



## OpenADR and CTA-2045



**CTA-2045-B Level 2  
CERTIFIED**

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Tristan de Frondeville, Skycentrics  
Walt Johnson, former EPRI (retired)  
Geoff Wickes, NEEA



# Agenda

- Welcome and Introductions

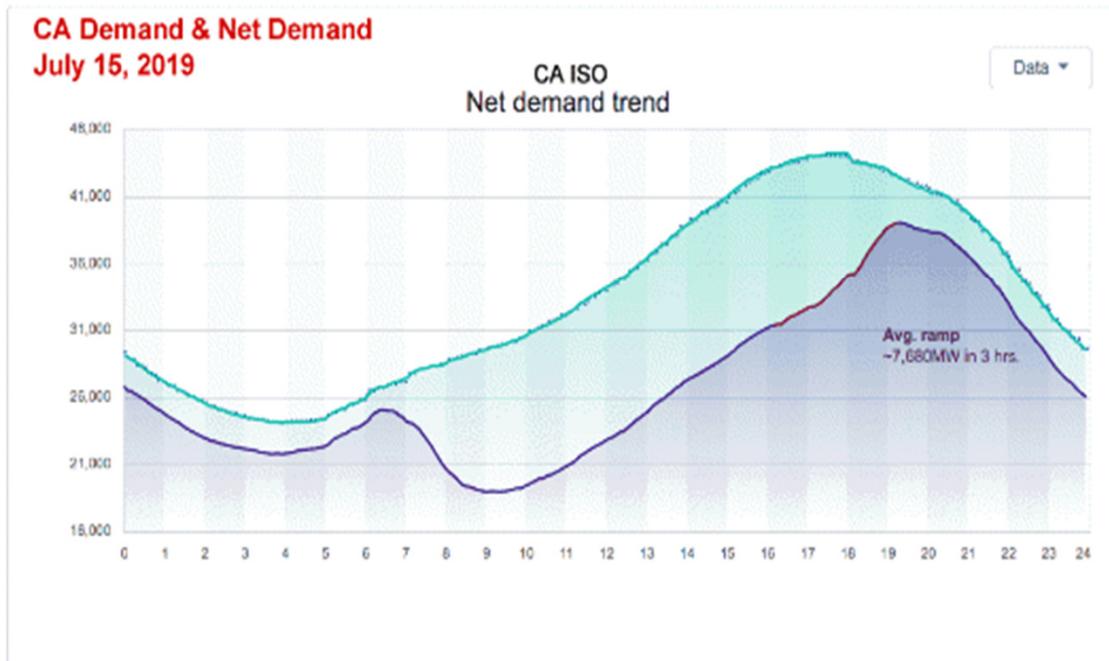
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Geoff Wickes, NEEA

- Brief overview of OpenADR
- Brief overview of CTA-2045
- OpenADR and CTA-2045 Cyber Security
- Use cases with both OpenADR and 2045 in the architecture
- Regulations requiring OpenADR and/or CTA-2045
- CTA-2045 certification program overview and timeline

# Why Controlling Water Heaters?

Net demand (demand minus solar and wind) AS OF 15:20

This graph illustrates how the ISO meets demand while managing the quickly changing ramp rates of variable energy resources, such as solar and wind. Learn how the ISO maintains reliability while maximizing clean energy sources.



01

Value of grid controlled, heat pump water heaters.

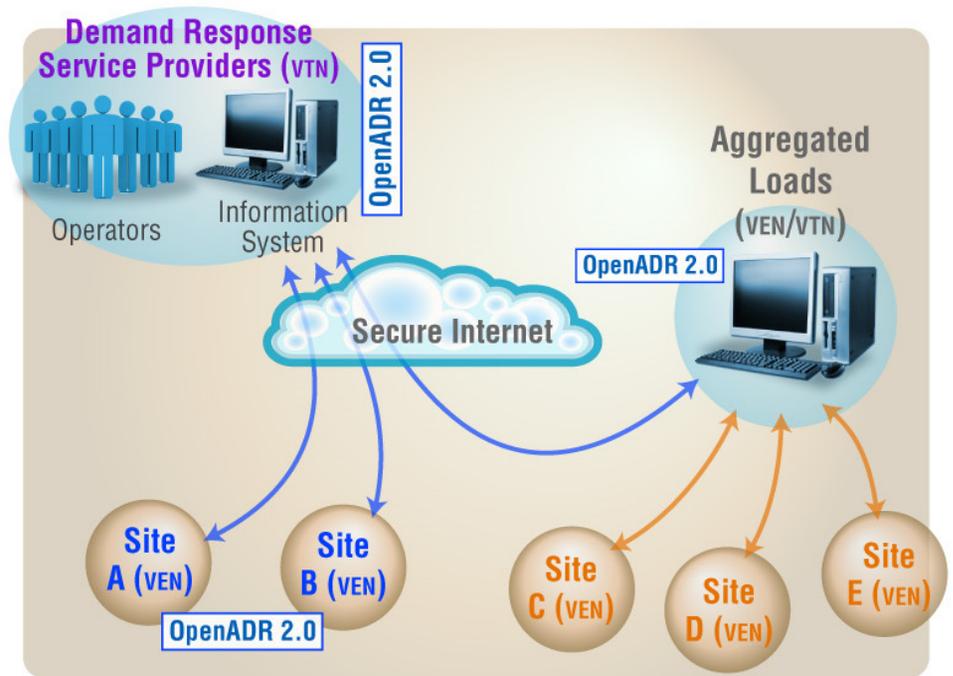
<http://www.caiso.com/TodaysOutlook/Pages/default.aspx>

<https://skycentrics.com/studies/index.html>

# Overview of OpenADR

# OpenADR in a Nutshell

OpenADR provides a non-proprietary, open standardized Demand Response (DR) & Distributed Energy Resources (DER) interface that allows DR service providers to communicate DR, DER, and TE (Transactive Energy) signals directly to existing customers using a common language and existing communications such as the Internet.



# The 'Entities' of OpenADR

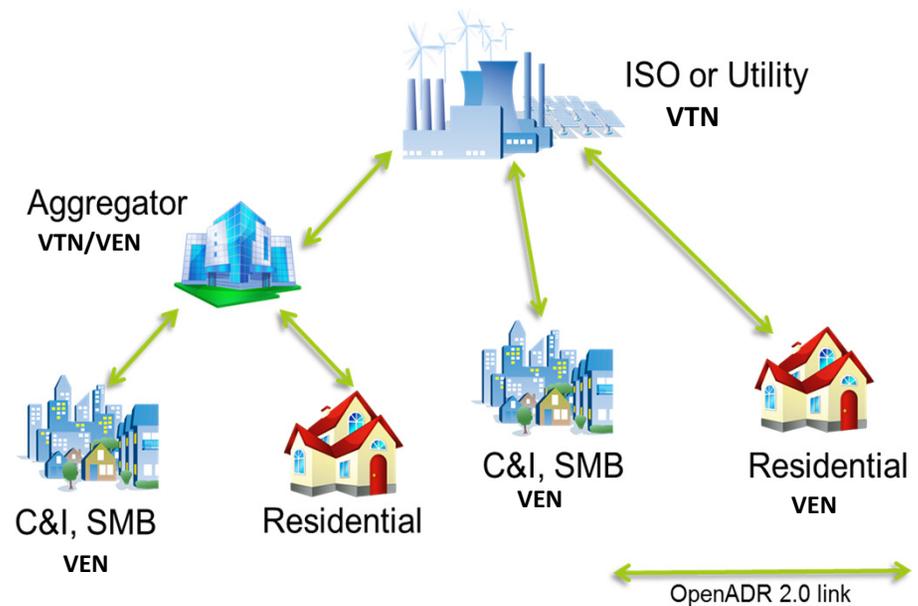
OpenADR is a message exchange protocol with two primary actors aka 'entities'

## Virtual Top Nodes (VTN)

- Manages Resources
- Creates/Transmit events
- Request Reports

## Virtual End Nodes (VEN)

- Receive events and respond to them
- Generate reports
- Control demand side resources

