



Managing Large Microinverter Fleets

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Dir, Codes and Standards

[e] enphase[®]
ENERGY

Introduction

- **Enphase Energy System**
 - Microinverters
 - Scalability
 - Envoy Communication Gateway
 - Enlighten System Monitoring
- **Script Driven Updates**
- **Updating Systems on Oahu**
- **What can you do with data?**

Reliability, AGF, and Managing Large Fleets

- **re•li•a•ble**
 - Capable of being relied on; dependable
- **As penetration levels increase, utilities will have to rely upon Advanced Grid Functions to help stabilize the grid**
- **Inverter performance needs to change as functions are added**
- **Reliably managing large inverter fleets is necessary**
 - What does that look like?

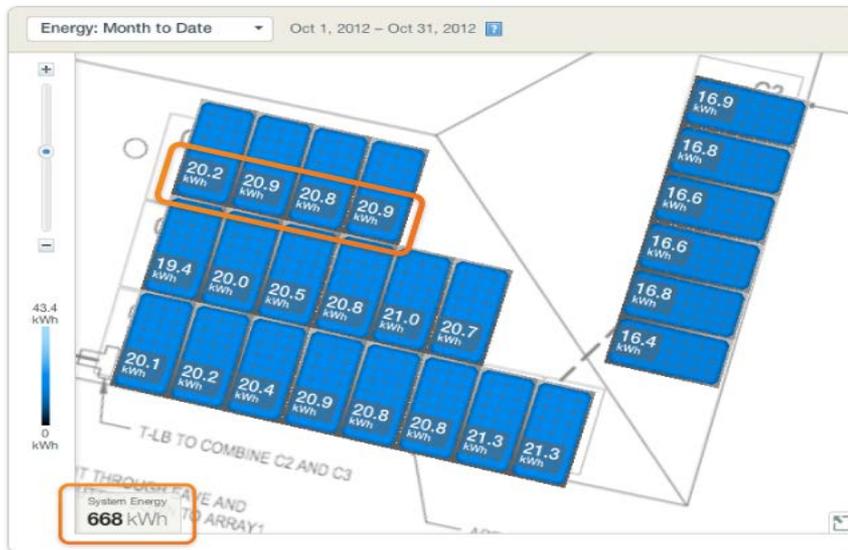
Enphase Energy System

Microinverter Basics

- One microinverter for each PV module
- Software driven architecture
- Powerful communication capability
- Easy to install with Engage Cable



Microinverter Basics



- Enlighten Remote Monitoring System
- Per module visibility
- Full telemetry: AC and DC volts, frequency, power, and temperature
- Scalable from a single unit to multi-megawatt power plants

