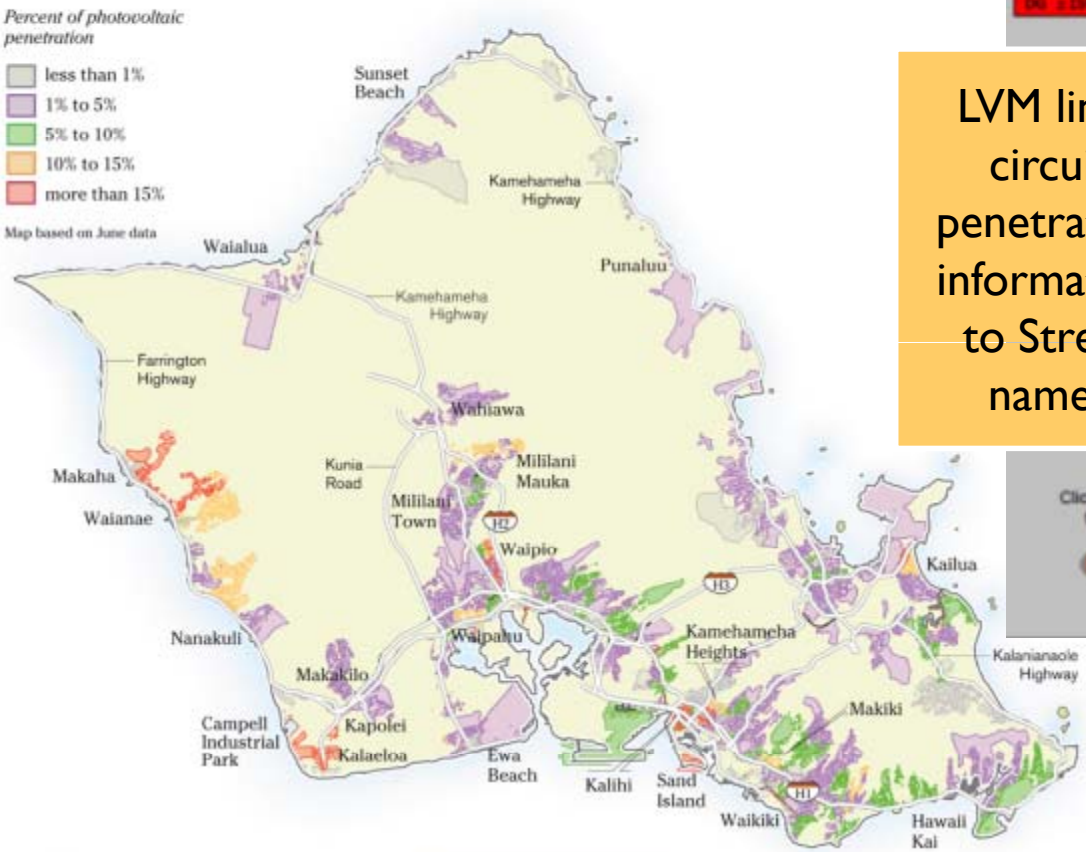


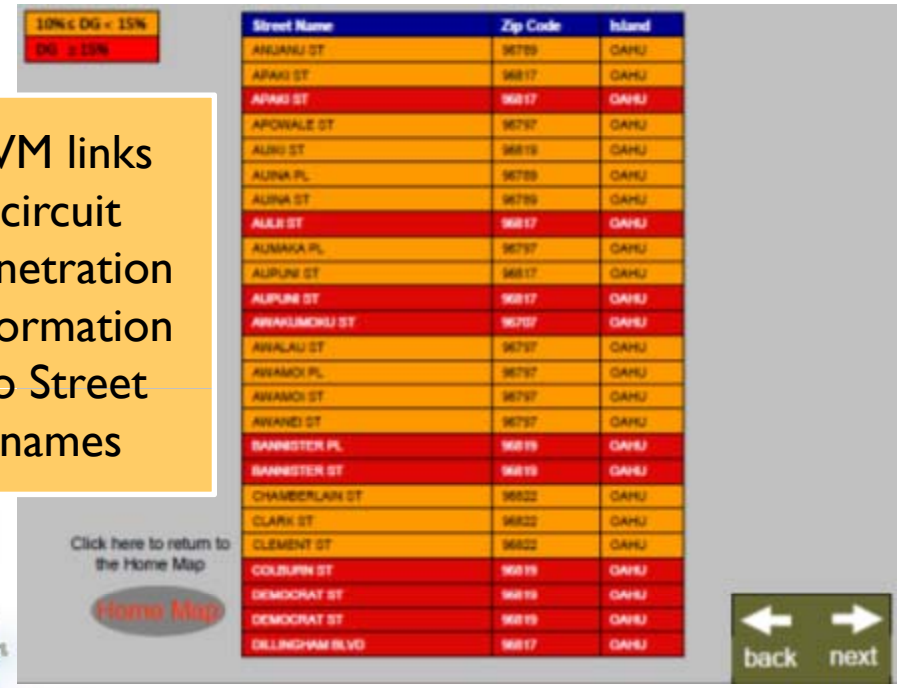
Red areas indicate circuits with > 15% PV penetration

Instituted LVM to Help Everyone See Areas of High Circuit Penetration

SOLAR SATURATION

Hawaiian Electric Co. says 15 of the utility's 465 distribution circuits on Oahu have customer-owned photovoltaic systems that account for more than 15 percent of the peak load on that circuit. Once the 15 percent threshold is reached, customers on the circuit who want to install additional PV capacity may be required to undertake an expensive interconnection study.

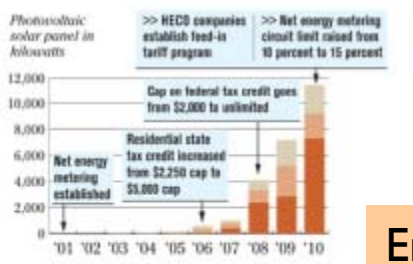




LVM links circuit penetration information to Street names

POWERING UP

The amount of solar electricity generating capacity installed by homeowners and businesses has grown dramatically since the net energy metering program was launched 10 years ago, allowing such systems to hook into the HECO, MECO and HELCO grids.