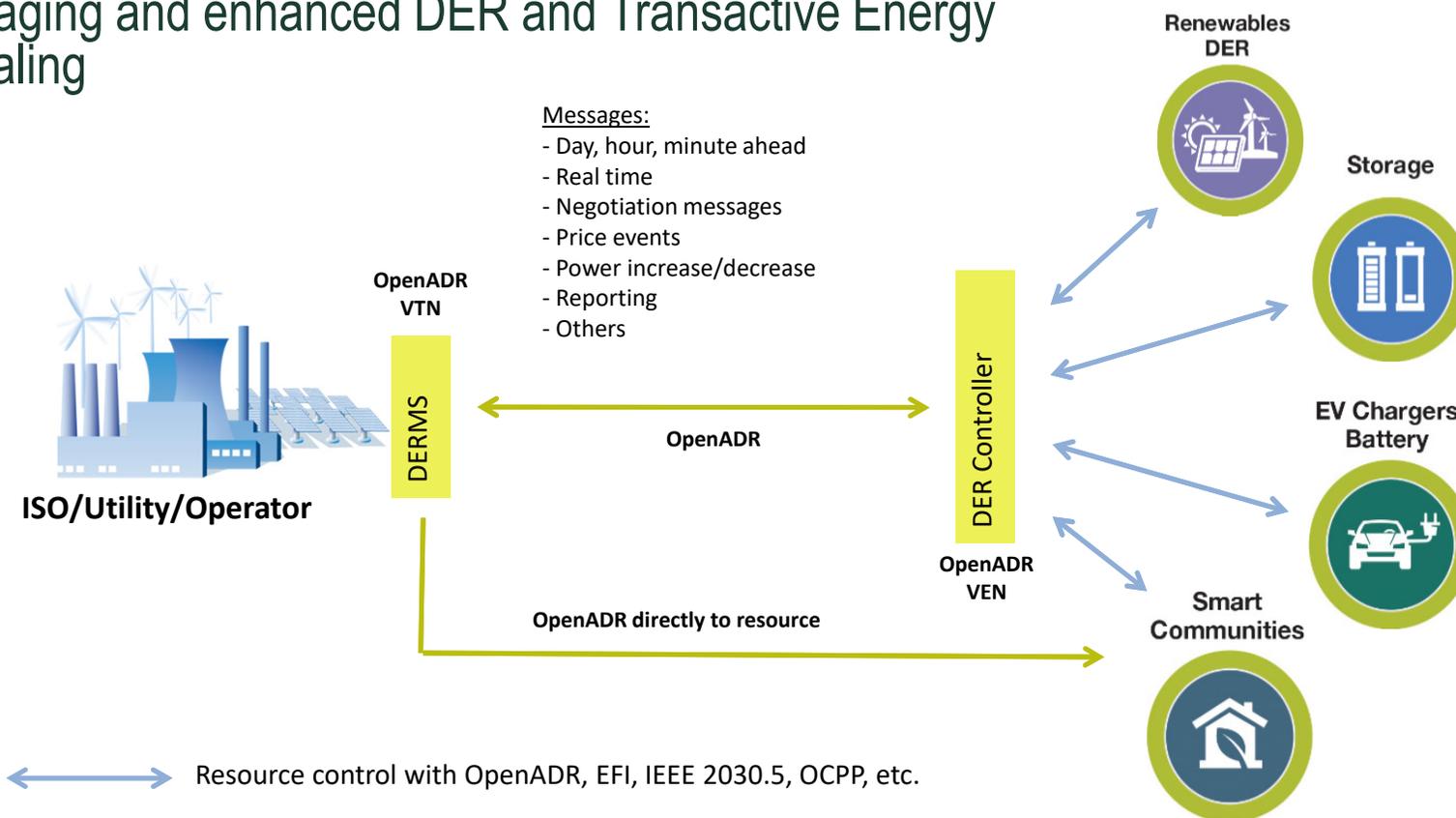


# The 'Services' of OpenADR

- Web Service like logical request-response services
  - Event Service – Send and Acknowledge DR Events
  - Opt Service – Define temporary availability schedules
  - Report Service – Request and deliver reports
  - RegisterParty Service – VEN Registration, device information exchange
- XML Payloads
- Communication through broadband or dedicated internet connection
- Security: TLS1.2 with server and client cyber sec certificates

# DER Control Made Easy

OpenADR is capable of managing resources using classical DR messaging and enhanced DER and Transactive Energy (TE) signaling



# Contact

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# Overview of CTA-2045

# The Need – an inexpensive standard modular connection

Remember these?

When computers did not have Wi-Fi!



## CTA-2045 – the USB port for appliances



- Flexible communication paths
  - Wi-Fi, cellular, smart meter mesh
- Future proofs the asset for life
- Modules can innovate more quickly
- Guarantees vendor optionality
- Lower cost at scale (no dongle-itis)
- Allows smaller OEMs without an IoT cloud of their own to compete
- Supports all software standards
  - Ex: OpenADR, DNP3, 2030.5

# CTA-2045 Appliance Family



Hot Water Heaters



Pool Pumps



PTACs

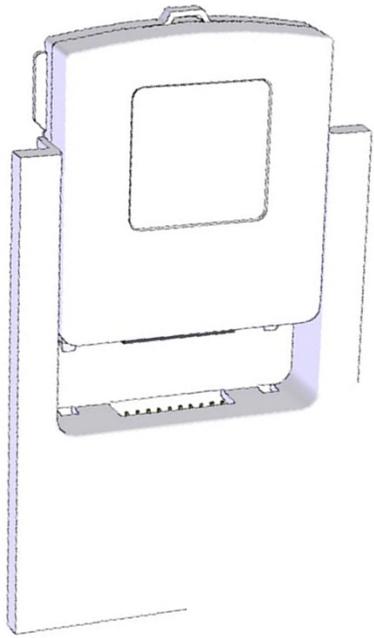


EV Chargers



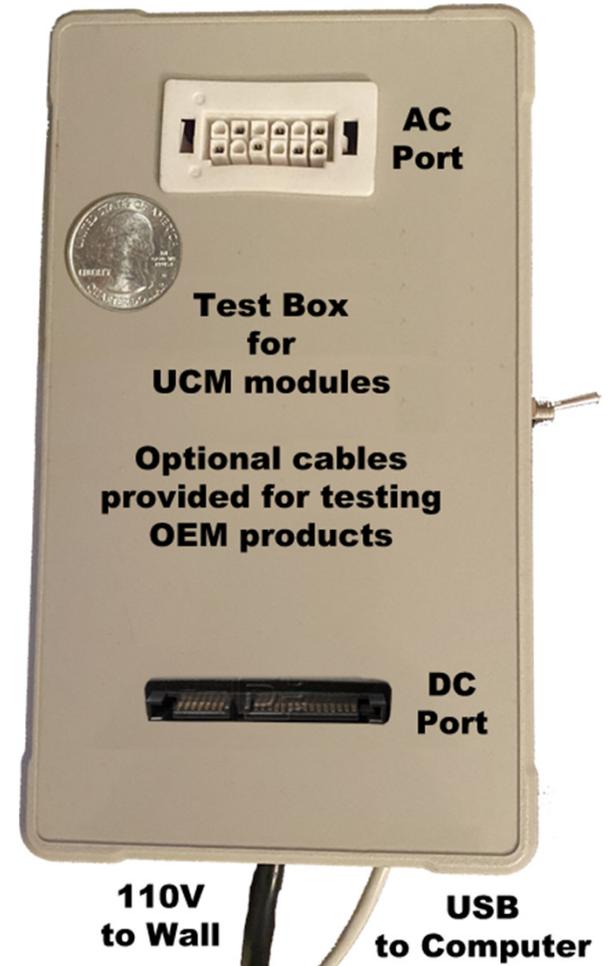
Heat Pump HVAC Mini-splits

# Physical Details - DC



US quarter

Not final product



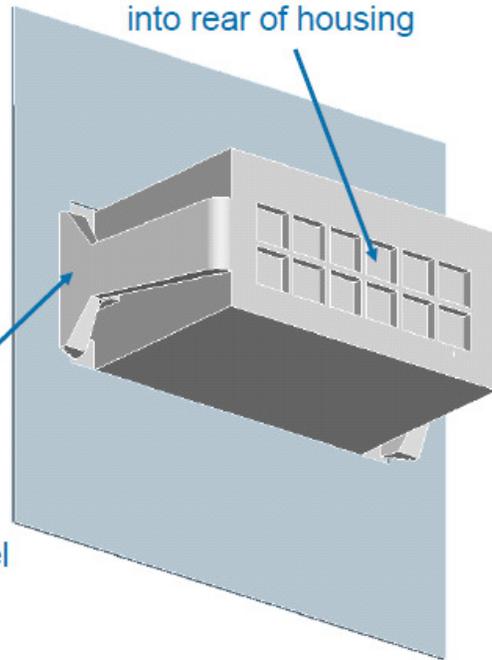
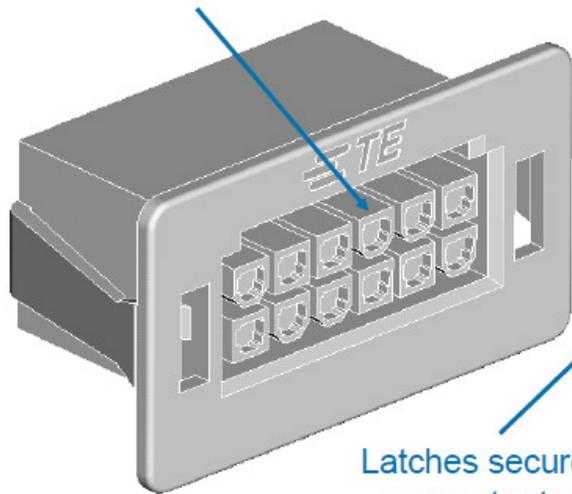
# Physical Details - AC