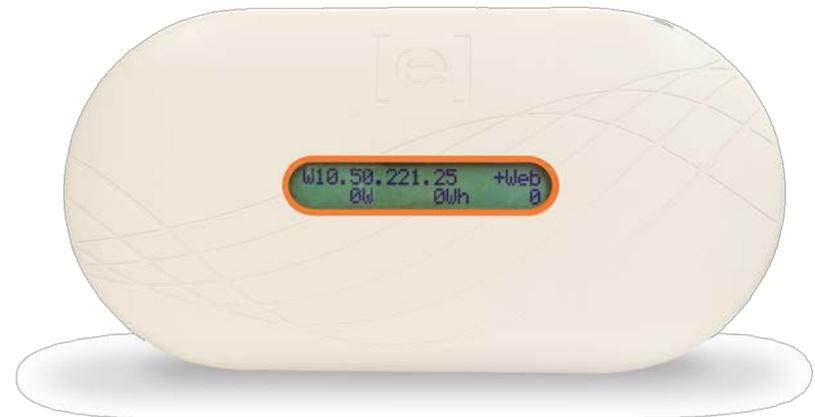


Microinverter Basics

- Engage Cable System



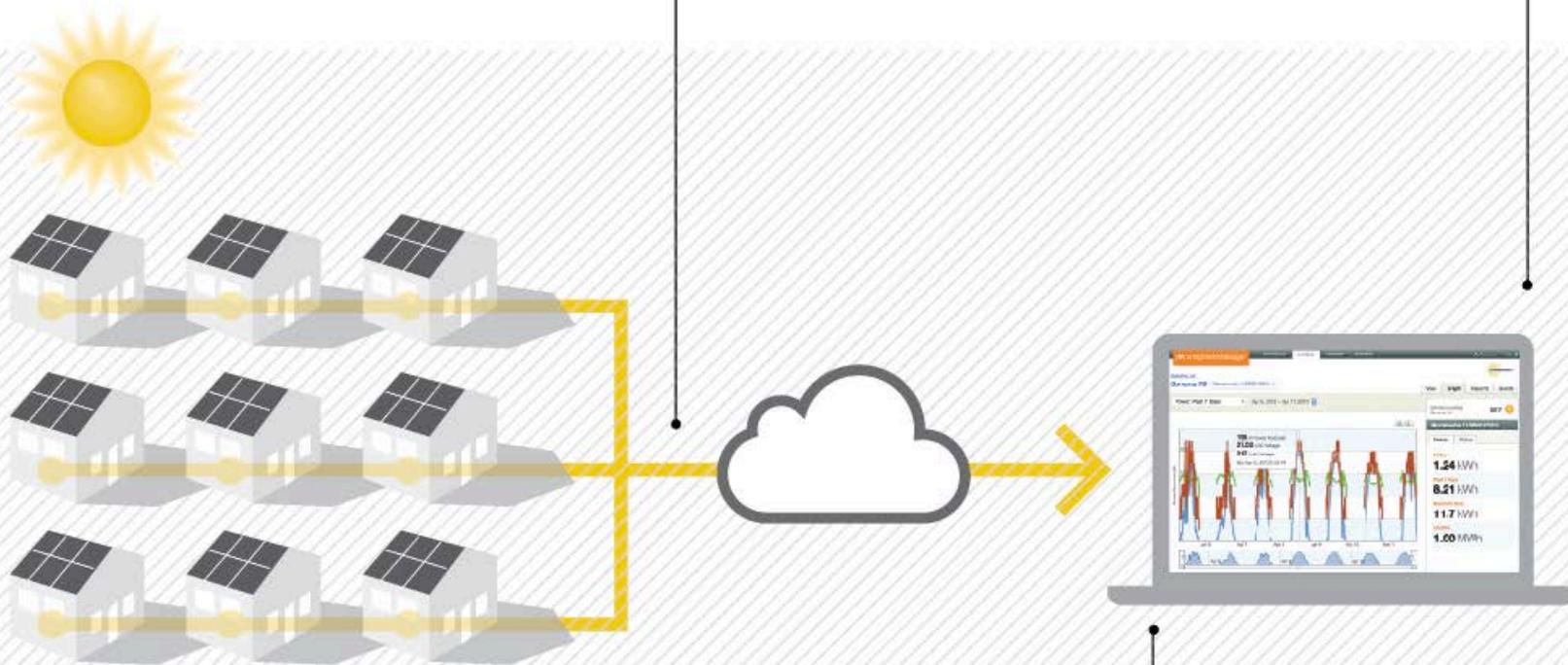
- Envoy Communication Gateway



Cloud Management of Multiple Systems

All Envoys report data to Enlighten via the internet.

Access performance info anywhere, anytime with one easy-to-use interface.

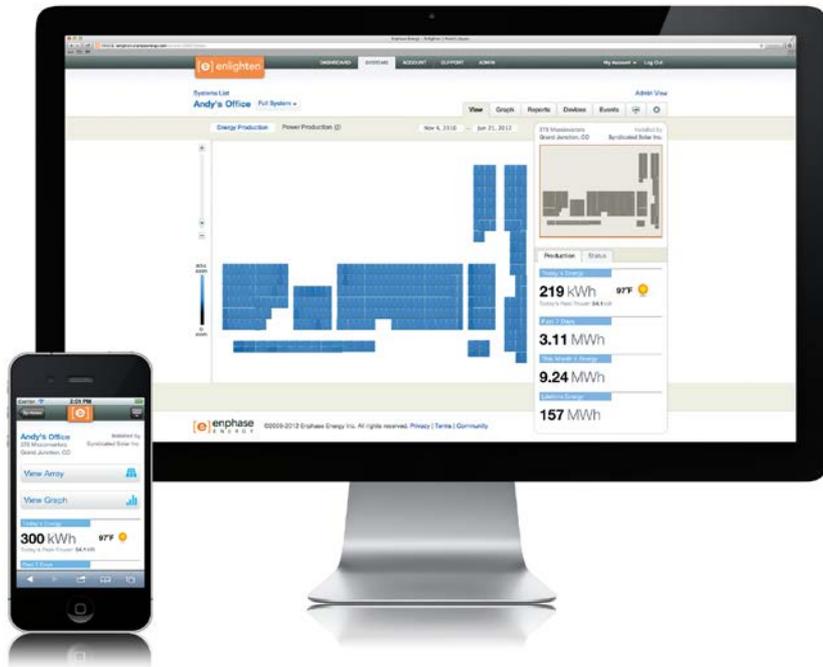


API access to integrate with third party systems.

