Sending the Duck Back to the Wild with Demand Response and Load Management

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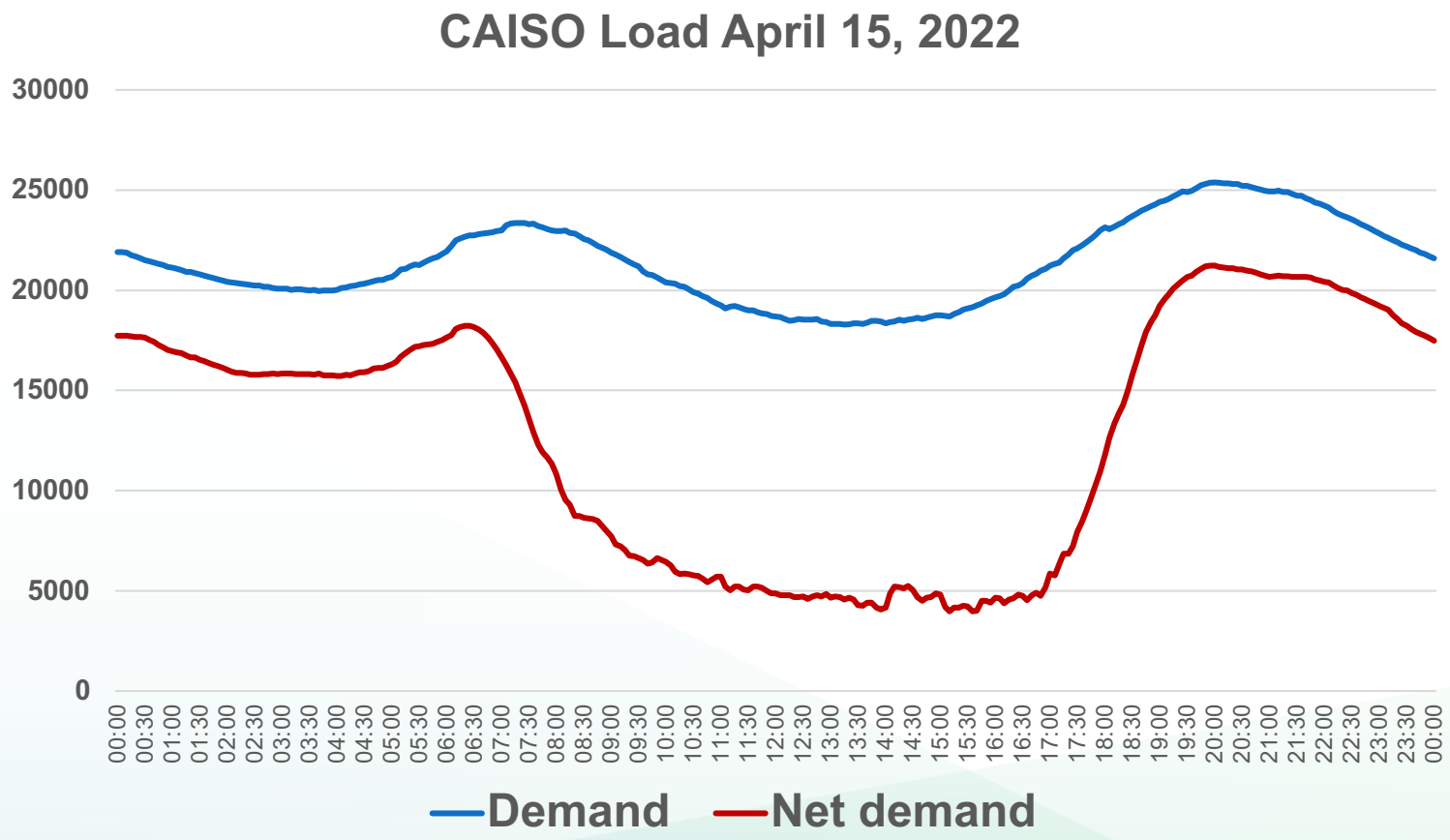
Agenda

- Electricity system challenges
- What are demand response and load management?
- Demand response: implementation, design, and impacts
- Load management: implementation, design, and impacts
- Societal benefits

California's Electricity Demand Picture

- Supply of clean renewable energy not well-matched with customer demand
- When sun sets, massive ramp of largely fossil-fuel resources to meet demand
- In the middle of the day, renewable generation may be curtailed if it will cause congestion and cannot be exported or consumed.