US quarter

Contacts protected from finger probe by housing silos

Crimped contacts inserted into rear of housing



Latches secure connector to panel  
Width increased to prevent rocking



SkyCentrics  
s/n: 20F85ED3A189  
Code: **KNWAKX**  
Mdl: US02A  
Reset 23.2016 Status

## Physical Details – Port Adaptors

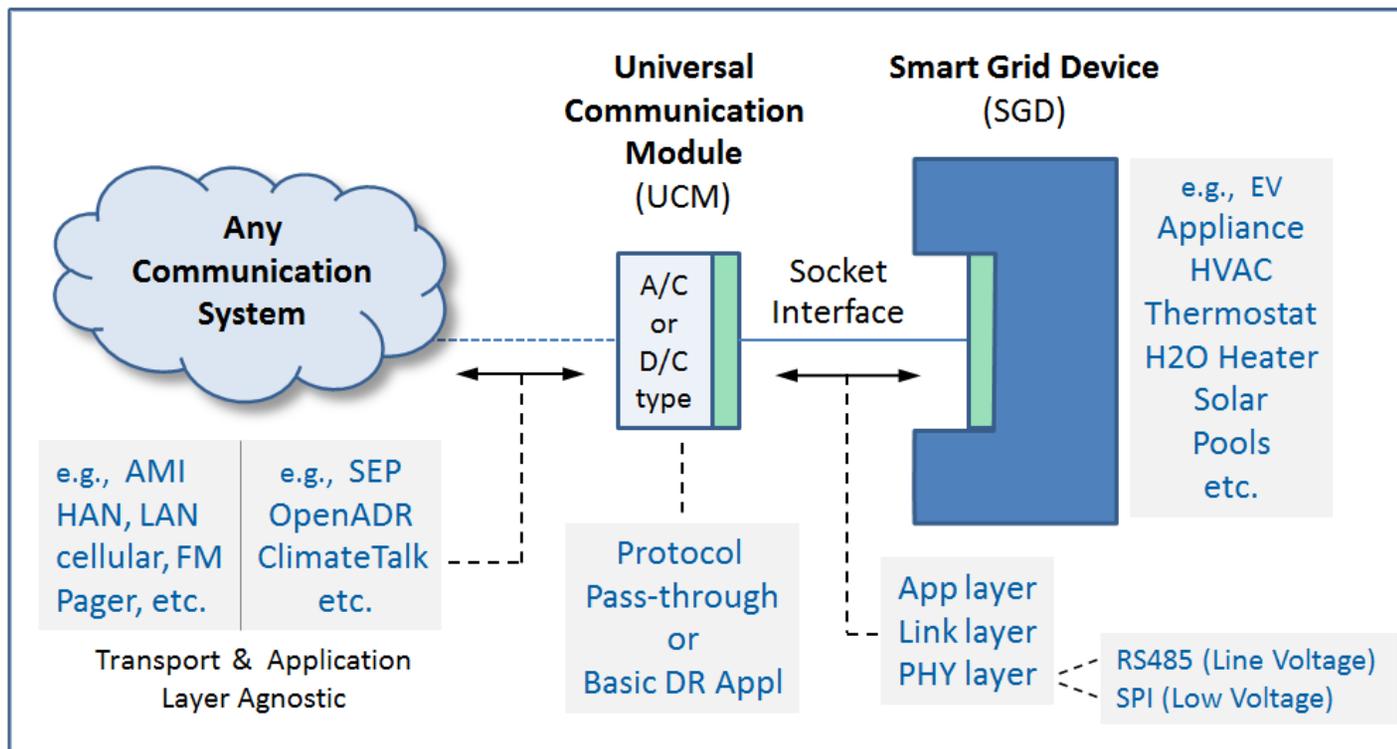


Mitsubishi Port Adaptor  
for DC CTA-2045



AO Smith Port Adaptor  
for AC CTA-2045

# Physical port on the appliance



## Modular Interface - Block Diagram

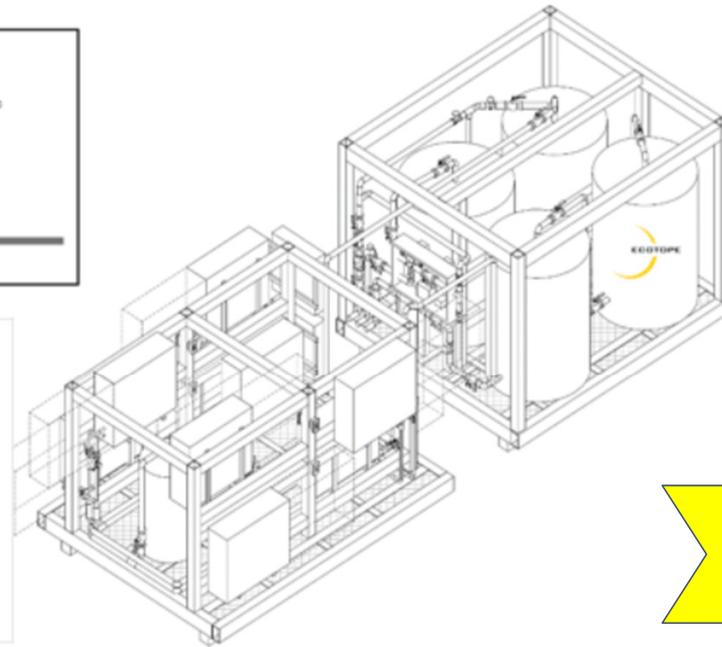
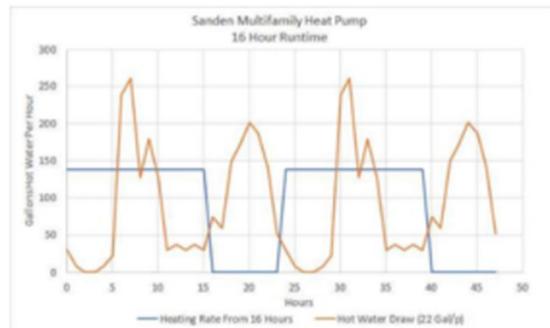
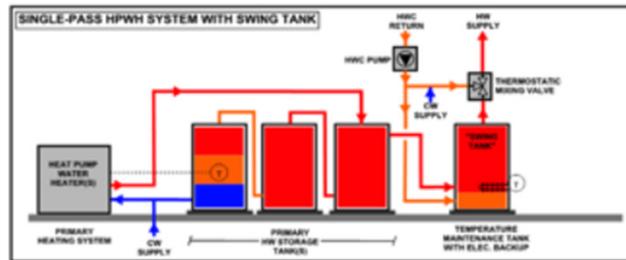
# CTA-2045 Appliance Family details

DC Powered	AC Powered
GE Appliances – Heat Pump Water Heater*	AO Smith – Electric Resistance Water Heater
Bradford White – Heat Pump Water Heater*	AO Smith – Heat Pump Water Heater
Mitsubishi Mini-Splits and Central-Ducted	Rheem – Heat Pump Water Heater
Siemens EVSE Car Charger	Pentair - Variable Speed Pool Pumps
Emerson 30 Amp Water Heater Switch	IslandAire - PTAC HVAC units
Emerson Thermostat	

