LM-1 solar availability sensors

Developing an Operational Eye on Solar

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TJD-1 mobile solar irradiance sensors

Motivation

Seeing is believing! Innovative utility actions are cost-effectively, smarting the system to "see" behind-the-meter solar resources

A fundamental shift toward more customer sited, distributed generation (DG) is occurring with the emergence of more PV and consumer self-generation programs. Today, the Hawaiian utilities are contending with PV penetrations in excess of 20% during maximum load conditions on certain distribution circuits (Figure 1a) and over 60% penetration during light load conditions. SMUD's Anatolia circuit hosts a national SolarSmart Homes R&D site with plans to connect 600 homes all equipped with 2 kW PV systems. At these penetration levels, there is growing concern that the protection and design points of traditional distribution systems are beginning to or are being compromised. While tremendous investments exist on the transmission side for enhanced control, visibility and communication, the distribution system has received considerably less attention, tends to be more disperse, non-standardize, less automated, and may pose the weakest link to reliability. Given the limited communication, control and visibility at distribution sites, utilities are essentially "blind" to the variability impacts of increasing levels of behind-the-meter resources. (Figure 1b)

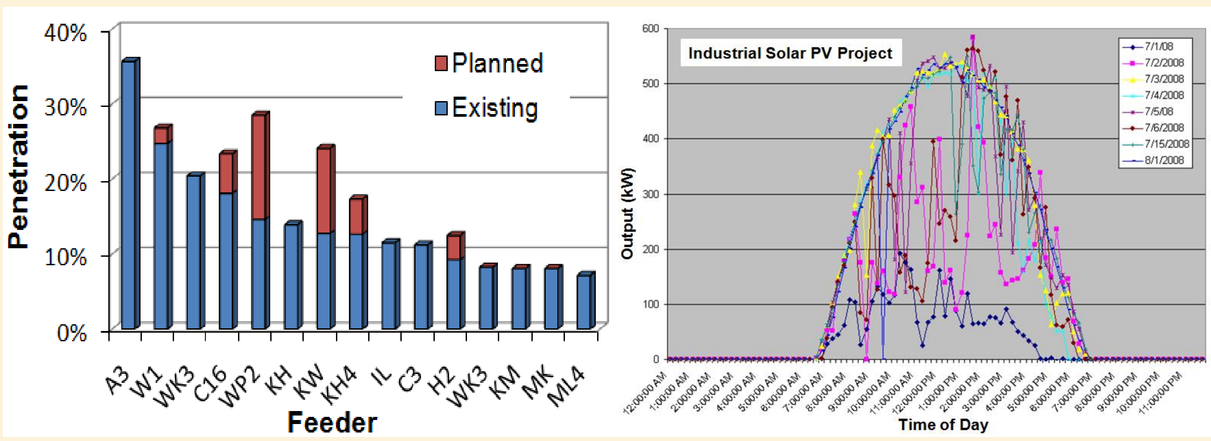


Figure 1. a) Tracking increasing PV penetration on circuits and b) variability of PV resources at utility substations using irradiance monitors (TJD-1).

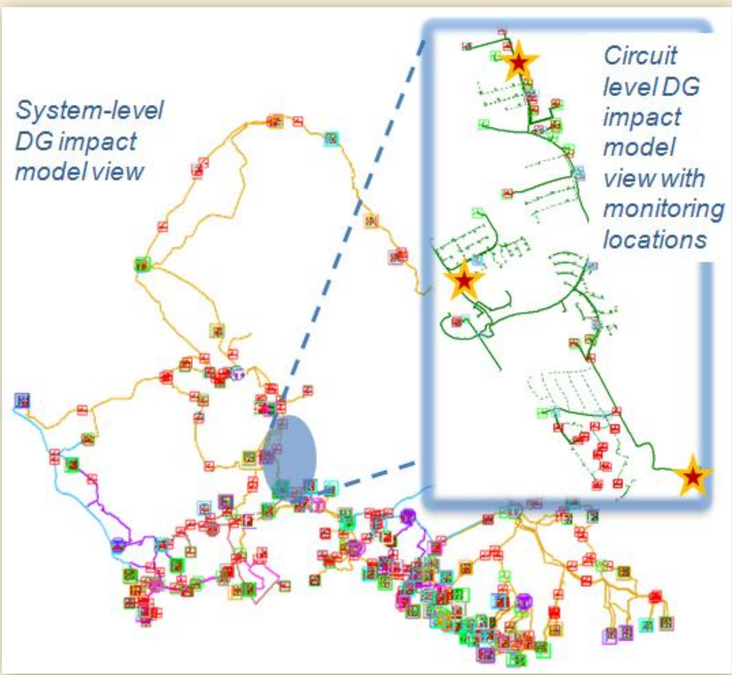


Figure 2. Enhancing utility models to capture impact of DG resources at both the distribution and system levels. Allow for accounting of DG impacts for system planning and operations. (Source: HECO Synergee output)