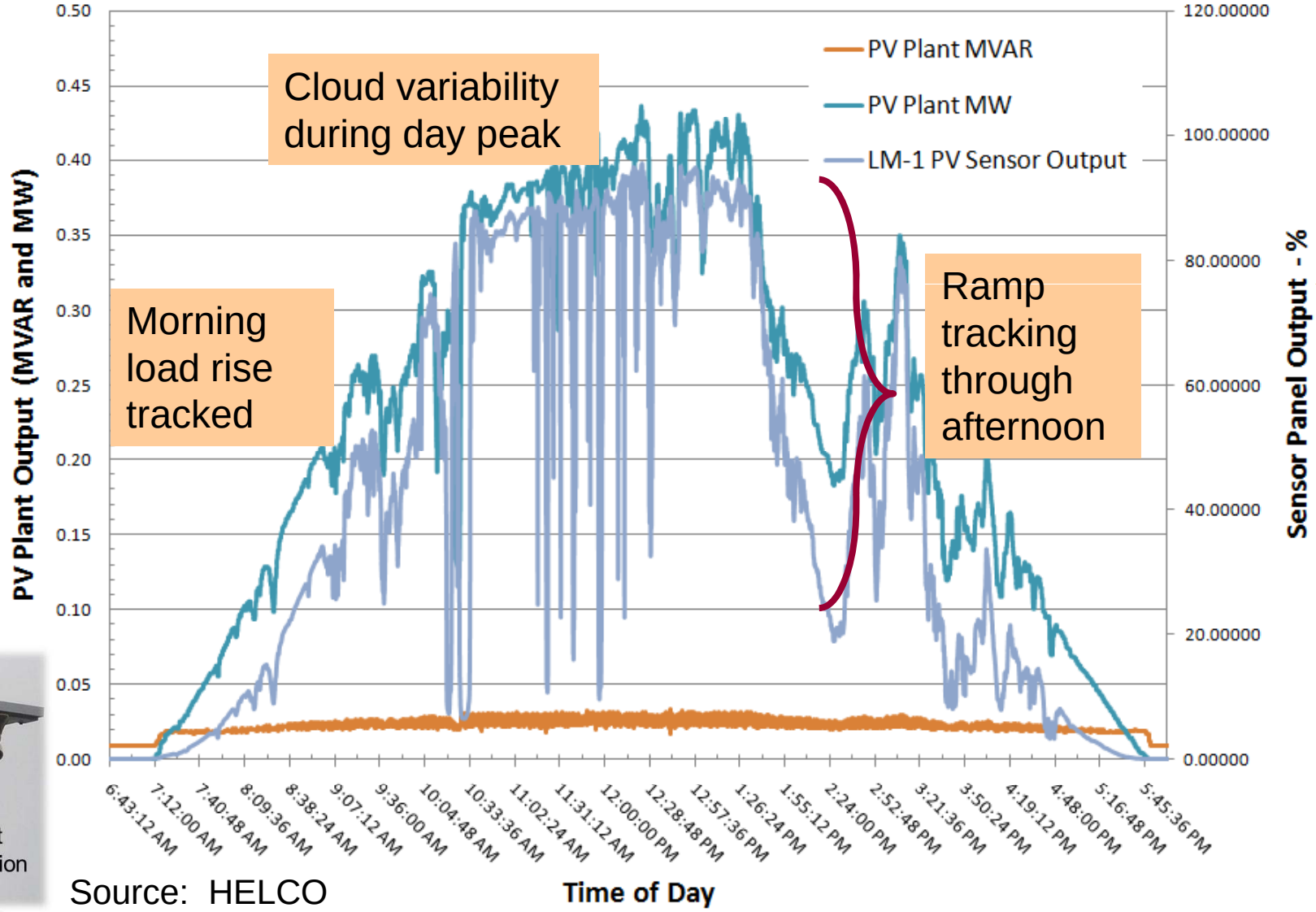


Sources: HECO and Rising Sun Solar

Recent article in Hawaii local news on Sun Screening by Alan Yonan of Star Advertiser 7/24/2011 captured current levels of penetration and ongoing needs to manage increasing penetration levels.

