Connected HVACR + Water Heating Equipment/Components

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Is one of the nation's larger trade associations

- 300+ HVACR and water heating manufacturers across 40+ product sections

Establishes 100+ international industry standards & guidelines

Administers 40+ rigorous certification programs

Advocates for industry

Oversees Research

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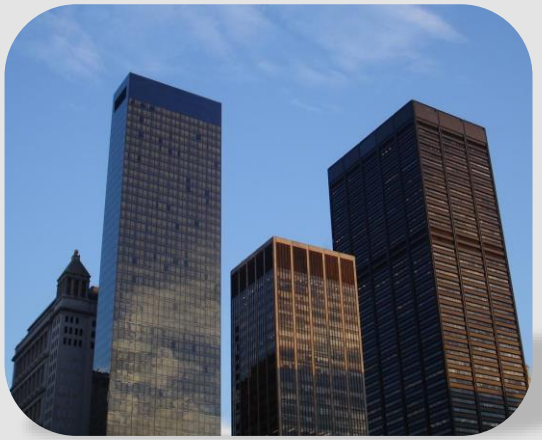
Broad Spectrum of Systems in Buildings

Focus of AHRI, CEE and EPRI collaboration to develop AHRI Standard 1380P



High unit volume

- Single family homes
- Small commercial
- Discrete systems
- Unitary AC & HP
- Water heaters

No building EMS

Demand response

- A few kW per bldg.
- Very high unit volume
- Direct communication with HVAC & WH utilized
- Standardized utility program
- PUC regulated

New a/c and com systems **opportunity for manufacturers**

Demand response

- Many kW per bldg.
- Low unit volume
- DR aggregators
- Negotiated contracts

Controls capabilities readily available

Low unit volume

- Large multistory com'l buildings
- Complex systems
- Chillers
- Heat recovery

Sophisticated EMS

Draft AHRI Standard 1380P, *Demand Response through Variable Capacity HVAC Equipment in Residential and Small Commercial Applications*

- **Structure**
  - Matrix of signals and equipment responses
  - Two Protocols: CTA2045 & OpenADR
  - Method of Test
  - Confirms DR capability
- **Control of equipment**
  - Power draw reduction based on full load, rapidly responding, flexible, and scalable
    - Ex. Curtailment of 30%, 60%, and 100% of full load (EER) power within 5 seconds