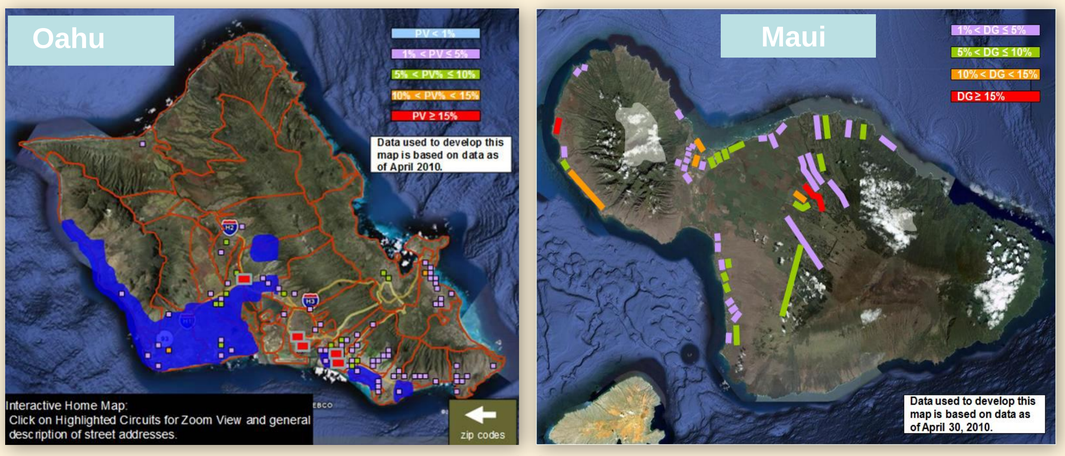
Approach

Hawaiian Electric Companies (HECO/MECO/HELCO) are partnering with the Sacramento Municipal Utility District in California to work with industry partners (i.e. equipment manufacturers, grid code developers, forecasters) in developing robust and cost-effective visualization, forecasting and modeling capabilities (Figure 2) to reliably account for growing levels of PV on the system and prepare for emerging levels of future DG, such as plug-in-hybrid electric vehicles (PHEV).

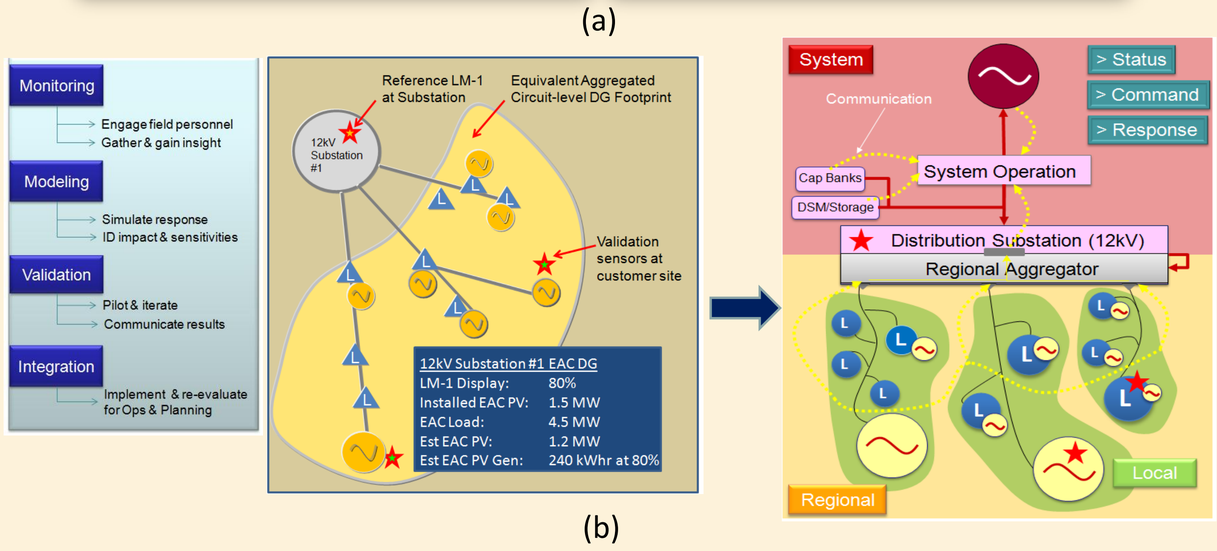
Results

To help track, trend and monitor significant levels of distributed PV systems on their systems, Hawaiian Electric Companies are developing new visualization capability to enhance operations and planning capabilities. Cost-effective and innovative approaches include