Enhancements: address search & nightly updates

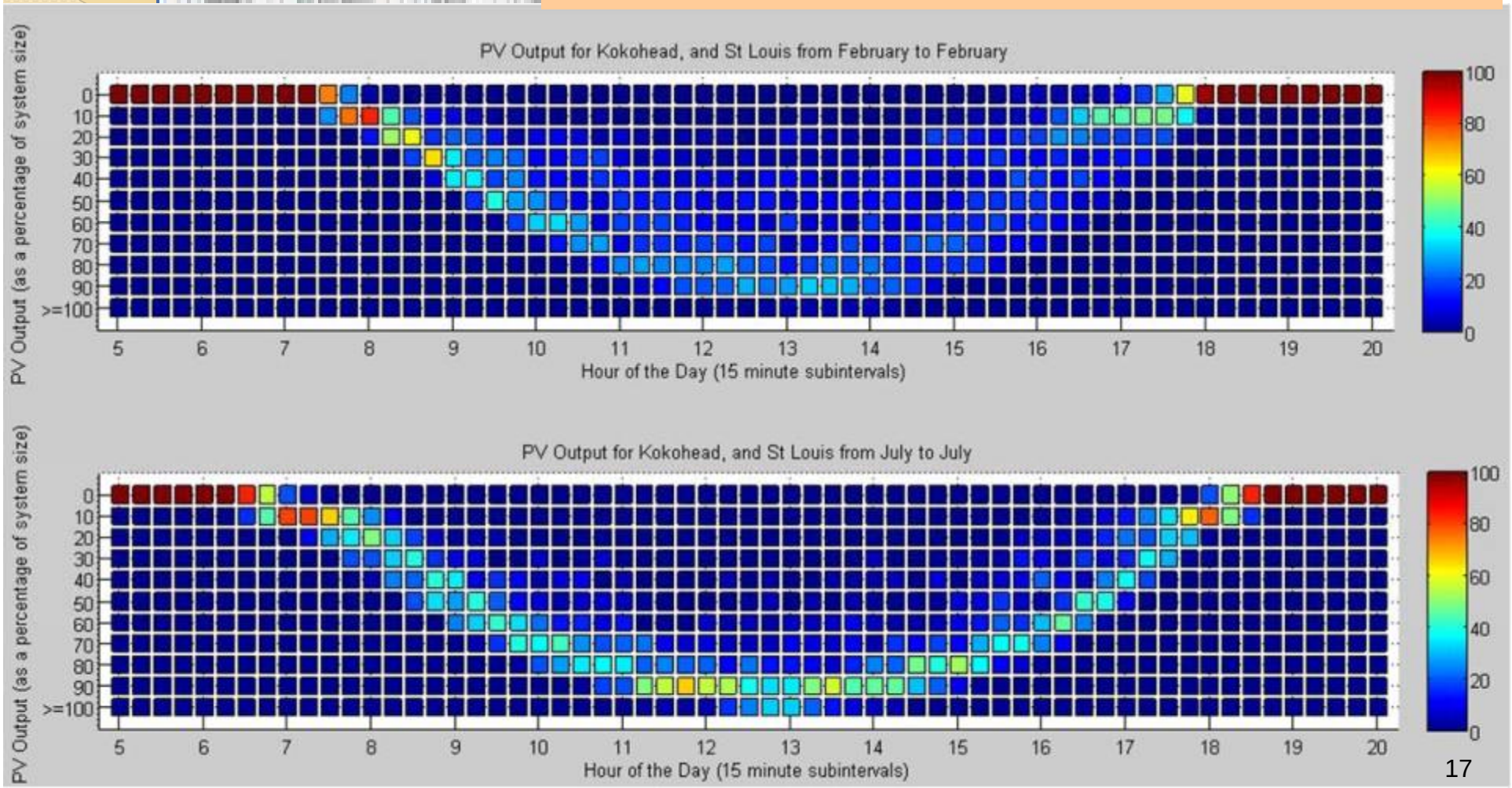
Field Validation Data



Source: HELCO

Visibility to DG
(Data to Output Probability)

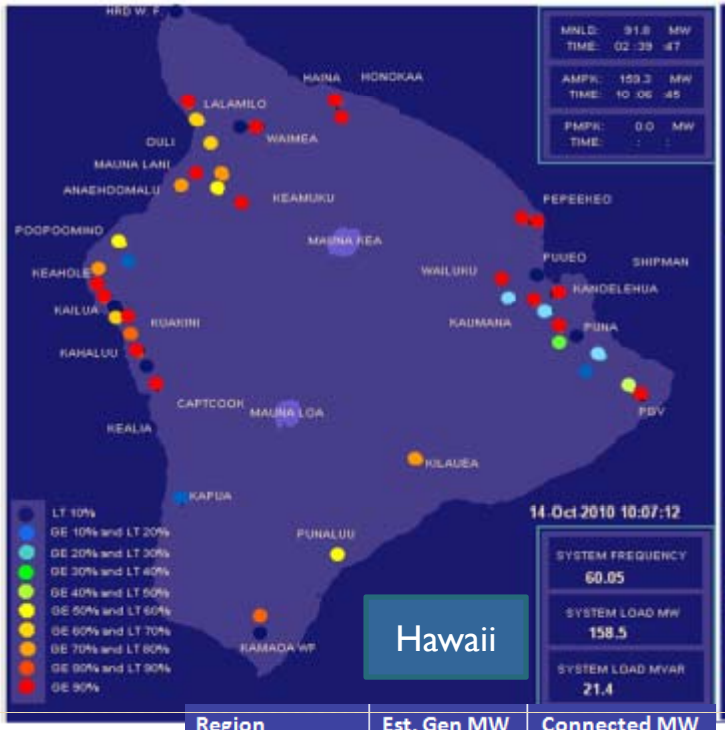
Capturing statistical variation of PV with respect to time and by geographic location.



Piloting Control Room Situational Awareness Tools to "See" Variability

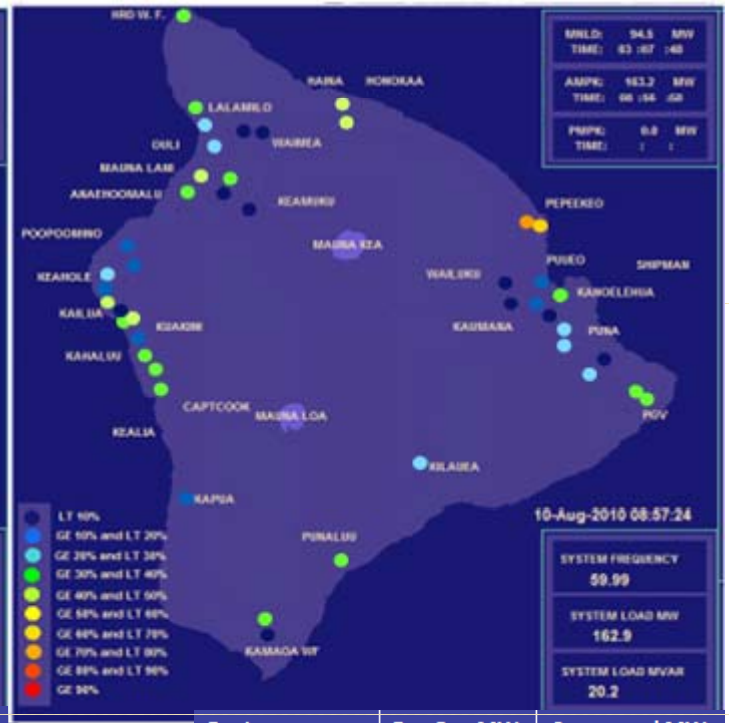
LM-1 solar availability sensors

Monitoring solar availability and variability at 2 sec SCADA rate. Potential to improve UFLS