\* Coming soon

# Multi-Family DR – 35,000 W-hrs

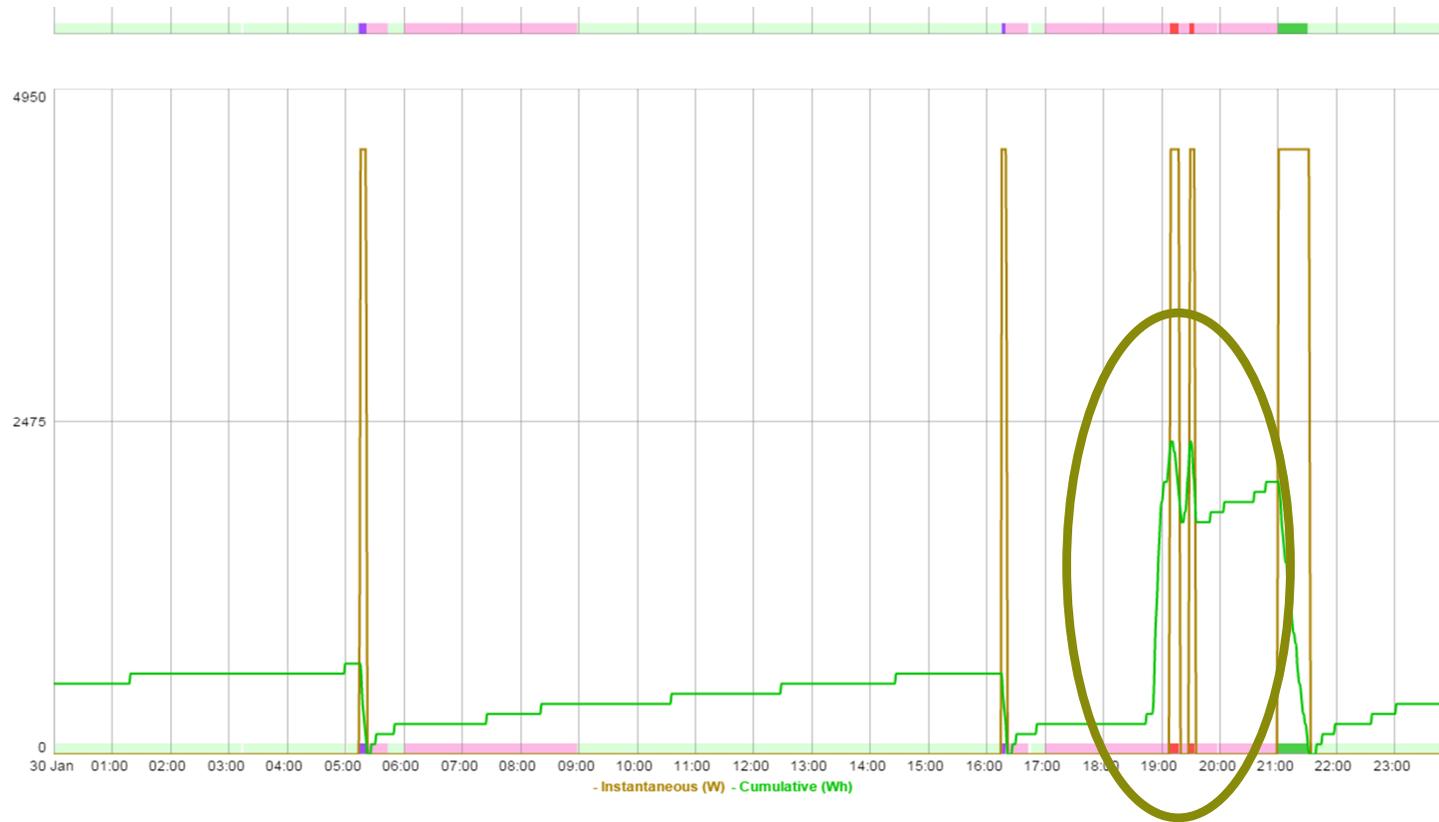
## Prefab Plug and Play Skid for Rooftops



- Culmination of focused effort around the Technology Innovation Model with Sanden plug and play solution.

100 Person, Load Shift Capable, Plug and Play Sanden Skid for Menlo Park Apartment Projects (840 units)

# Smart = cold water prevention algorithm

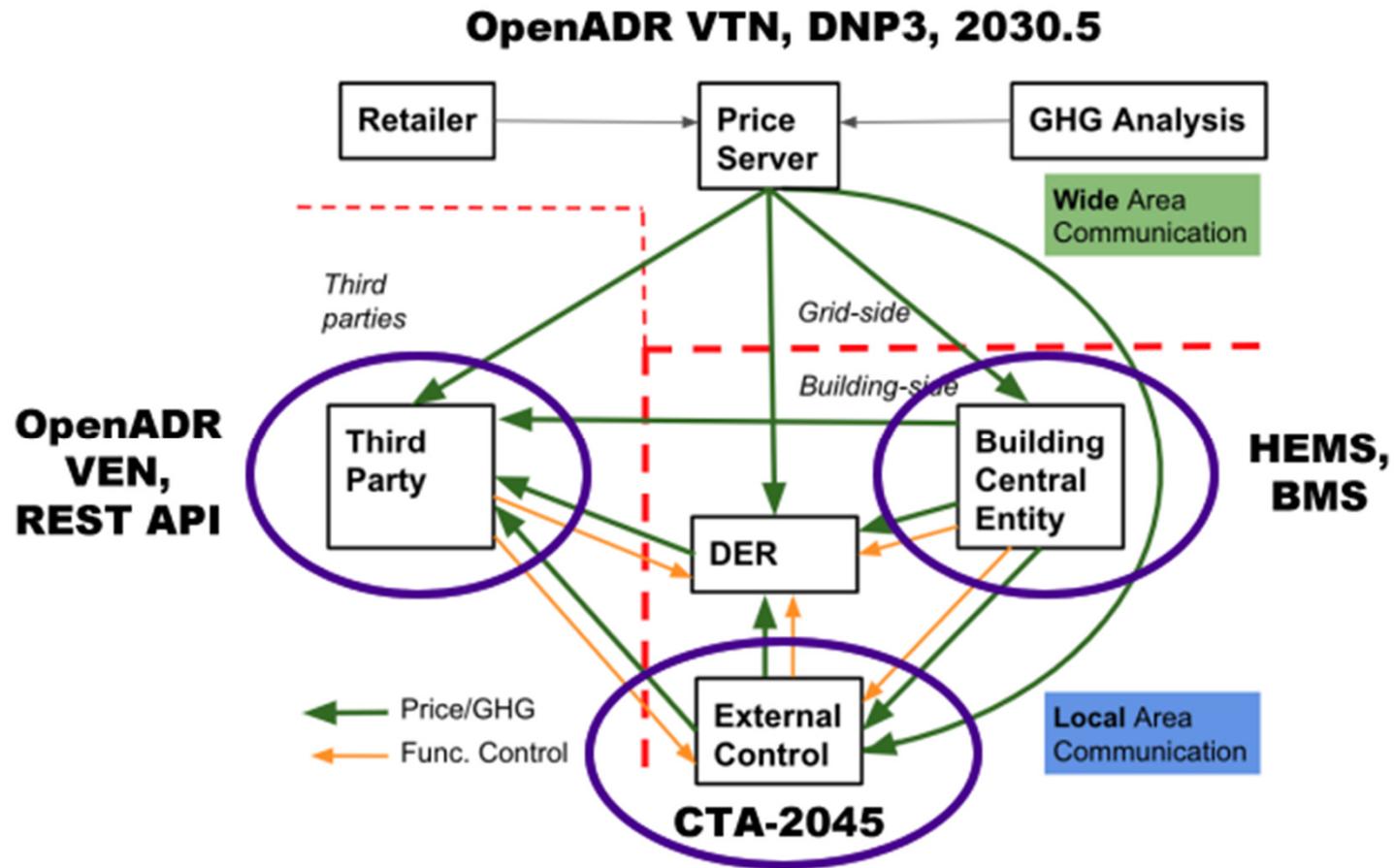


During a shed from 5:00 to 9:00, you can see a large draw (green goes up), and water heater comes on to 'top off'

