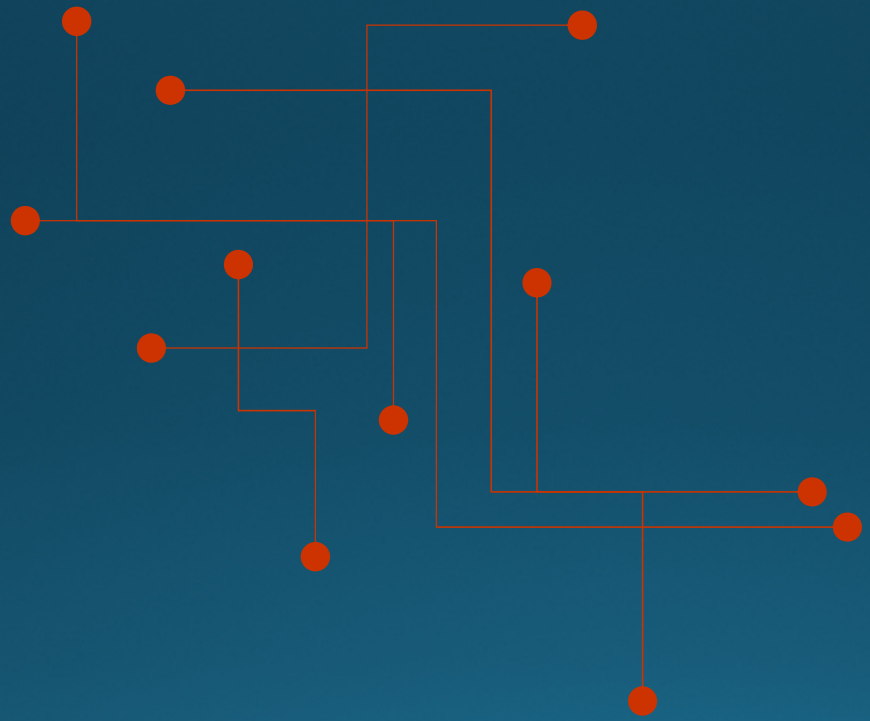
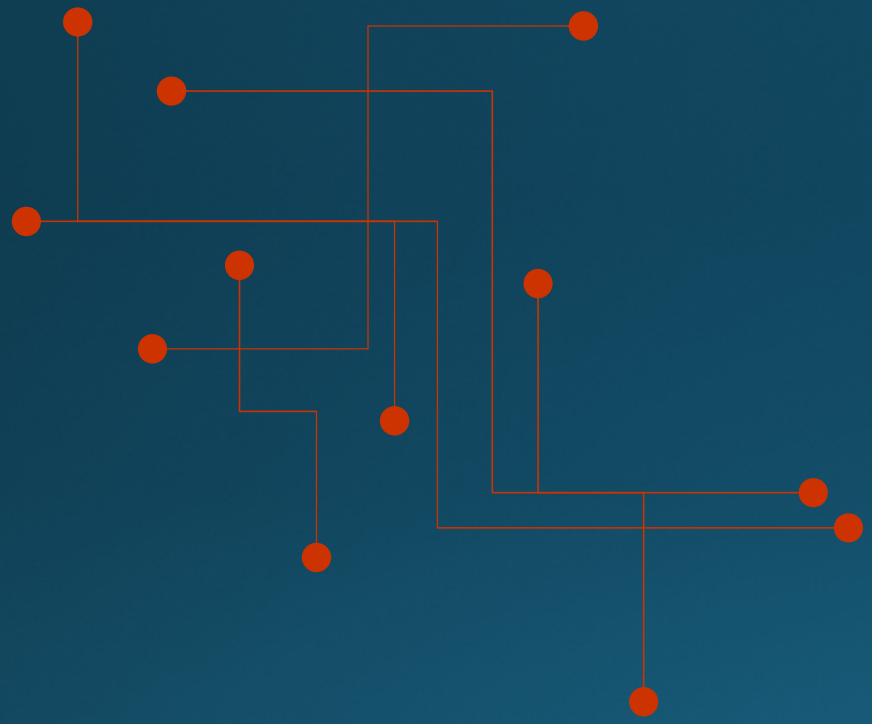
May 10, 2017