California's Electricity Supply Picture

- Supply of clean renewable energy not well-matched with customer demand
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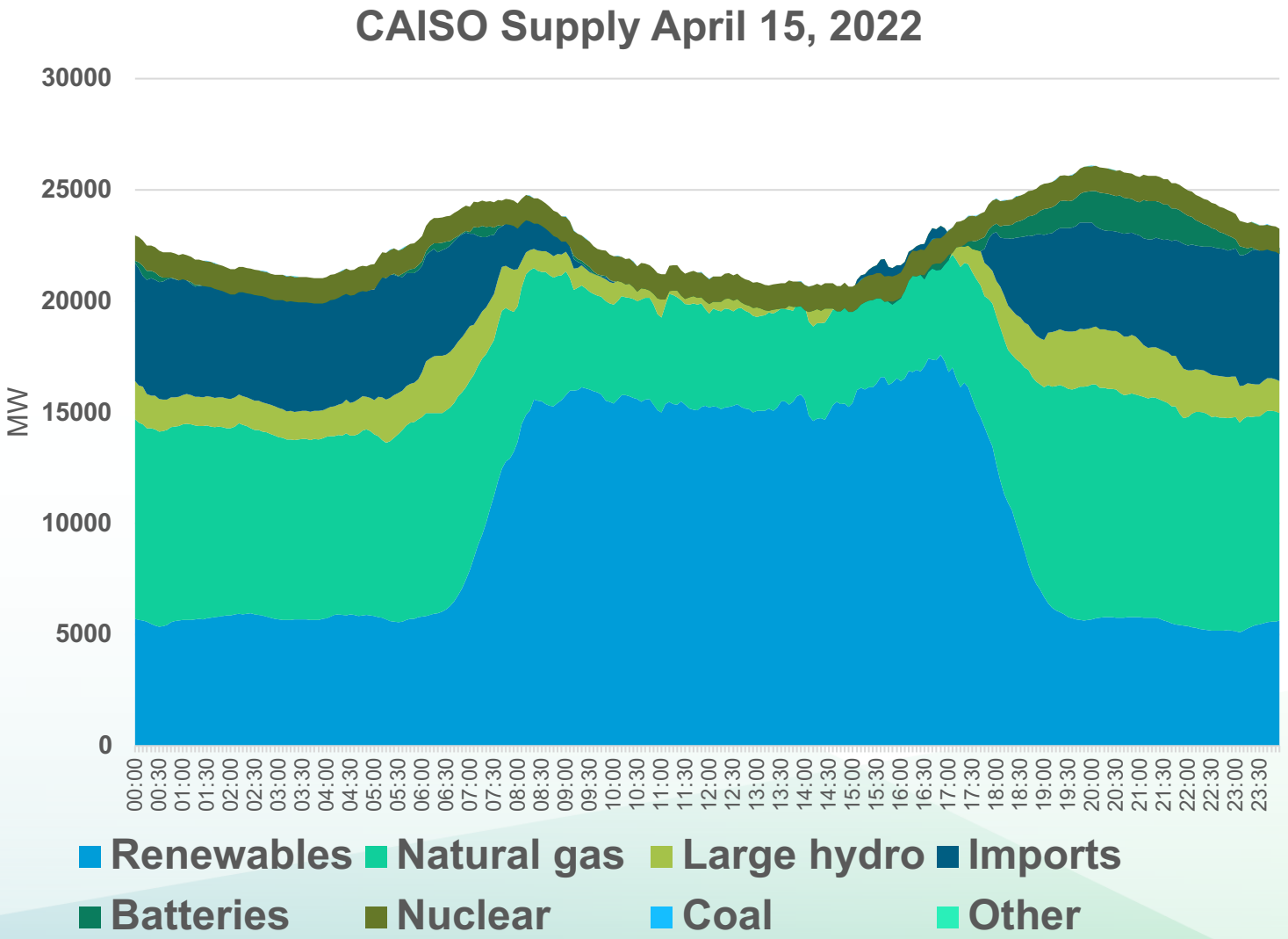
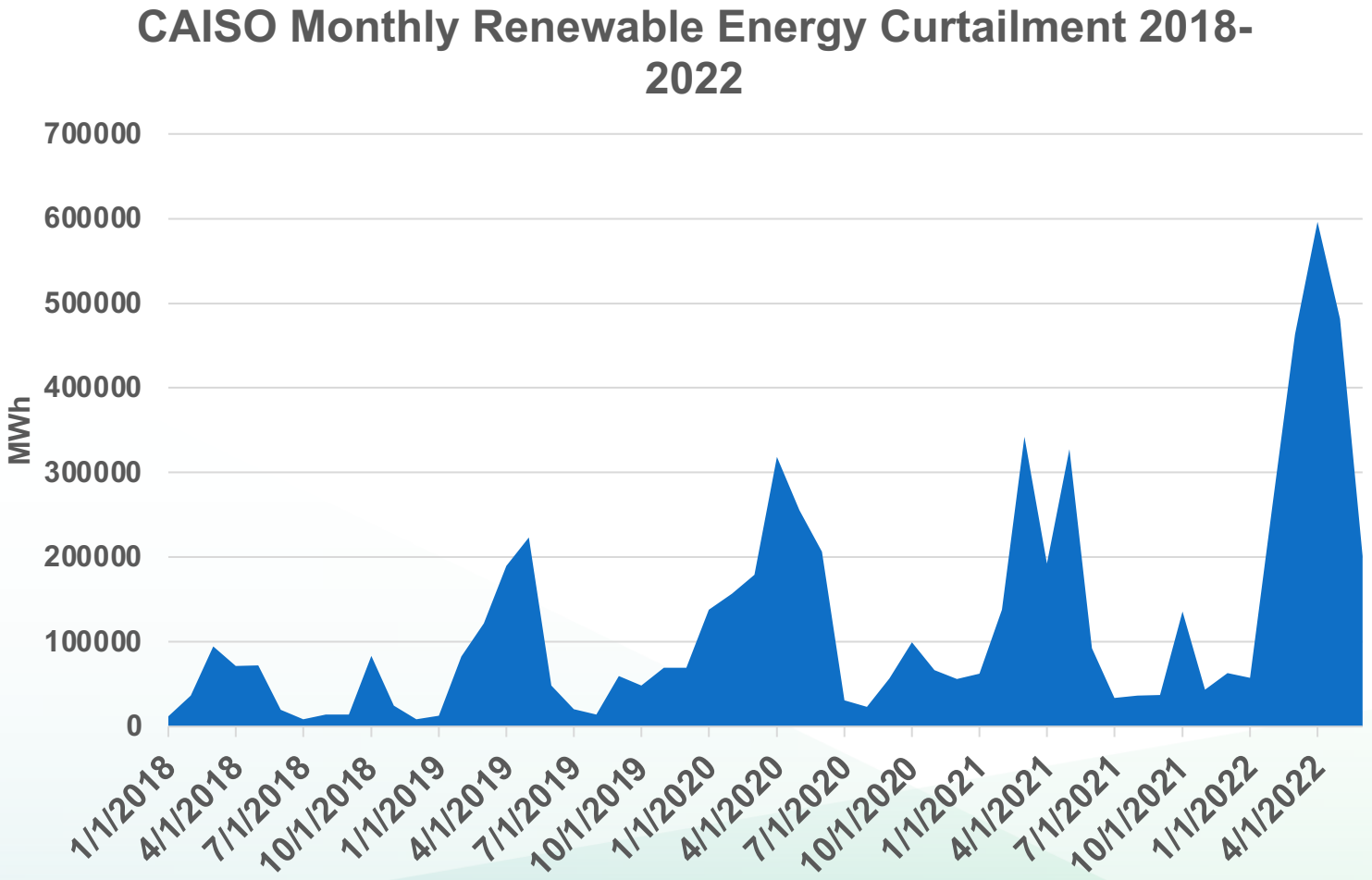