## CTA-2045-B Level 2

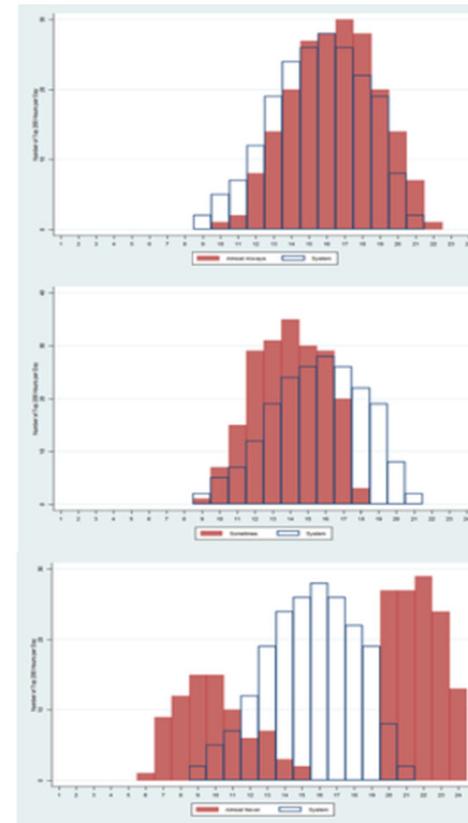
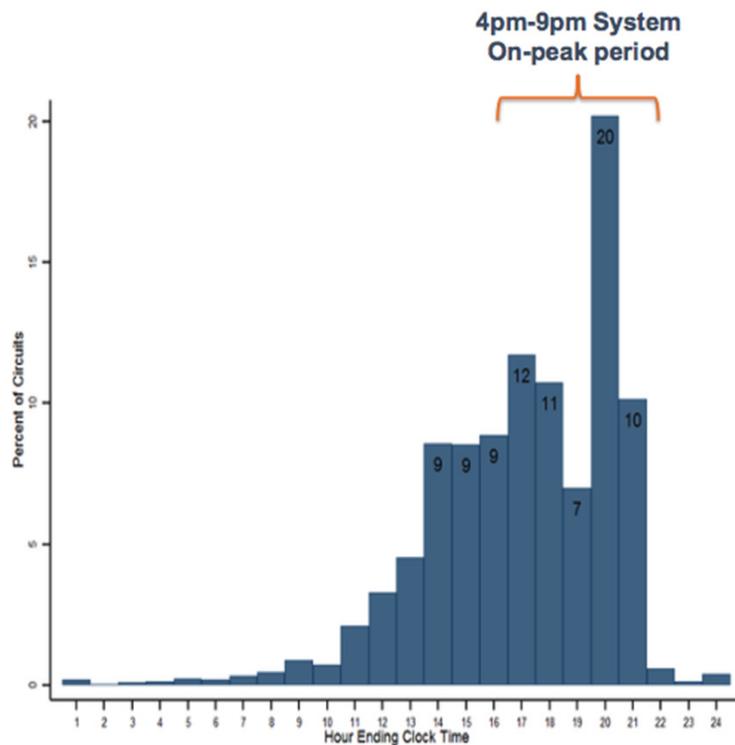
1. **Grid signal choices** - 3 levels of shed, 2 levels of Load Up
2. **M&V** – power usage and storage capacity in both load ups
3. **Customer override** – 24-72 hrs with automatic return to grid control
4. **Advanced Load Up** – To comply and match with Title 24 JA13 which defines and Advanced Load Up function to load up more than the normal Load Up.
5. **Efficiency Recommendation** – To be able to change between Heat Pump only, Hybrid, etc.
6. **Prices to Devices** – Can accept 64 time/price pairs for 24 hour ahead smart planning
7. **Time of Use schedule formats** can be supported in the CTA-2045 module to support Title 24 JA13 for the OEMs that do not want to do it themselves, but do want to support CTA-2045.

# Overview of grid signals to devices



# SDG&E comparison of circuit load profiles

The timing of circuit peaks may not align with system peak



## Daily schedule changes provide 2-5x benefits to GHG and grid

	Schedule Type	Pro-Con	Cost
	Unscheduled	EE benefits of Heat Pump only	-
	TOU – changes every 6 months	Misses daily, weekly, and monthly variability	JA13 – built in to water heater
	Daily changes	Can match daily variability	Cellular + yearly fee
	Real Time changes	Needed for the 3 months of DR or Fire season	Cellular + yearly fee x2

## Contact



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# OpenADR and CTA-2045 Cyber Security

# OpenADR Cyber Security

- OpenADR security section went through NIST, SGIP, and IEC Cyber Security reviews
- Alliance has implemented server AND client certificates
- Usage of TLS1.2 is mandatory for certification
- Additional security (XML wrappers) are optional
- Alliance has established a Certificate Authority (Kyrio/DigiCert – formerly Symantec)

→ End-to-end protocol security



# CTA-2045 Cyber Security

- No protocol security needed
- CTA-2045 represents a physical interface with a direct connector
- Security is part of the protocol that is used in the module or the SGD (e.g. OpenADR)