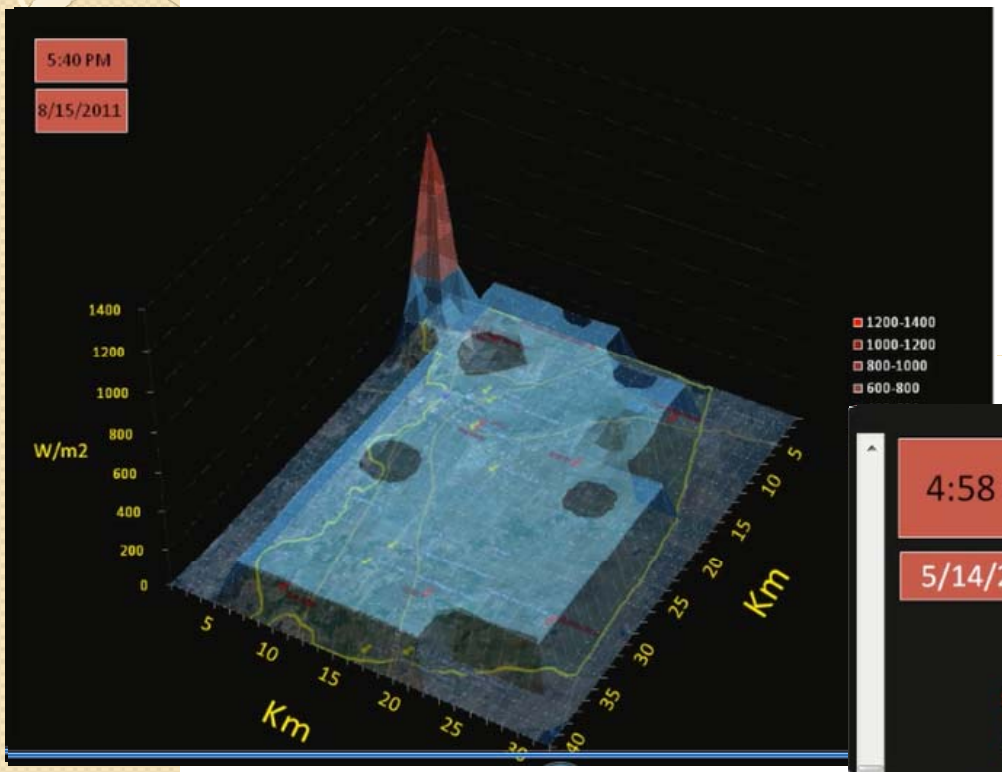
Hawaii

Region	Est. Gen MW	Connected MW
North Hawaii	1.3	1.7
East Hawaii	2.9	4.1
West Hawaii	2.6	3.7
South Hawaii	0.0	0.1
Total PV (MW)	**6.8**	9.6



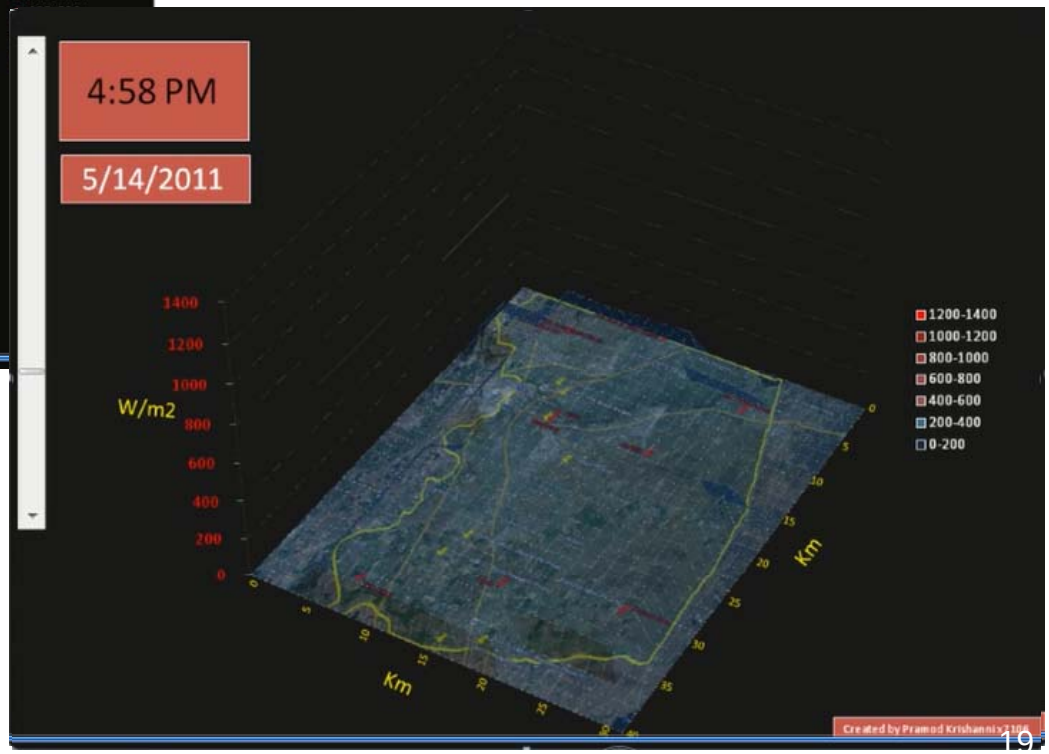
Region	Est. Gen MW	Connected MW
North Hawaii	0.5	1.7
East Hawaii	0.8	4.1
West Hawaii	1.3	3.7
South Hawaii	0.0	0.1
Total PV (MW)	**2.6**	9.6