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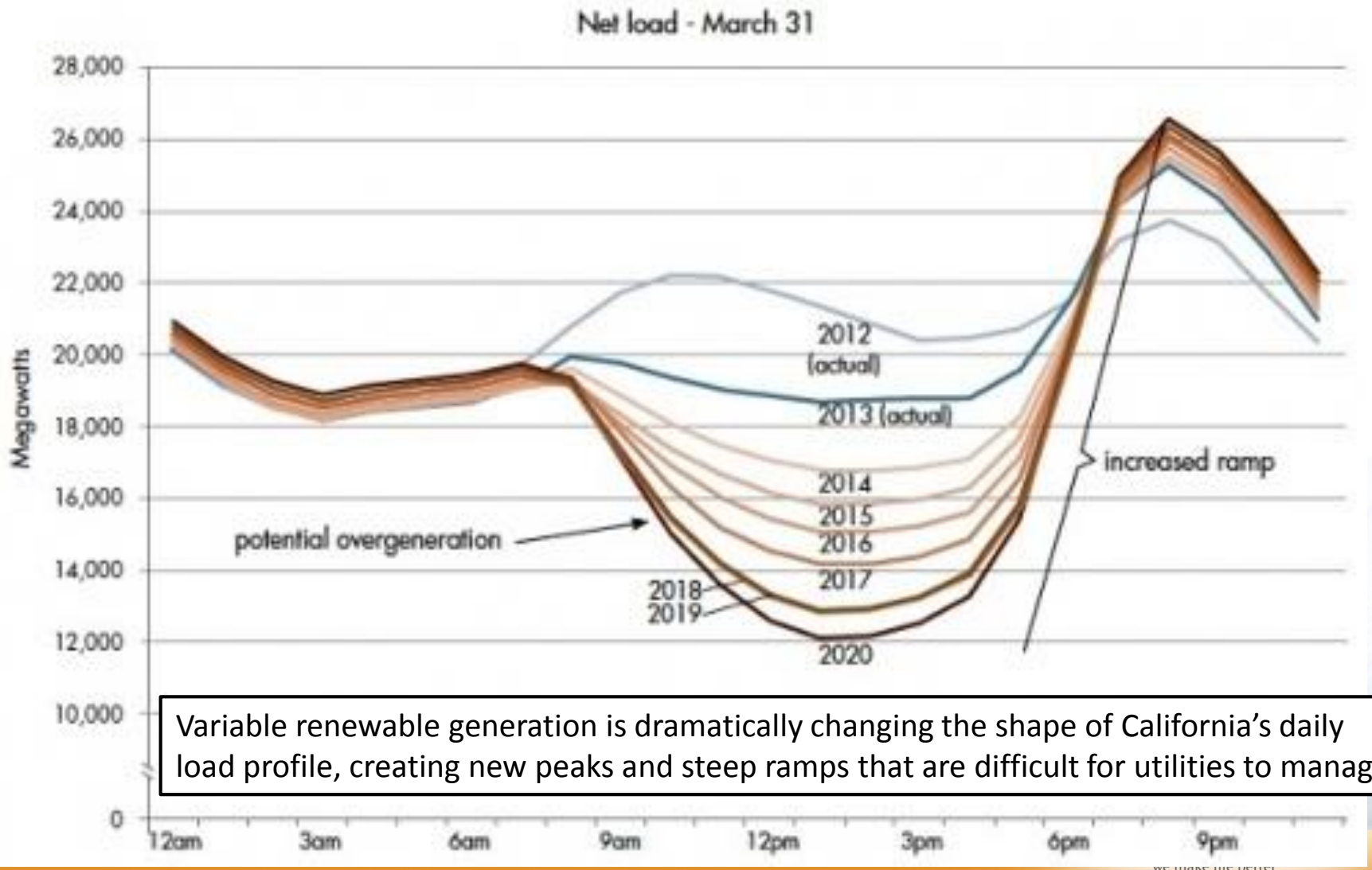
Why Now?

- Effective tool to address growing utility peak load problems
- Growing solar generation causing new and sharper peaks
- Compressor technology is mature
- Communications protocols and technology improving
- Growing pressure to manage load and increase equipment efficiency

Solar Generation Dramatically Changing Daily Load Profiles

California Independent System Operator (Cal-ISO) "Duck Curve"



Variable renewable generation is dramatically changing the shape of California's daily load profile, creating new peaks and steep ramps that are difficult for utilities to manage.

Current State of Smart Water Heating

- **Large, electric-resistance water heaters are still the tool of choice**
- **Product class = "Grid-enabled Water Heater". Among other things, U.S. law requires:**
  - Heater to be >75 gal water volume
  - Manufacturers to provide activation lock with water heater
    - New interaction between utility and manufacturer
    - Added time required to deploy systems
  - Heater to provide < ½ of stated First Hour Rating if locked.
- **Else, >55 gal electric water heater must be a heat pump**
- **Electric resistance has advantages over heat pumps**
  - More capacity when utilities need to shed demand or store excess energy
  - More predictable performance when trying to meet varying utility and consumer demands

Commercial Implementation - Thermal Energy Storage

- **Technology stores energy created at a particular time and makes it available to be used at a later time**
  - Typically used in buildings that have large cooling loads during the day as compared to night time
- **AHRI Standards 900 (I-P) & 901 (SI), *Performance Rating of Thermal Storage Equipment Used for Cooling***
  - Testing and rating requirements: net usable storage capacity and auxiliary power input ratings

Figure 1. Typical TES Cooling Load Profile