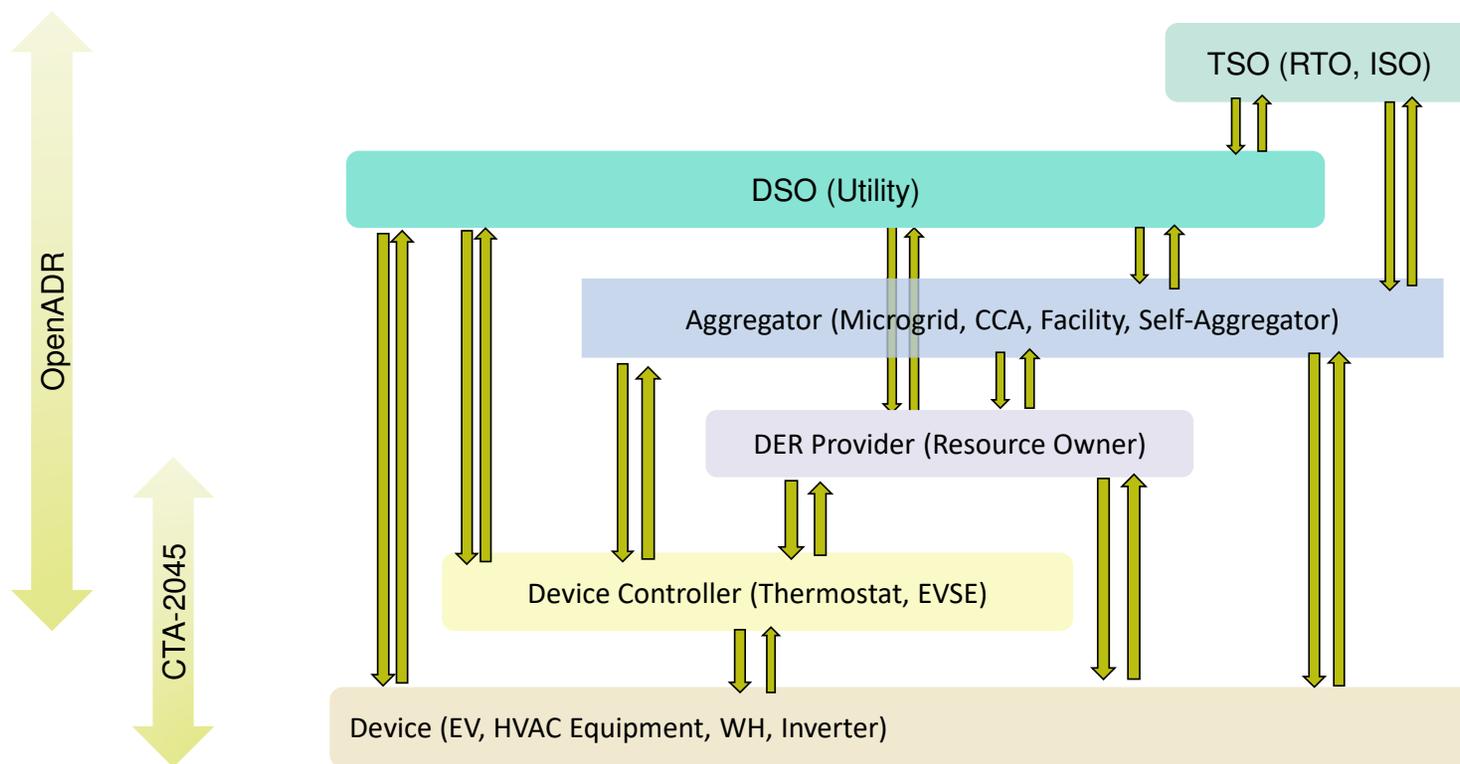


# Cyber Security for Vendors

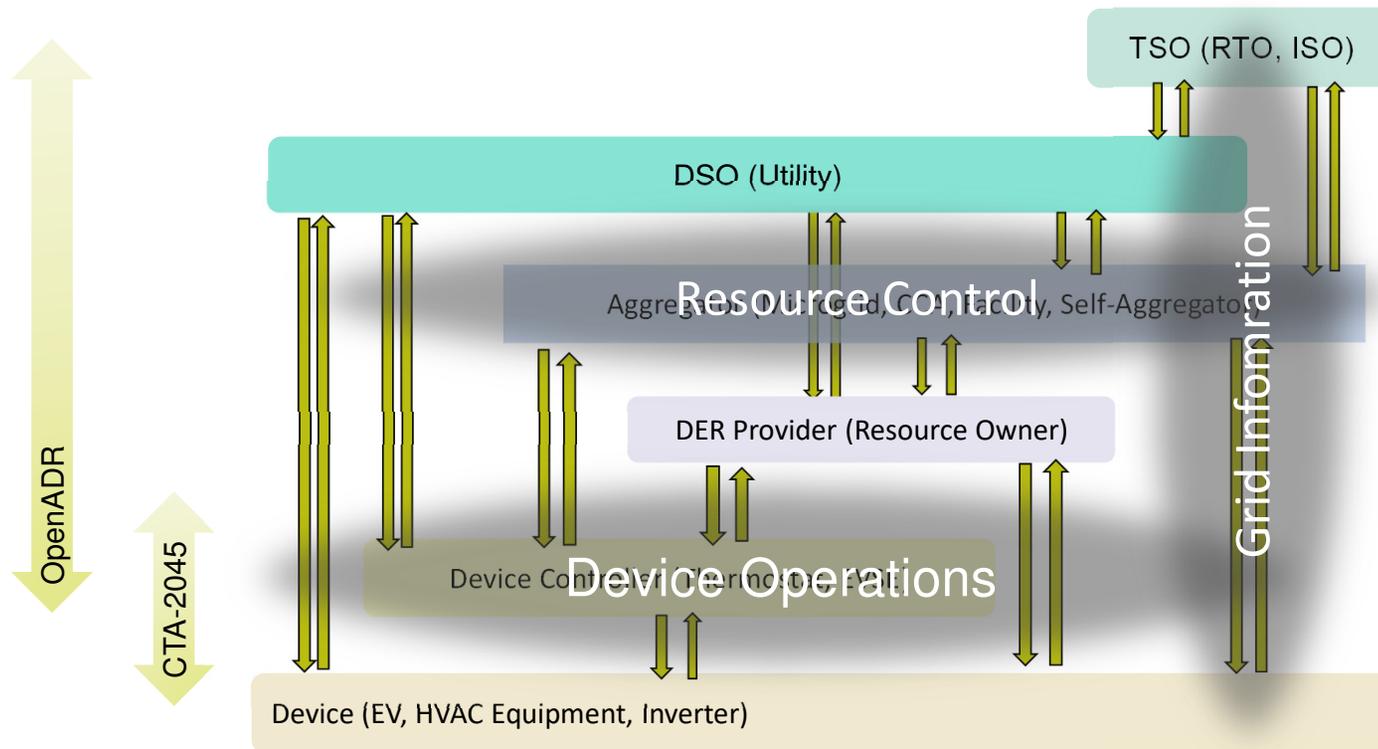
- TLS/SSL between module and cloud (e.g like OpenADR, but can be on a shared certificate which is the way Amazon IoT does it)
- OpenADR or another protocol can be put on the module. Should typically be done on sophisticated devices, or systems that aggregate devices like a HEMS or BMS.
- The UCM vendor cloud should follow industry best practices and if on Google or Amazon, should show that they follow those cloud service best practices.
- Always remember Common Core security requirements.

**Use cases with both OpenADR and 2045 in the architecture**

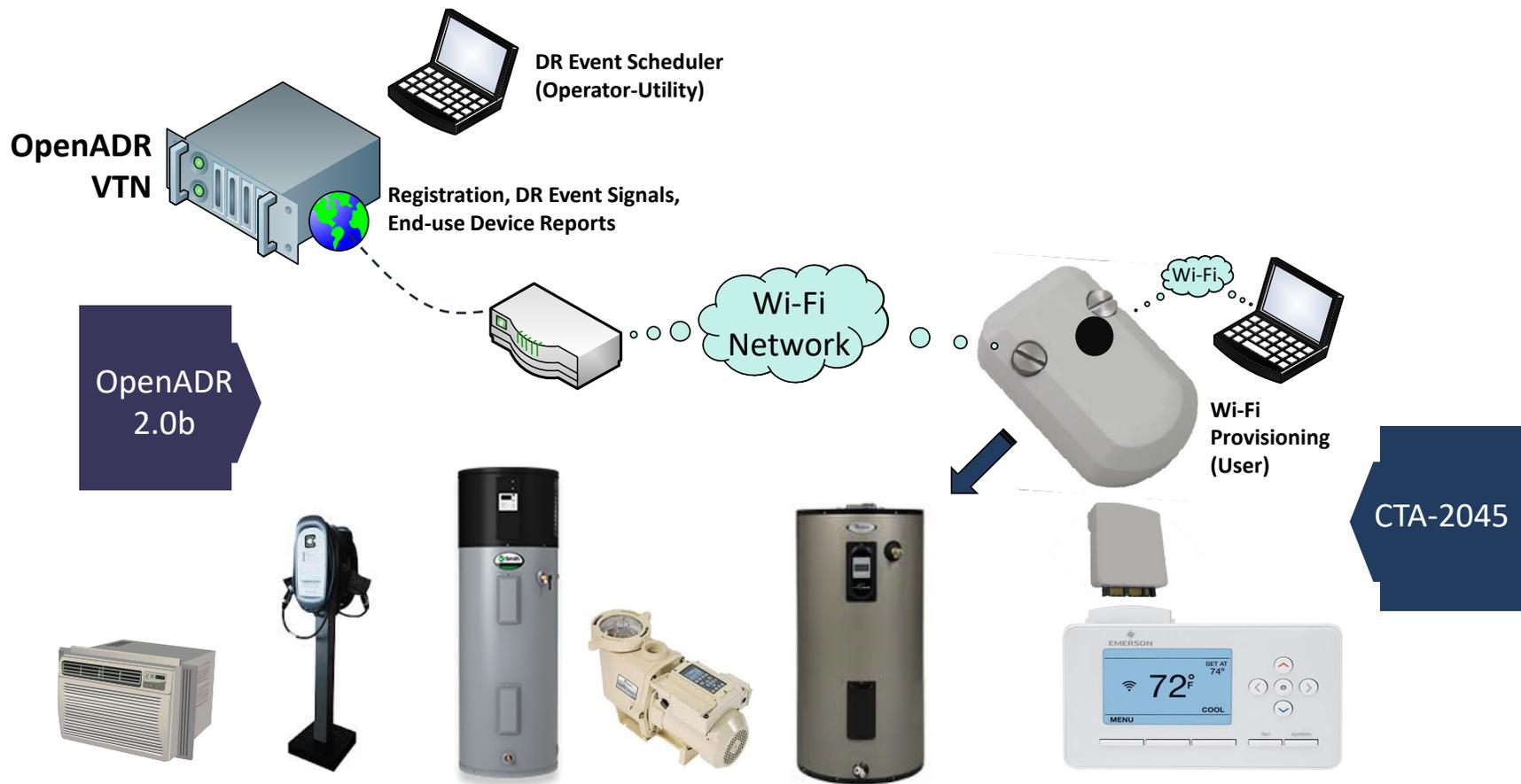
# Application Domains for OpenADR and CTA-2045



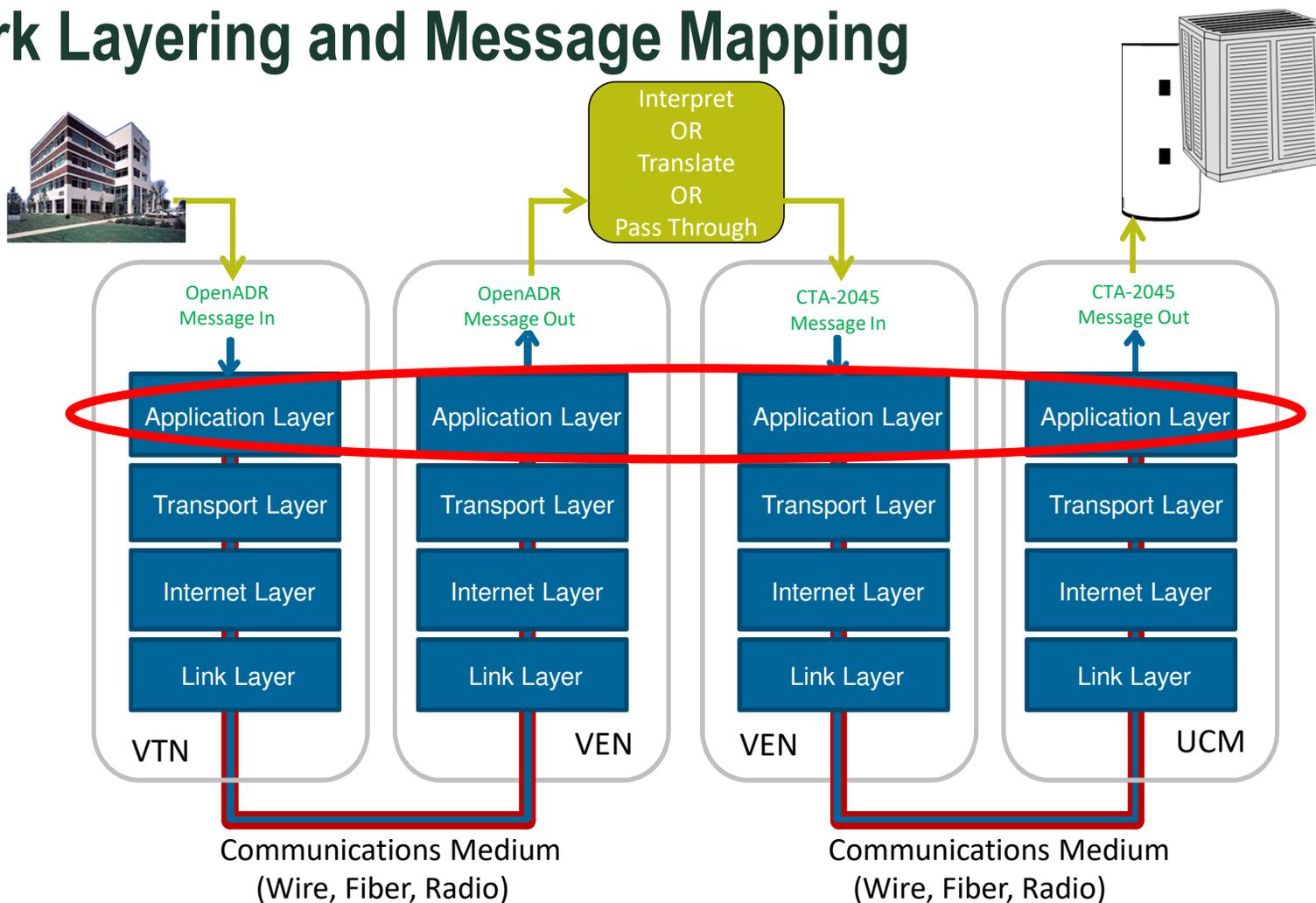
# OpenADR and CTA-2045 Basics: Different Functions