Visualizing Solar Variability Across SMUD



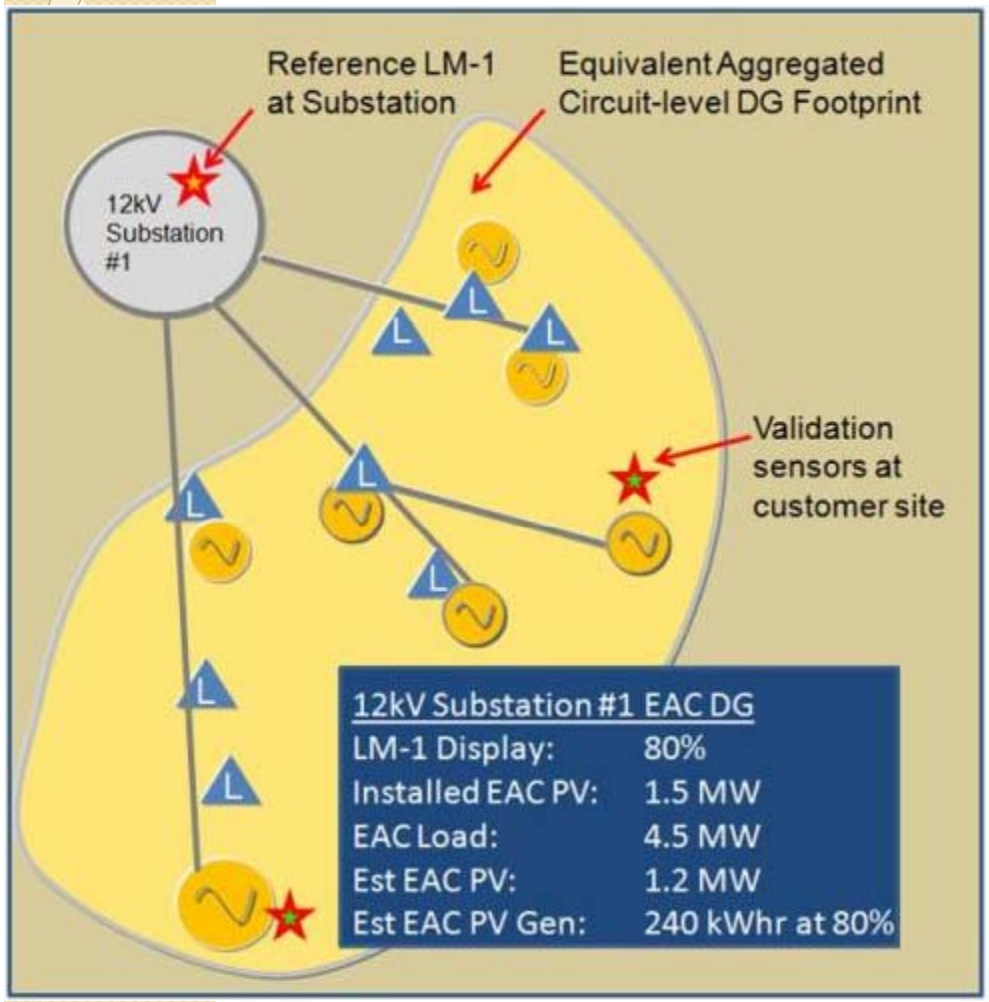
Clear Day

Cloudy Day



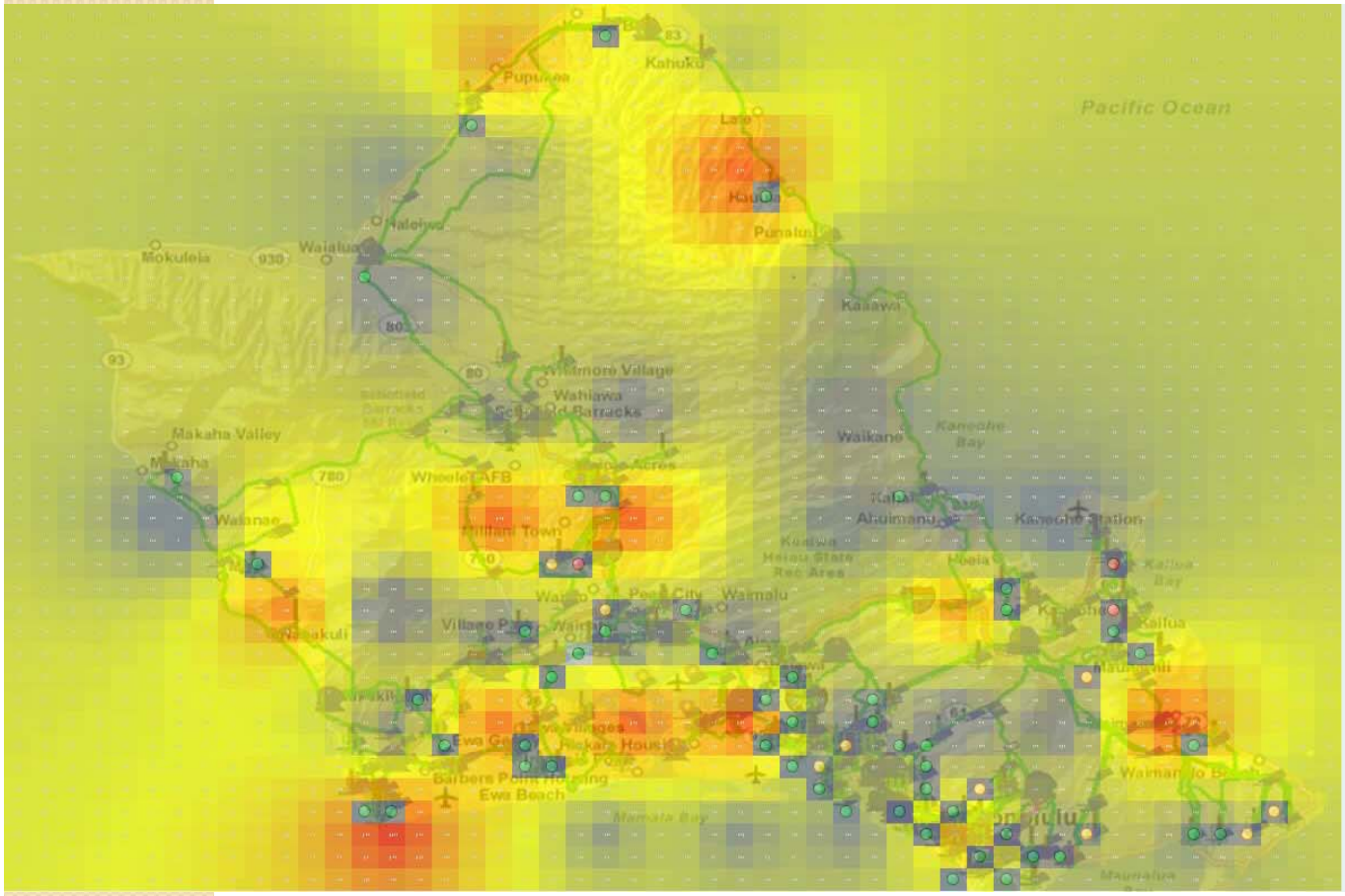
NEO Virtus Engineering, Inc

Nodal Estimation Approach to Expedite PV Integration Studies



- Characterize discrete and aggregated circuit load profiles at 12 kV substation (residential, industrial, commercial)
- Expedite circuit evaluations and aggregate DG impacts for planning
- Use reference LM-1 sensors to estimate solar resource output at location