California's Electricity Curtailment Picture

- Supply of clean renewable energy not well-matched with customer demand
- When sun sets, massive ramp of largely fossil-fuel resources to meet demand
- In the middle of the day, renewable generation may be curtailed if it will cause congestion and cannot be exported or consumed.



Role of Demand Response and Load Management Programs

- Direct customers to **shed and shift** demand
- Avoid excess strain on the electricity system
- Lower costs to utilities and customers
- Match customer demand to renewable generation

What is Demand Response?

Per CPUC D.17-12-003 "… *reductions, increases, or shifts in electricity consumption by customers in response to their economic signals or reliability signals.*"

How does Demand Response operate?

- Demand response is initiated by emergency or economic triggers.
- Trigger is communicated by a utility or third party to a customer or technology
- The customer or technology then reduces or stops consuming energy for a specified amount of time.

Residential DR Technologies

Commonly controlled residential DR technologies:

- Air conditioner compressors
- Smart thermostats
- Heat pumps
- Pool pumps
- Resistance water heaters

Non-Residential DR Technologies

Commonly controlled Non-residential DR technologies:

- HVAC
- Pumps
- Process loads
- Refrigeration

Emerging DR Technology

Electric Vehicles

- Vehicle to grid integration
- Vehicle to load integration
- Smart charging

Behind the Meter Batteries

- Smart controls
- Pair with PV system

Demand Response Programs

How are DR programs categorized?

- Market-integrated
- Dispatchable

California ISO Market

- DR = procurable resource by utilities to meet electricity demand.
- Load serving entities and third parties bid DR into the CAISO markets.
- Utilities, CCAs, and third parties design programs that react to certain triggers.
- Payments made based on the capacity and energy provided.

IOU DR Programs

- IOUs offer several market integrated DR programs

- Emergency (804 MW)
  - Base Interruptible Program
  - Agricultural Pumping Interruptible
- Economic (393 MW)
  - Capacity Bidding Program
  - AC Cycling
  - Smart Thermostat Program

Third-Party DR Programs

- Third-party companies aggregate customers
- Contract capacity and energy to utilities, CCAs, or offer through Demand Response Auction Mechanism (DRAM)
- DRAM is a pilot for third-party demand response provider (DRP) participation in the CAISO market
- DRAM is technology-agnostic

Load-Modifying DR Programs

- Mostly focus on time-varying rates
- Offered by utilities directly to customers
- Shed and shift load away from peak hours

Dispatchable Programs

Electricity price changes during a triggered event.

Example, during times of grid stress.