# OpenADR to CTA-2045 Communication: Architecture Overview



# Network Layering and Message Mapping

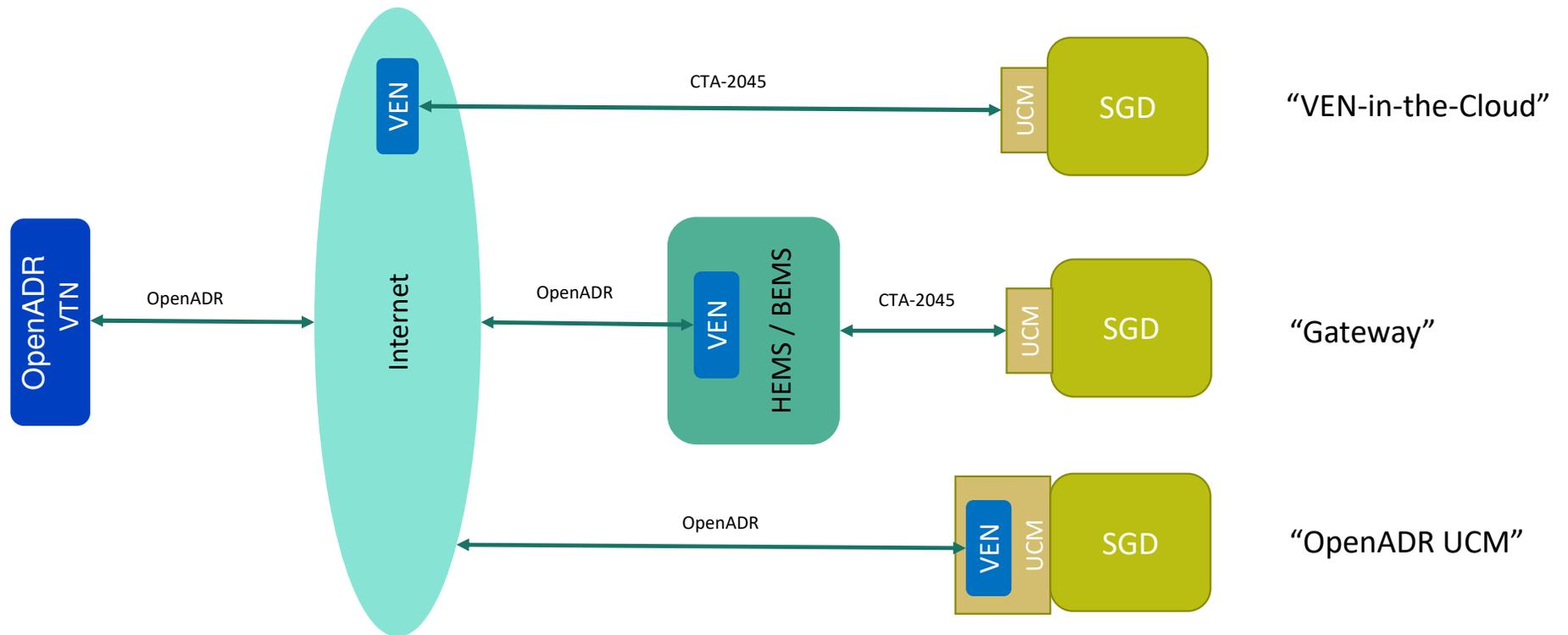


# Mapping between OpenADR and CTA-2045 Signals

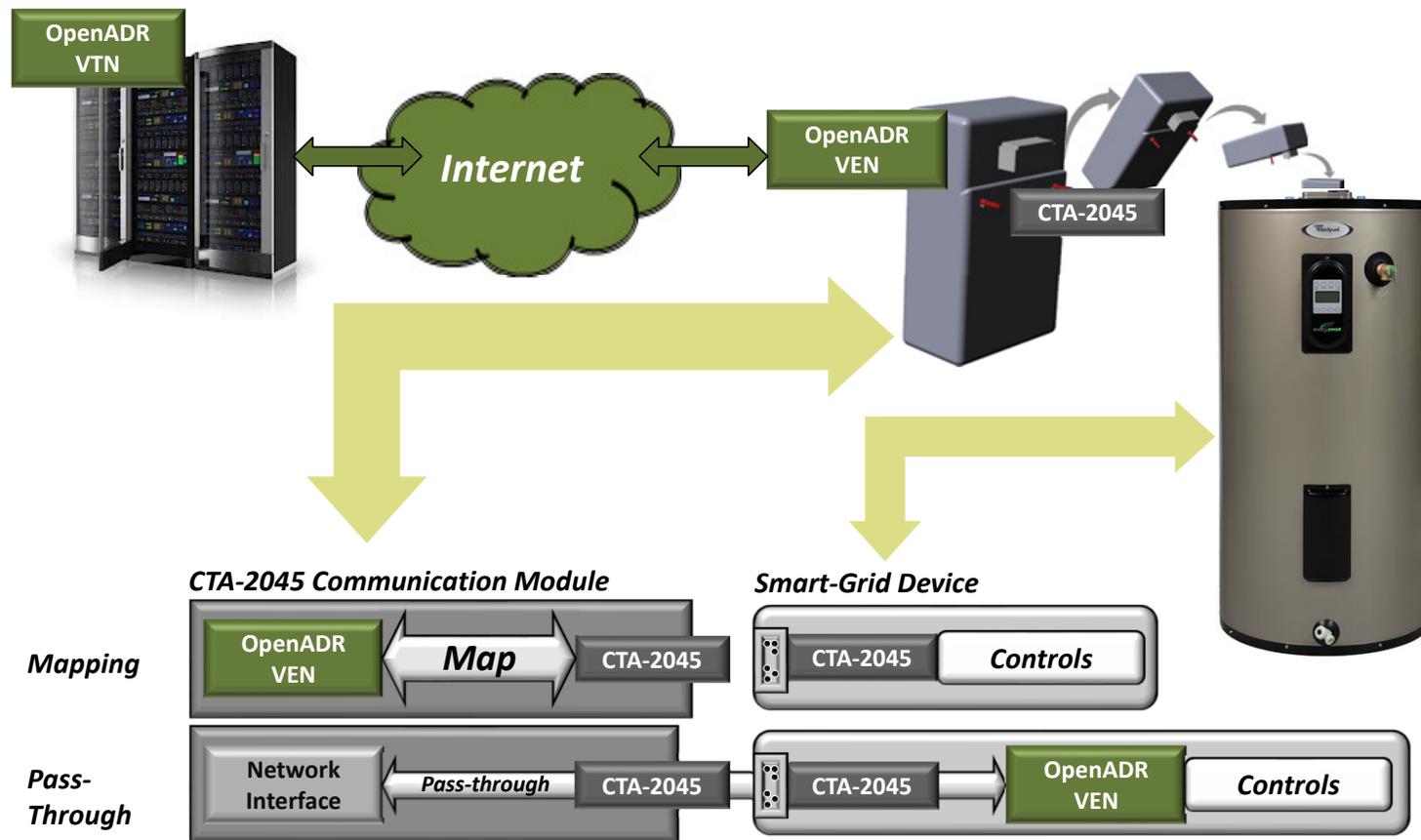
This sort of “fixed” map could be used to enable the user to schedule DR events for specific programs without having to select a variety of signal types.