- Extend solar forecasting to account for aggregated impact of behind-the-meter generation

Coupling DG Modeling & Real-time Data to Inform Variability Management for System



Start Animation

Time
12:31:30 PM

Press
Ctrl + Break
to Cancel Animation

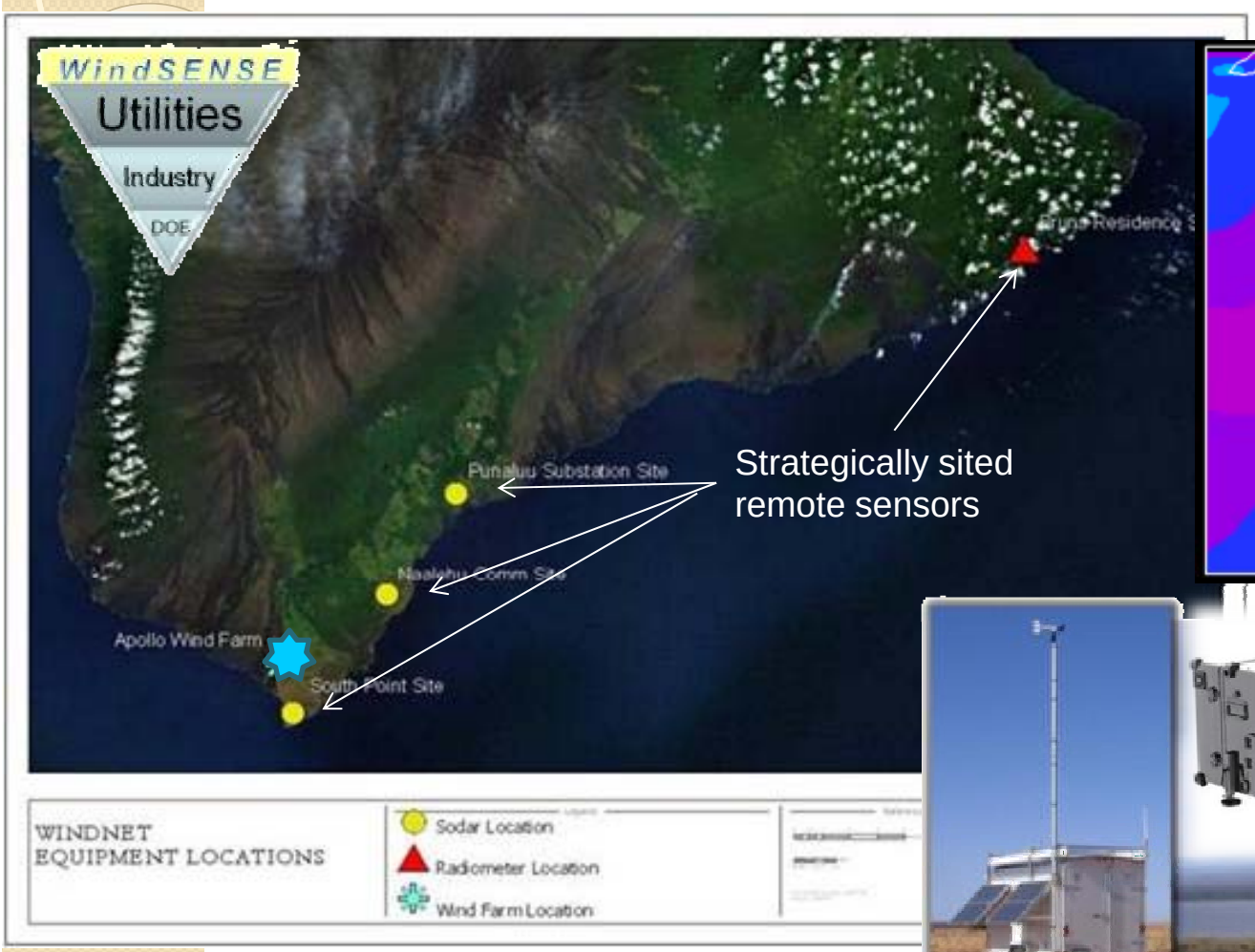
	Select		Actual Values	
Actual Load / Peak-Load	60%	%		
LOAD	586	MW growth	463	MW net
PV power / Peak-Load	30%	%	21%	%
PV power	Peak Power 300		Actual Power 123	MW