The Right Version for the Right User

Enlighten Manager

Panel uptime & troubleshooting
for the **solar professional**



MyEnlighten

Energy performance and
education for the **system owner**

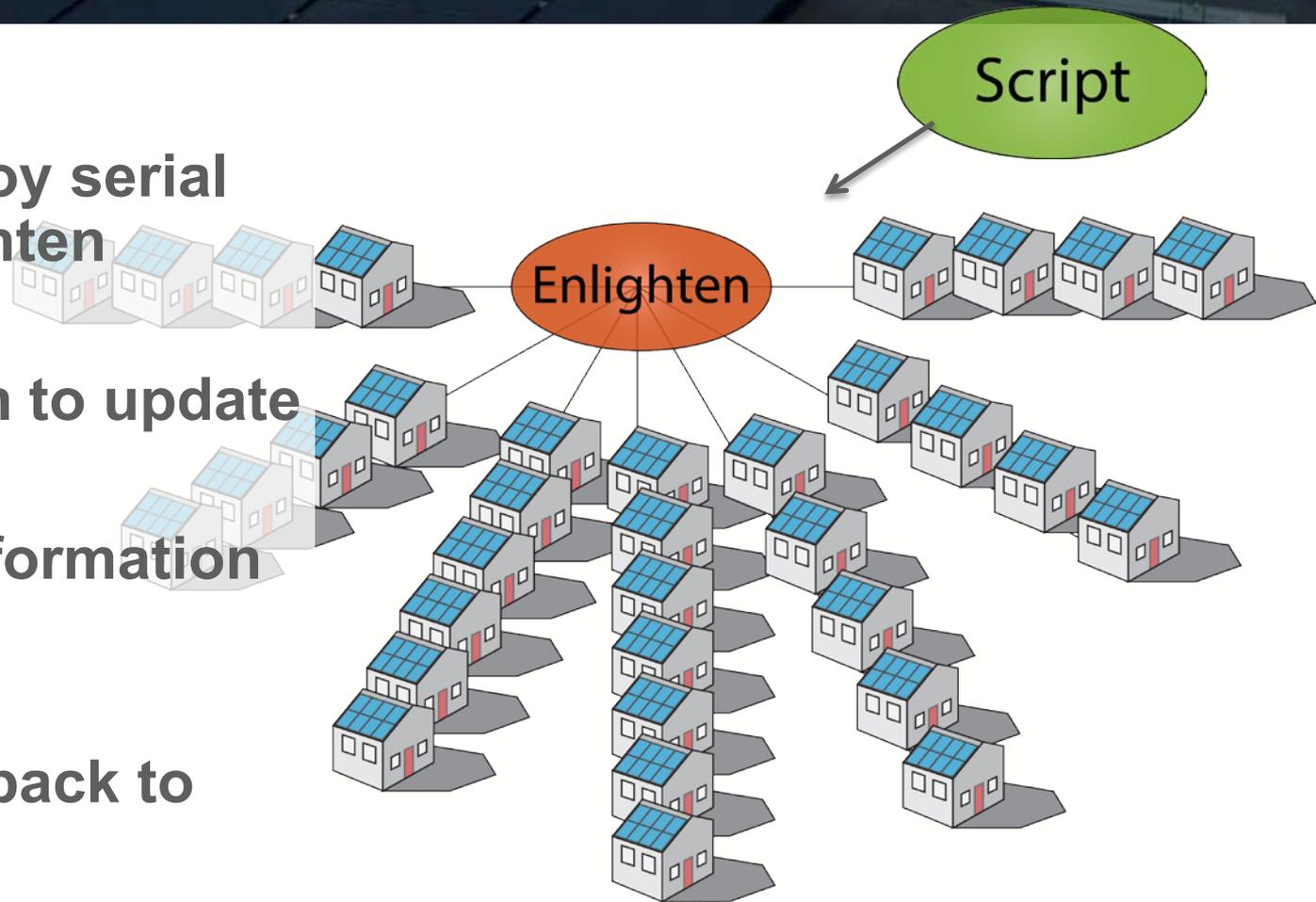


Let's Look Under the Hood



Script Driven Updates

- Identify Sites
- Determine Envoy serial numbers Enlighten updates Envoy
- Script is written to update sites
- Envoy takes information and updates microinverters
- Envoy reports back to Enlighten
- Upgrades are automatic



Hawaii Islands – Oahu, Maui, Hawaii, Lanai, Molokai

800,000 Microinverters Remotely Retrofitted on Oahu—in One Day

By Peter Fairley

Posted 5 Feb 2015 | 16:00 GMT

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Photo: iStockphoto

- 872,000 Microinverters
- > 200 MW
- 34,000 Sites
- Within the first few hours 75% updated
- Sites are continuously updated as they check in

Accessing the Enlighten Systems API

Systems Endpoints	What is it good for?
Index	A list of systems
Summary	Energy summary for a system (day, week, month, lifetime, status)
Energy_lifetime	Daily energy totals for the lifetime of the system
Monthly_production	Total energy produced on a system in a given month
Stats	5-minute production of microinverters
Rgm_stats	15-minutes production of meters
Inventory	Listing of serial numbers on a system (NO production data)
Envoys	A list of envoys on a given system

- **Energy(J)**
- **AC Volt (V)**
- **AC Freq (Hz)**
- **DC Volt (V)**
- **DC Current (A)**
- **Temp (C)**
- **Power (W)**
- **Energy (Wh)**
- **Events – ACVOOR, ACFOOR, AI, etc**

Oahu ACVOOR Events



What is Next?

- **Enphase has strong infrastructure to support big data. This needs to grow as conditions change**
- **Enphase is developing tools for use by utilities to visualize the massive amounts of data collected**
- **We are working with utilities to define visualization types and user interface**
- **Enphase is in its infancy. We plan to learn and grow**

Thank You

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