Program Message	Tier	OpenADR (Signal, Value)	CTA-2045
Load Up	1	Simple, 0	Load Up (LU)
Moderate	2	Simple, 1	Shed (S)
Critical Peak	3	Simple, 2	Critical peak Event (CPE)
Grid Emergency	4	Simple, 3	Grid Emergency (GE)
Time of Use	Up to Four	Simple, 0–3	LU, S, CPE, or GE
Real-time Price	N/A	PriceMultiplier, Variable	Relative Price

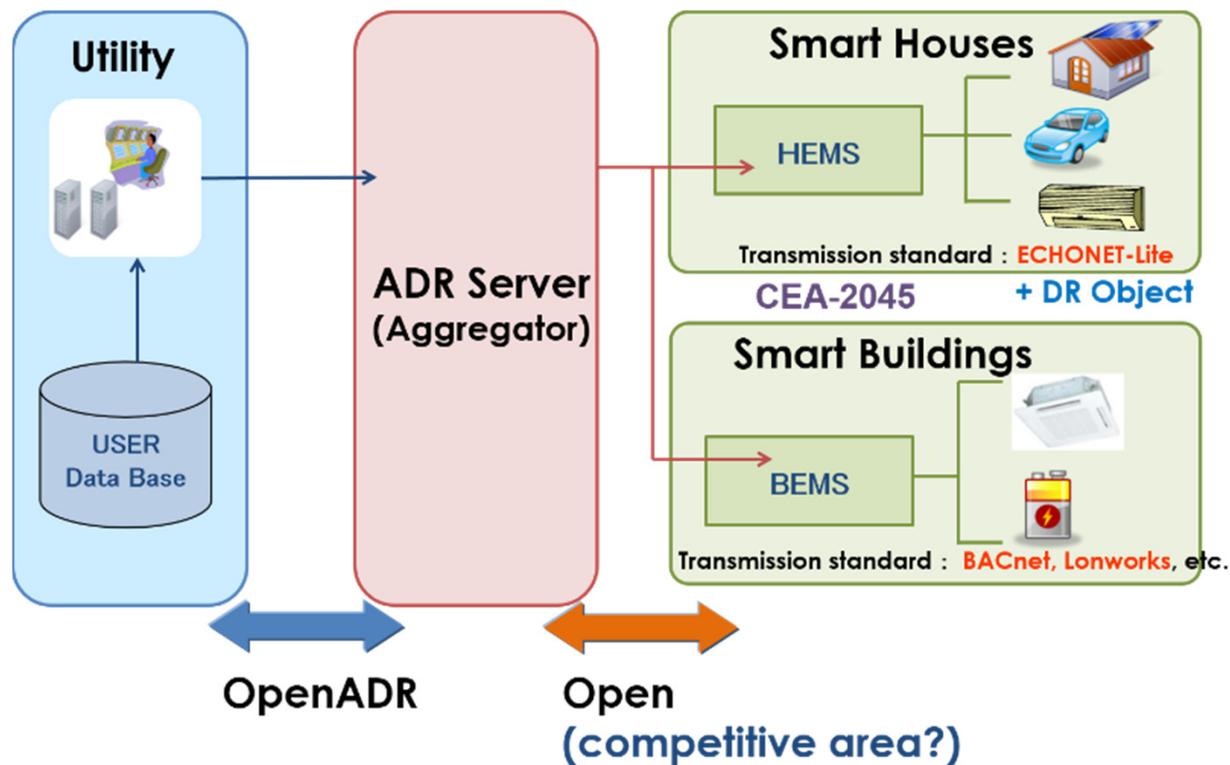
# Some OpenADR/CTA-2045 Deployment Architectures



# Example Architecture Use Cases: OpenADR UCM and Pass-Through



# OpenADR/CTA-2045 Architecture Example from Japan



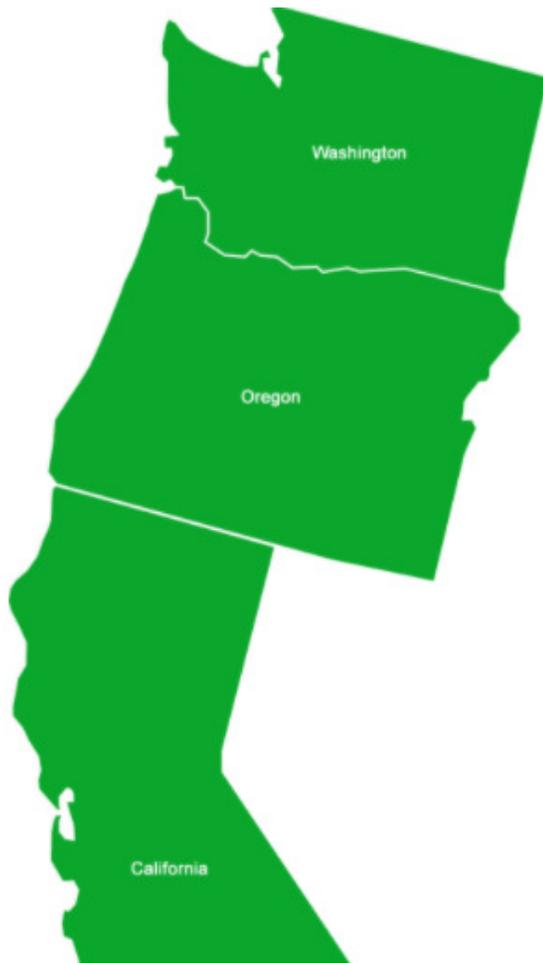
Thank you!

**Contact:**

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# Regulations requiring OpenADR and/or CTA-2045



## The West Coast is leading with CTA 2045

- NEEA Advanced Water Heating Specification requires CTA 2045 on tier 3 and above
- Washington State (40-120gallons) under 12kW (SB1444)
  - HPWH January 2021
  - Electric Resistance January 2022
- Oregon (Executive Order 2020-04)
  - HPWH and Electric Resistance 2022
- California
  - Under review for T-24 and T-20 and incorporating
  - JA 13 points to AWHs 7.0 tier 3 or greater

## Who Else is working Load Management

- NE States – Reviewing and following the WA model
- ENERGY STAR ® - Voluntary Standard next version soon
- DOE – Developing test Procedure for listing
- The Advanced Water Heating Initiative – Connectivity Group – CTA 2045
- AHRI 1380 OpenADR and or CTA 2045 (HVAC)
- AHRI 1420 just getting started – CTA 2045 for water heating

# OEMs are getting on board

## On Board

- Rheem Proterra
- AO Smith
- Eco2
- Mitsubishi Mini-splits
- Siemens Car Charger
- Pentair – Pool pumps (OpenADR and CTA 2045)

## Under Consideration

- Mitsubishi – Central water heating
- Bradford White – Water heaters
- General Electric – Water heaters
- Many more



# Other Points of Unification



States and Utilities don't want dongles to solve the connectivity challenge

Wi-Fi won't work at scale

Large multi-family developers are aligning on HPWHs and standards

Central water heating will have CTA 2045 and OpenADR

As the Grid Get Greener - the more we need storage

Standard low-cost solutions

Future Proofing Assets

# Contact

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# CTA-2045 certification program overview

# CTA-2045 Certification Program

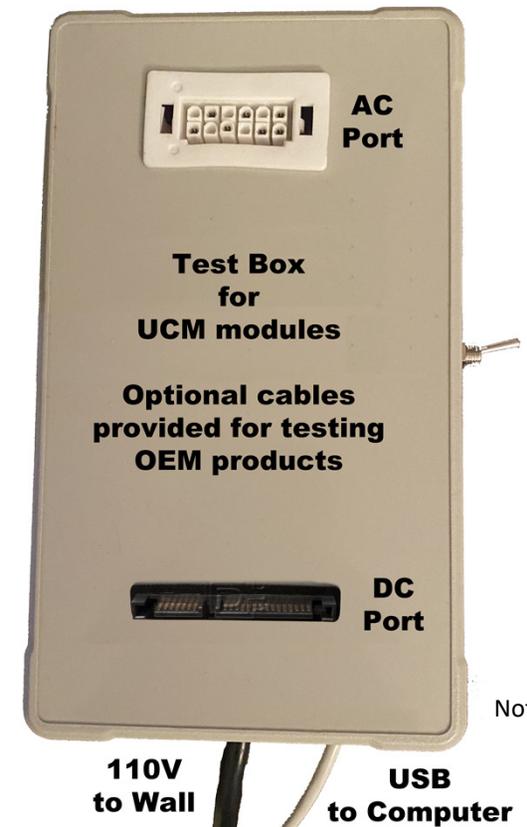
- Components of a Certification Program
  - Test plan & test tool
  - Accredited test house
  - Documentation & Certification → Certificate
  - Branding and product listing on OpenADR Website
- CTA-2045 certification program will be very similar to OpenADR certification\*
- Test plan: Will be finalized based on EPRI recommendation
- Initially for Water Heater profile, further appliance profiles can follow

\*compare to <https://www.openadr.org/certification-process>

# CTA-2045 Certification Program (2)

## Timeline to Certification Program Launch

- Test plan & Test tool development by December 2020
- Initial validation tests and first certified products during test tool development in Q4 2020 and Q1 2021
- Product listing page completed January 2021
- Test house available for certification testing in Q1 2021



Not final product

**Thank you!**

Q&A and Panel Discussion