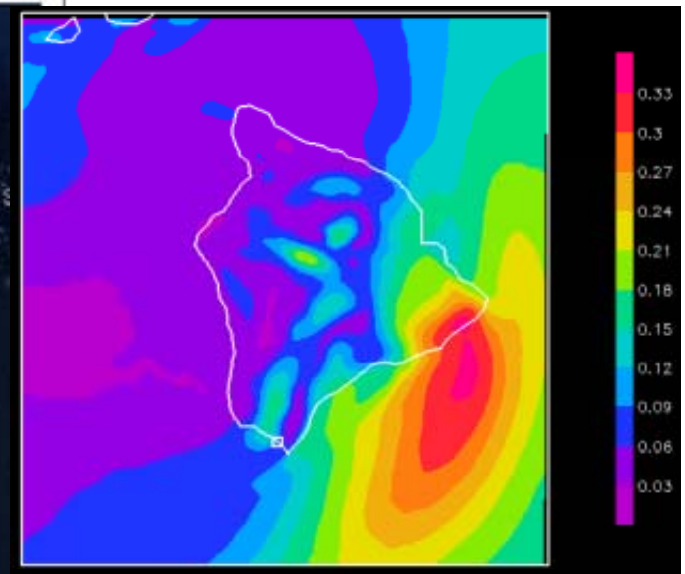
Color-coded impacts at distribution substations

- Represents Backfed Current Through Substation
- Represents > 50% of Demand at Substation is Served by PV
- Represents 0 - 50% of Demand at Substation is Served by PV

Simulated results at 30% PV penetration across the islands and impacted areas

Jump Starting Solar Forecasting – Priorities Based on Lessons Learned from Wind





Using <u>state-of-the-art tools</u> (SODAR, LIDAR) Provide operators a <u>30 min to 1 hr "look-ahead"</u> forecasts and ramp alerts. NWP forecast for <u>next 6 hours, 24 and 48 hours</u>

Industry Partners: US DOE ARRA funding; AWS TruePower, Atmospheric Research Technologies

Situational Awareness & Decision Support for Operations

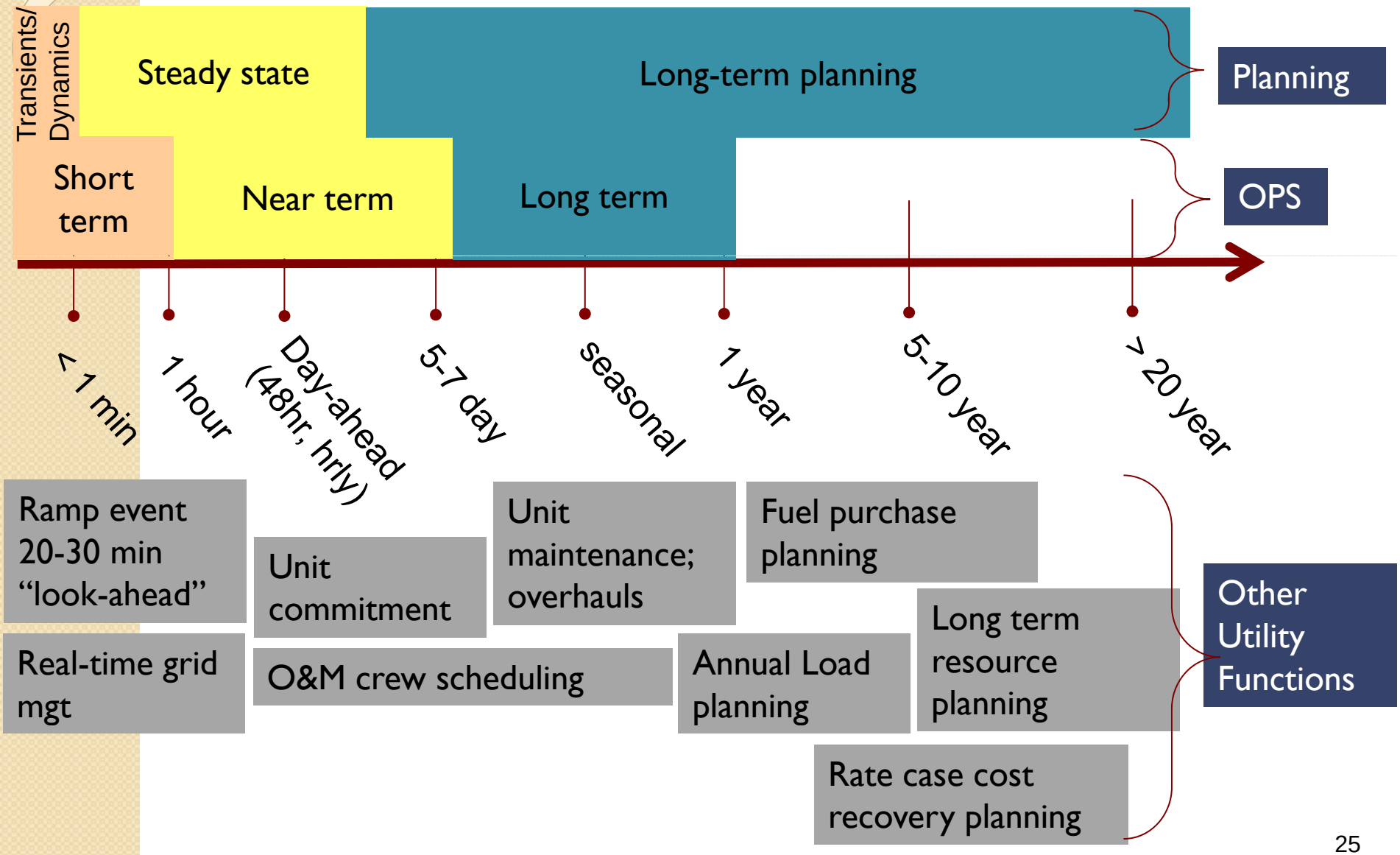
- Improve operational awareness of ramp (0-2hr) conditions and impacts
- Animated images of global horizontal irradiance
  - Visual to measured data
  - NWP forecast for next 6 hours
- Animated visible satellite image
  - Actual satellite image for last 6 hours
  - Simulated forecast of visible image for next 6 hours