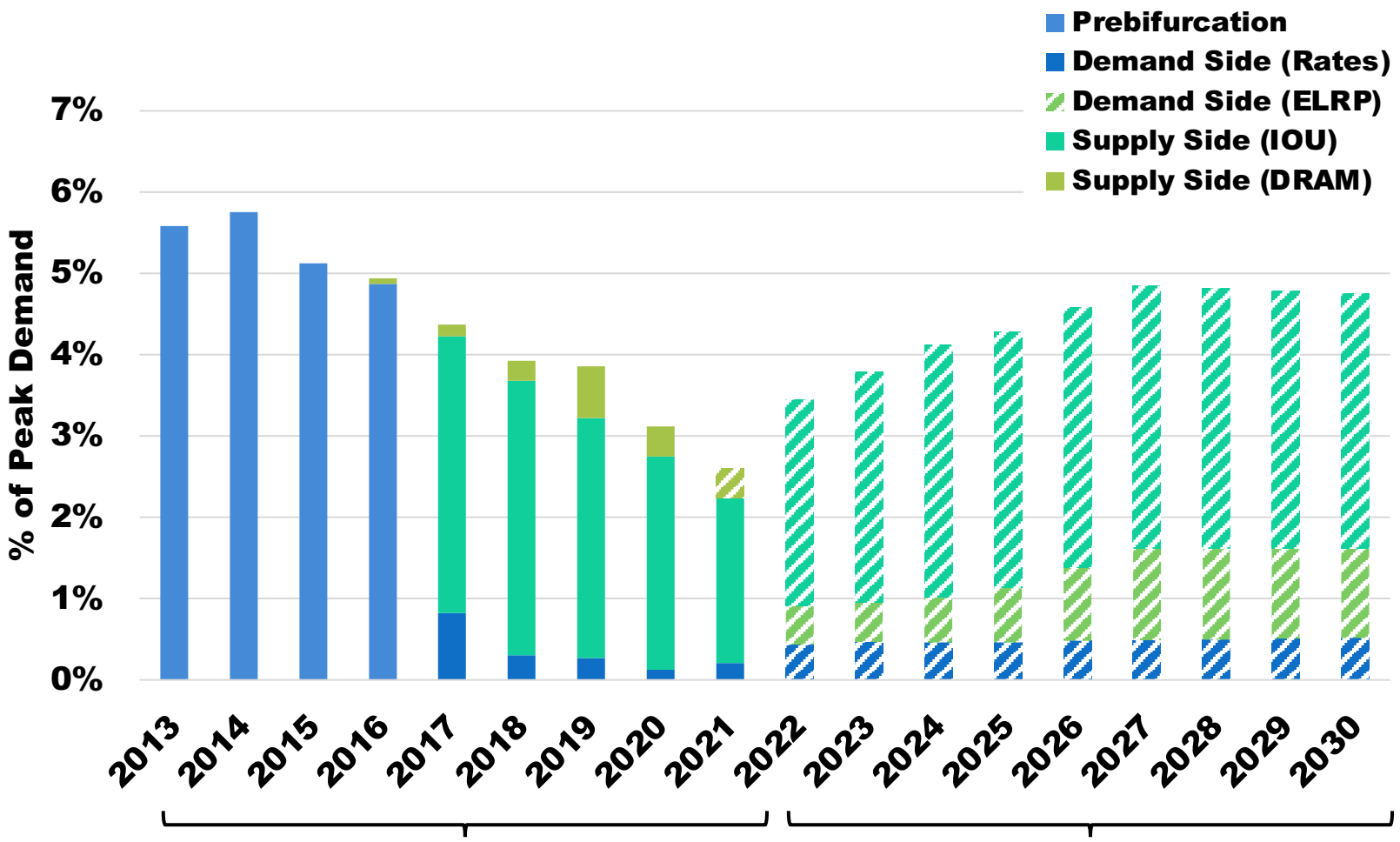
Programs include:

- Critical Peak Pricing
- Peak Time Rebate

Non-Dispatchable Programs

- Includes tiered and time of use rates
- Customer generally knows when and by how much the cost of electricity will change
- Real time pricing is not widely available
  - CEC and CPUC working on regulation to provide access to RTP

Demand Response Status



Actuals *from IOU DR Monthly Reports for August*

Projections *from 2022-2027 IOU DR Applications where available; gaps filled with 2021 load impact evaluation ex ante projections)*

- 2021: DR resource about 3% of peak demand
- Major changes to programs and qualifying resources in last decade
- New growth from ELRP

These projections use existing programs only

Demand Response Outlook

Improvements to drive DR growth

- Reviewing possible changes to methodology for qualifying capacity[1]
- New efforts: Demand Side Grid Support[2] and Emergency Load Reduction Programs[3]
- CPUC Demand Flexibility Rulemaking[4]

1. Flynn, Tom and Lyon, Erik. 2022. Qualifying Capacity of Supply-Side Demand Response Working Group Report. California Energy Commission. Publication Number: CEC-200-2022-001-CMD2
2. Demand side grid support program: https://www.energy.ca.gov/programs-and-topics/programs/demand-side-grid-support-program
3. Emergency load reduction program: https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/electric-costs/demand-response-dr/emergency-load-reduction-program
4. CPUC Demand Flexibility Rulemaking: https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M492/K688/492688471.PDF

Load Management

- Also called Demand Flexibility or Load Flexibility
- Adjust electrical usage rather than spending much more on generation and T&D infrastructure
- ”Prices to devices”
  - Optimize electricity use to the available supply
  - Doesn’t have to be prices, it could be a load shape
  - Save on bills
- Enables widespread electrification without overwhelming the grid
  - HVAC
  - Water heating
  - Transportation

Load Management Definition

The process of maintaining the electric supply-demand balance by adjusting the load rather than the power station output.

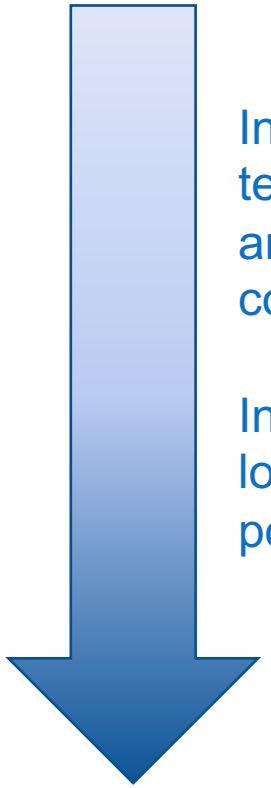
CA Legal definition: Any utility program or activity that is intended to reshape deliberately a utility's load duration curve – PRC § 25132