Hawaiian Electric Modern Grid Technology & Leading Practices Workshop

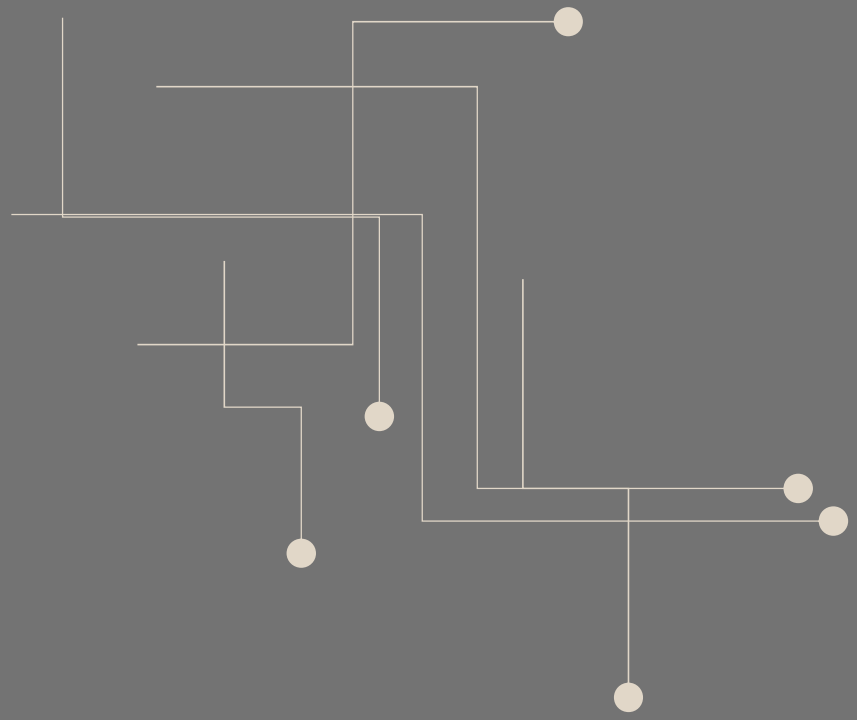
Utility's greatest asset is the grid



Grid's value is driven by market participation



More Valuable



Less Valuable

DER's: the great underutilized hero of the grid

FIGURE 1: DER CAPABILITIES MATRIX

TECHNOLOGIES	ENERGY	GENERATING CAPACITY	DISTRIBUTION CAPACITY	VOLTAGE REGULATION	FREQUENCY REGULATION	LOAD FOLLOWING	BALANCING	SPINNING RESERVES	NON-SPINNING RESERVES
DISTRIBUTED SOLAR	Energy Generator	◑	◑	●	●	●	●	No	No
DISTRIBUTED SOLAR + ADVANCED INVERTER FUNCTIONALITY	Energy Generator	◑	◑	⊙	⊙	◑	●	No	No
BATTERY STORAGE	Energy Storage	⊙	⊙	⊙	⊙	⊙	⊙	Yes	Yes

Source: Smart Electric Power Alliance, 2016

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DISTRIBUTED SOLAR + ADVANCED INVERTER FUNCTIONALITY	Energy Generator							
BATTERY STORAGE	Energy Storage							

Traditional Solar Tariff Models

Net Energy Metering
(and some recent successors)

Leave these capabilities untapped and uniformly incentivize DERs to be interconnected regardless of impact on grid