1) Development of the Locational Value Maps (LVM) to track DG growth and help inform customers of high penetration locations (Figure 3a). LVMs also aid in planning and validation of aggregation models (Figure 3b).
2) Use of LM-1 monitors to estimate in real-time aggregated PV production on the system to enhance operators' ability to account for and visually see where PV resources are generating (Figure 4). LM-1 provides a low-cost situational awareness of the resource to help manage the rest of the grid.



(a)



(b)

Figure 3. a) Preliminary LVM showing high penetration circuits and b) conceptual modeling and validation effort to develop an equivalent aggregated circuit DG estimation (EAC) process for operations and controls.

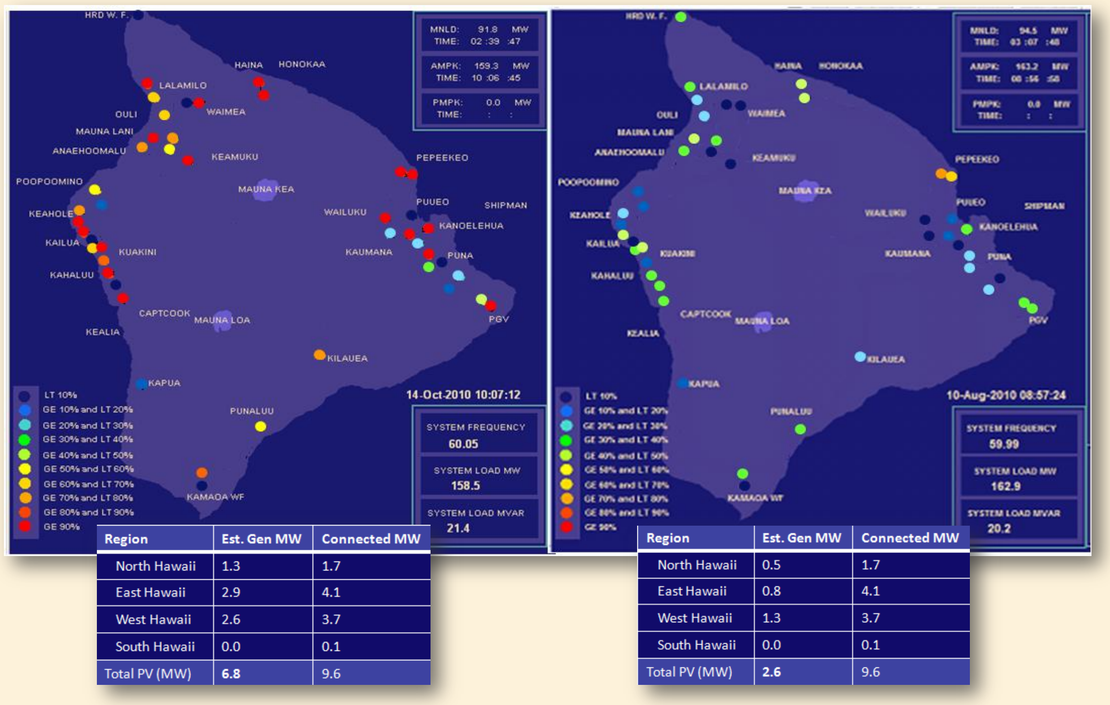


Figure 4. Real-time aggregated PV availability screen being piloted in HELCO Ops.

Goals

- Operationalize low-cost, low-maintenance data analysis and visualization capability to track increasing penetrations of "as-available" DG such as PV
- Integrate timely DG modeling with resource estimation (field data) and forecasting capability for expediting planning and enhancing operational awareness
- Strategically target deployment of new "smarter" automation technology at regional and local levels to help manage variability and grid resources

Benefits

- Increasing public awareness of system critical periods and accounting for aggregated impacts of DG and other variable resources on system reliability
- Improving modeling and assessment tools to incorporate distributed resources and system information for designing new protection and control schemes
- Informing strategic deployment of regional/local automation and controls to reliably integrate DG resources

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Hi-Penetration PV Initiative