Load Flexibility Benefits

- Reduce greenhouse gas emissions while maintaining services
  - Avoid use of high-polluting peaking plants
  - Shift loads towards times of carbon-free energy production
- Improve grid reliability
  - Prevent transmission & distribution congestion
- Reduce system costs
  - Minimize electricity use when generation costs are high
  - Avoid construction of battery and power capacity
  - Reduce renewable curtailments
- Increase customer choice
  - Reduce customer bills by shifting load out of high-cost hours
  - Customers can contribute to GHG reductions

How to Flex

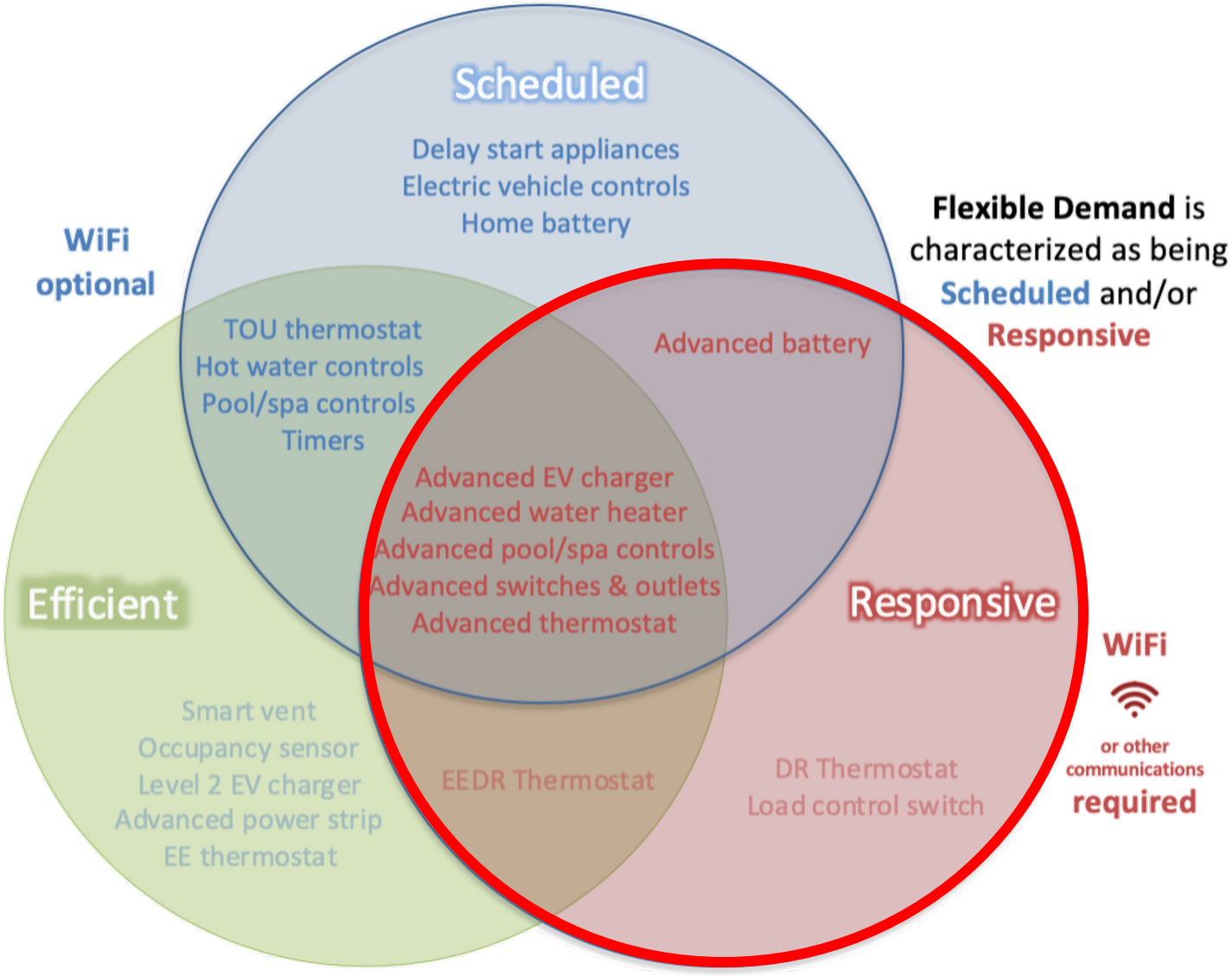
- Timer required
  - Schedule load using timers
  - Respond to existing TOU rates
- Automation and one-way communication required (Prices to devices)
  - Use existing grid and marginal GHG emissions signals (SGIP)
  - Use dynamic marginal cost-based rates (RTP)
- Automation and two-way communication required
  - Transactive rates