Customer self supply

DER's: the great underutilized hero of the grid

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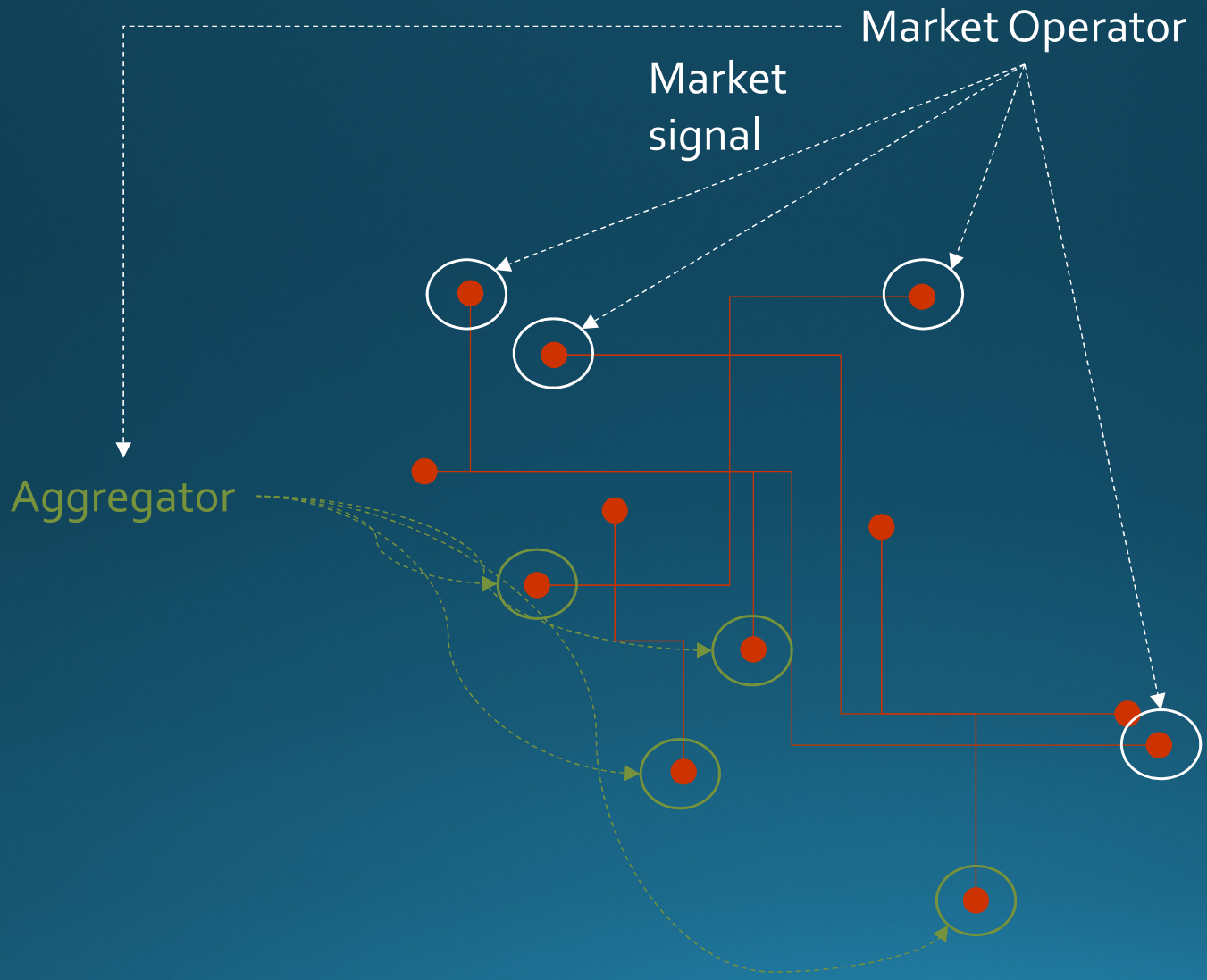
DISTRIBUTED SOLAR + ADVANCED INVERTER FUNCTIONALITY	Energy Generator	◑	◑	●	●	◑	○	No	No
BATTERY STORAGE	Energy Storage	●	●	●	●	●	●	Yes	Yes