Forecasting Industry Partners: EPRI, AWS TruePower, US DOE WFIP, SCE, SMUD, CaISO, UH Manoa, UCSD

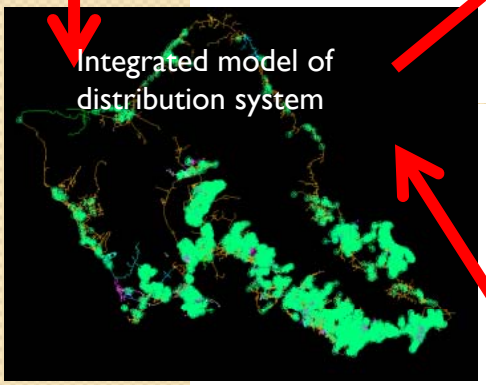
Next Steps - Integration of Data & Visuals into Operational Tools

- Meetings with T&D Planners & Operators to define new process and procedures to account for new data
- Alstom and Siemens developing new DMAS capability to account for DG solar & information into EMS-based tools

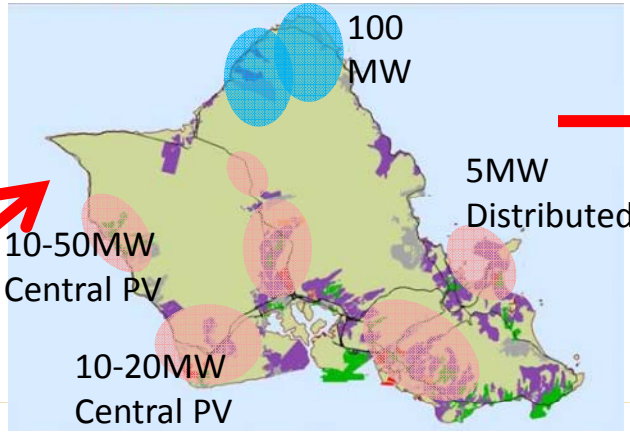
Benefits: Multi-use of Visuals & Resource Data



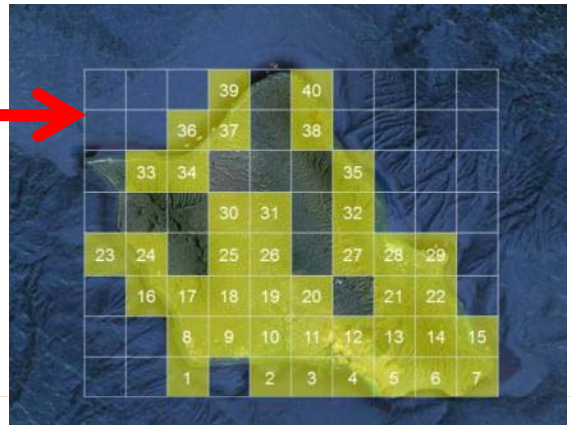
Benefits: Enable Ability to Evaluate Impacts from DG to System back to DG Level



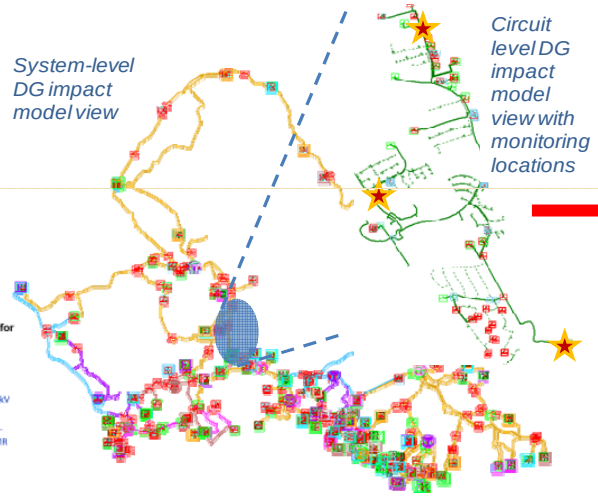
Develop complete distribution model with DG generation

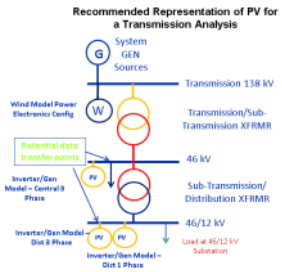


Identify DG and Central PV Scenarios for HSIS Study

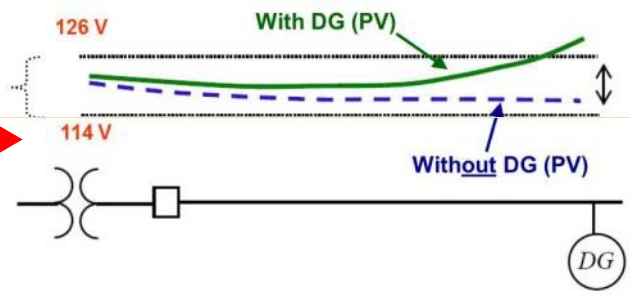


Aggregate individual DG generators for transmission modeling





Model & field verification



Inform & expedite feeder level studies (nodal & clusters)

Q&A

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Hawaiian Electric Company

Thank You

Mahalo