Increasing technological and/or policy complexity

Increasing load flexibility potential

Flexible Loads – Residential



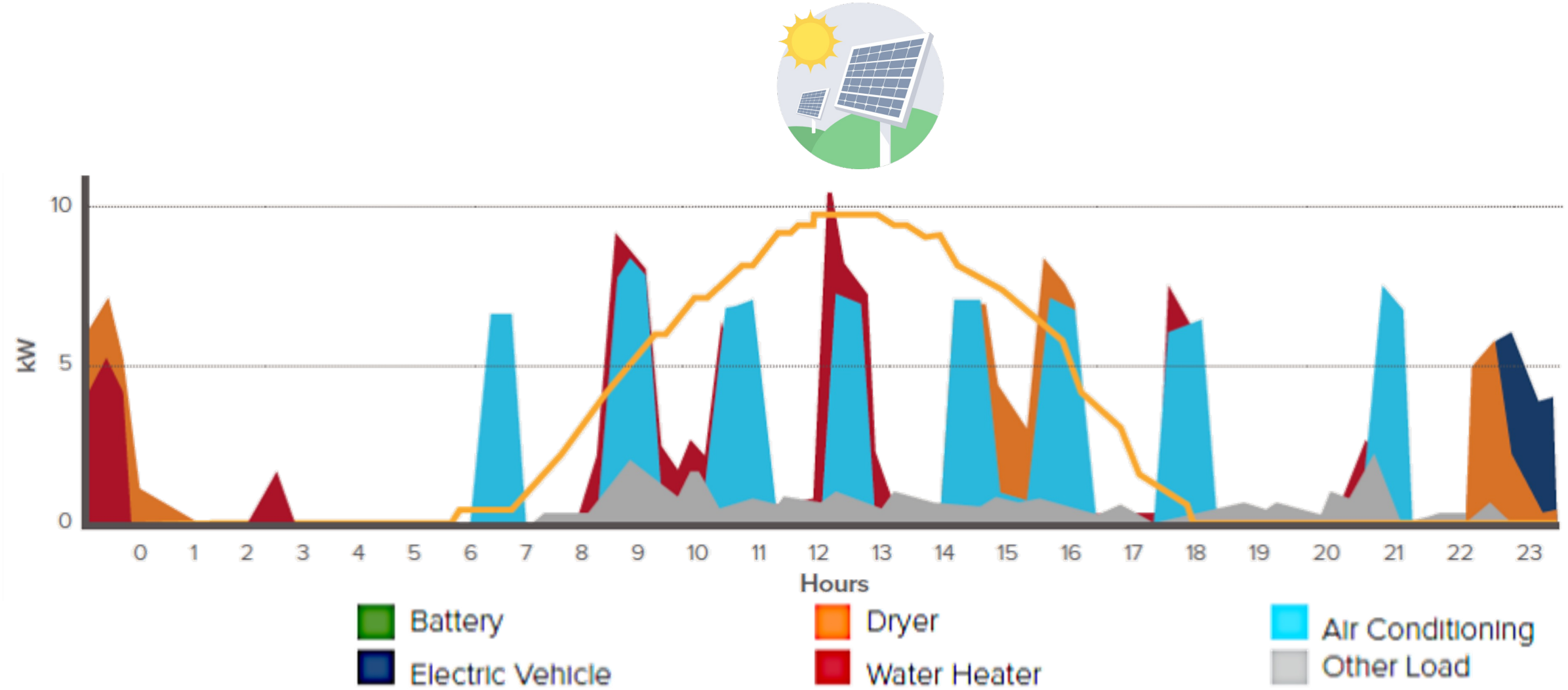
BUT – only about 75% of California homes have Internet

Source: Karen Herter

Flexible Loads – C&I

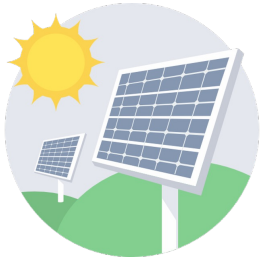
- Water pumps – State Water Project, Municipal, and Ag – pump controls
- Refrigerated Warehouses – delay loading and unloading, precooling
- Industrial Processes – schedule for off-peak or run at lower rates
- Heating and Air conditioning – precool or preheat, reduce runtime
- Data centers – HVAC controls, non-urgent compute tasks
- Electric vehicles – Fleet EV supply equipment
- Water heating – heating controls
- Pools and hot tubs – pump and heating controls (e.g. hotel chains)
- Battery storage – charging controls
- Refrigerators & freezers – compressors and anti-sweat heaters