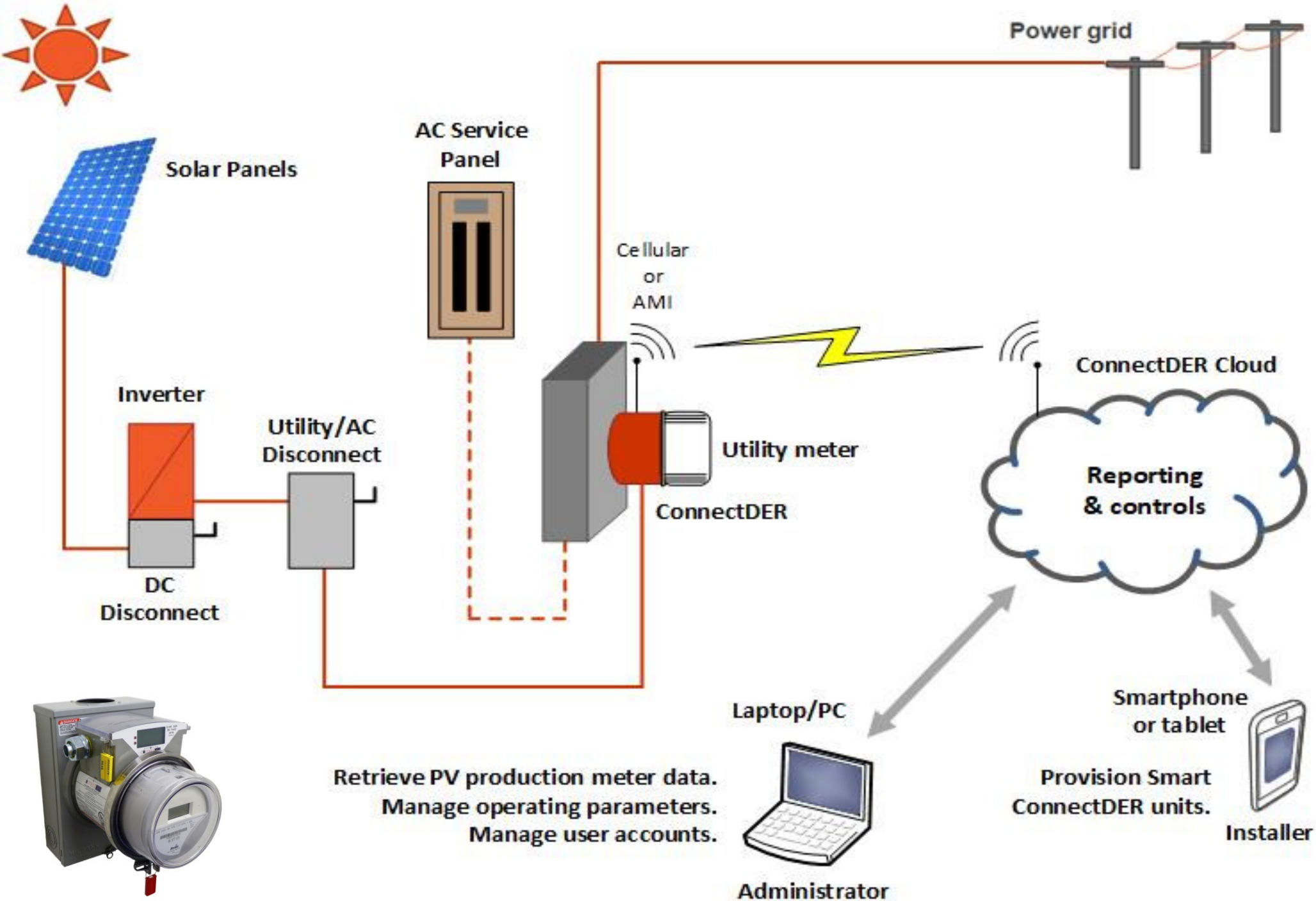
Sweet spot

Source: Smart Electric Power Alliance, 2016

Enabling DERs to be market participants



ConnectDER solution in Hawaii



Today vs. tomorrow

Migration to plug and play network with automated provisioning of assets to market operations

Capability	Today	Tomorrow
DER power interface	Terminal block (80a)	Plug and socket (80a)
DER data interface	Modbus over TCP/IP (port)	Modbus over powerline
Metering	DER only (ANSI C12.20)	DER + premises
DER control provisioning	Manual	Automatic
WAN Communications	Cellular 4G	AMI or cellular
DER control	Relay	Operating modes/setpoints
Whole premises islanding	None	Relay operating with DER

Missing links

How do you talk to assets? Secure communications network

- High-speed to every endpoint not needed?
- Day ahead scheduling may deliver large % of real-time control value

How do you speak the same language? Interoperability standards

- Leverage already emerging models for best result
- SunSpec, Rule 21, UL 1741 (extensible standard)

How do you ensure participation? Robust market model

- Must abstract away complexity for the average participant
- Reasonable proxies in ISO markets, but need to be revised to accommodate range of participants

Principles for a robust DER participation market

Fairness

Transparency

Certainty

Create new markets for services the grid needs

Pay your customers for participating

Use all the capabilities available

(Keep the money in Hawaii)

Get to 100% renewables