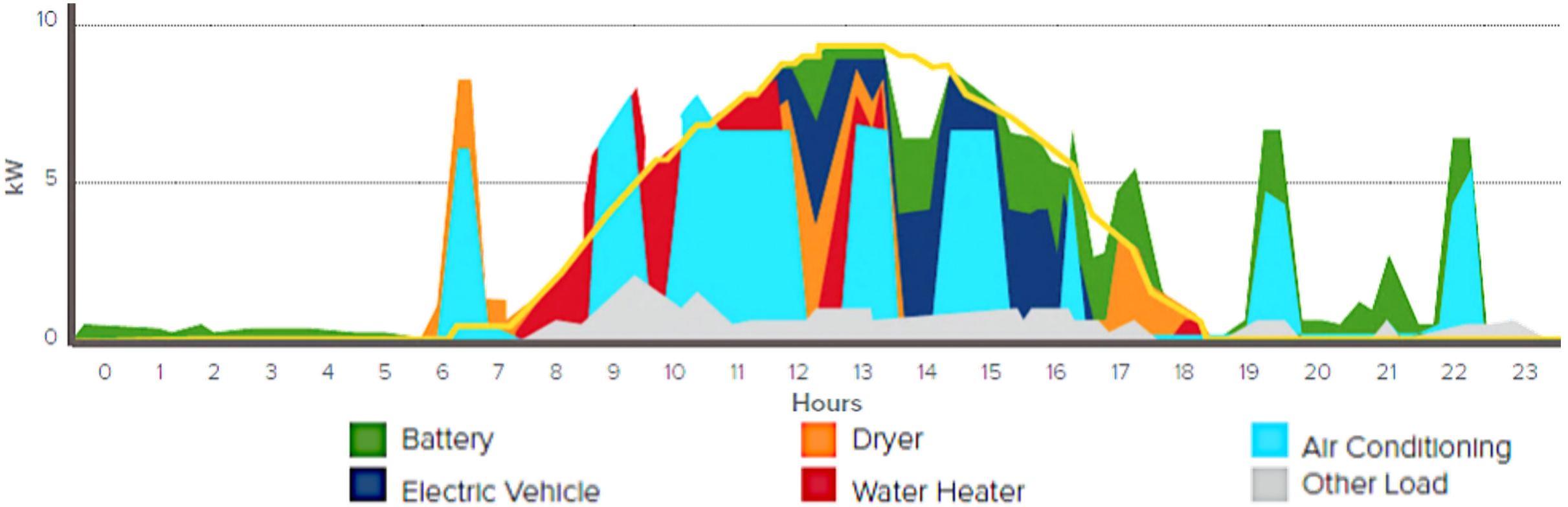
Uncontrolled Load Profile



Source: RMI 2018

Flexible Load Profile





Source: RMI 2018

CEC Load Management Authority

- The commission shall… adopt standards by regulation for a program of electrical load management for each utility service area.
- In adopting the standards, the commission shall consider, but need not be limited to, the following load management techniques:
    1. Adjustments in rate structure to encourage use of electrical energy at off-peak hours or to encourage control of daily electrical load.
    2. …
    3. Mechanical and automatic devices and systems for the control of daily and seasonal peak loads.

    - Warren Alquist Act, 1974

    Public Resources Code § 25403.5

California Context

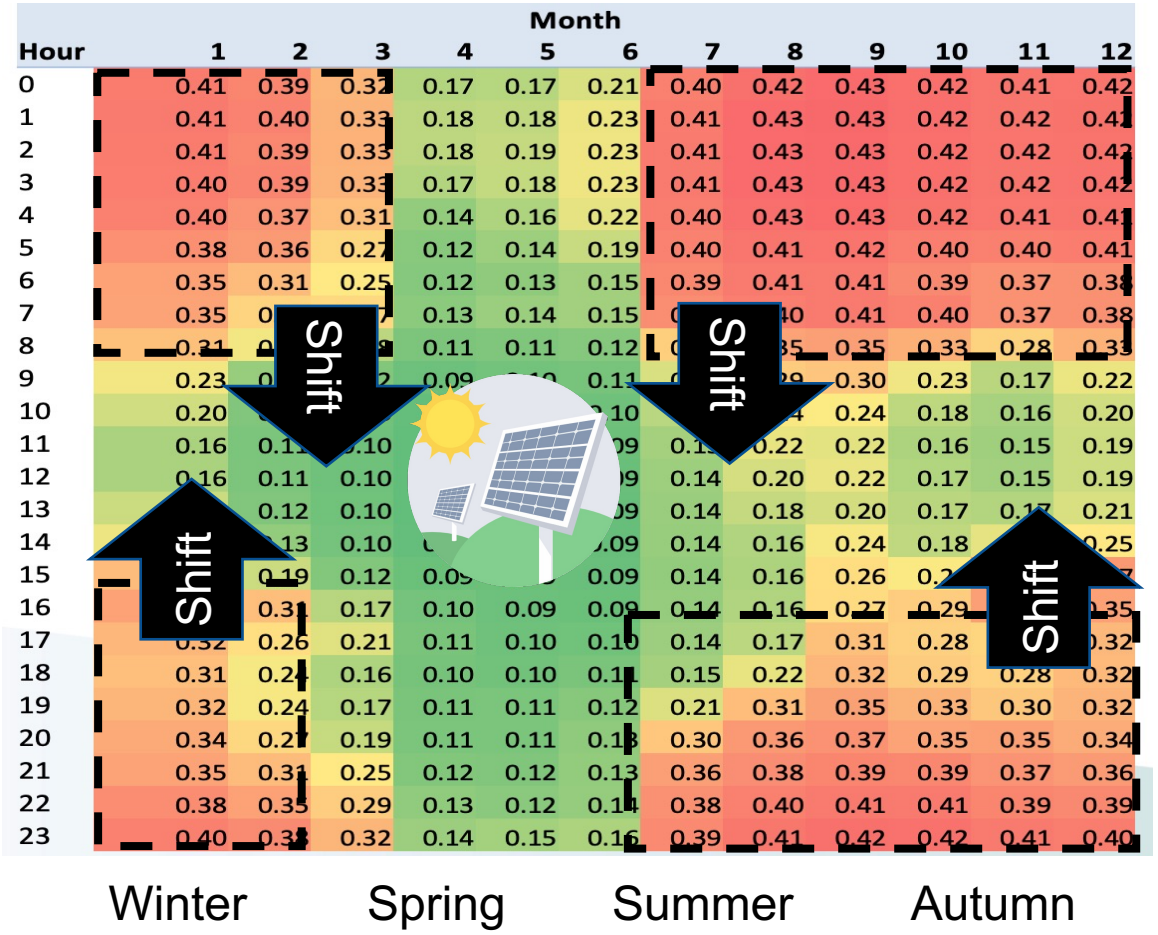
- Goals
  - **60% renewable generation** by 2030
  - **100% of new vehicles emissions free** by 2035
  - **100% carbon-free grid** by 2045
- Opportunities
  - TOU default for all customer classes at 4 of 5 top electric utilities in CA
  - 5-minute GHG signal from CPUC's Self Gen Incentive Program (SGIP)
  - Connected devices increasingly available and affordable
- Challenges
  - No statewide access to machine-readable rates (addressing with MIDAS)
  - Lack of responsive automation (because of above)
  - Broadband Internet access in ~75% of CA homes[1]

[1] Source: broadbandnow.com

Renewables alone aren't enough

Load management helps decarbonize the grid

2021 Hourly Marginal Emissions Intensity (MT CO_2/MWh)



Shift electricity use from dirty hours…

…to clean hours

(charge, heat, cool, pump: 9am to 3pm)

HOW?

Publish price & emissions signals for automation devices to reschedule default run-times

Source: Angela Tanghetti, CEC

3-year Load Flexibility Roadmap

1. CEC publishes a central statewide **Rate Database: MIDAS**
2. Utilities establish a system to enable third-party **automation services**
3. CEC creates **Flexible Demand Appliance Standards**
4. Utilities establish **programs** to help customers respond to prices and GHG emissions
5. EPIC Load Flexibility Research Hub provides research and on load flexibility and tests communication pathways and flexible devices
6. Utilities offer optional locational marginal hourly and sub-hourly **rates to all customers** (Load Management Standard and CPUC Rulemaking 22-07-005)

Load Management Standards

1	Rate Database	• Maintain existing and future time-varying rates in the publicly available and machine-readable MIDAS rate database
2	Automation Services	• Develop a standard rate information access tool to support automation services
3	Hourly Rates	• Develop and submit locational rates that change at least hourly to reflect marginal wholesale costs
4	Customer Education	• Integrate information about new time-varying rates and automation technologies into existing customer education and outreach programs

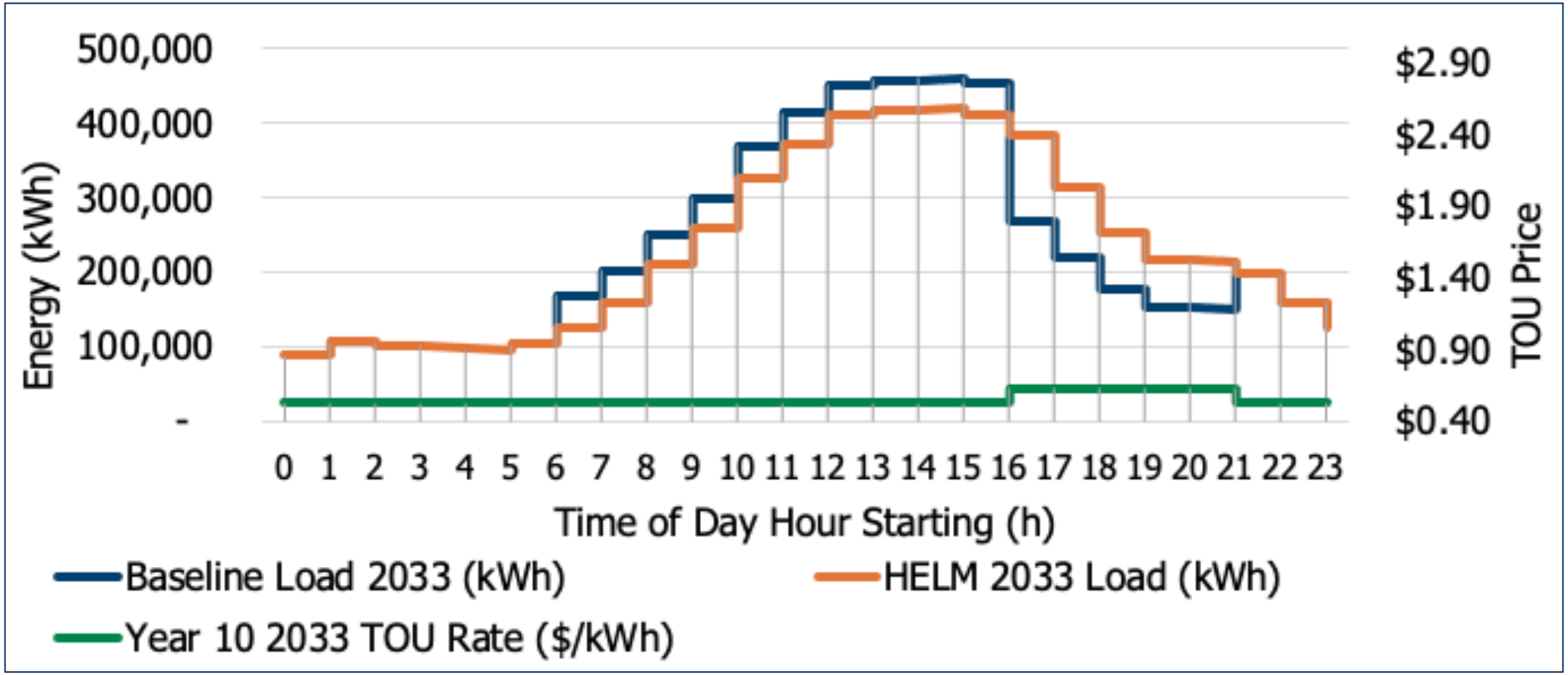
Flexible Demand Appliance Standards

Flexible demand standards for pool controls are feasible and cost-effective

Phase 1	Phase 2	Phase 3
Pool Controls	Electric Storage Water Heaters	Electric Vehicle Supply Equipment
Dishwashers*	Behind the Meter Batteries	
Electric Clothes Dryers*		
Thermostats*		

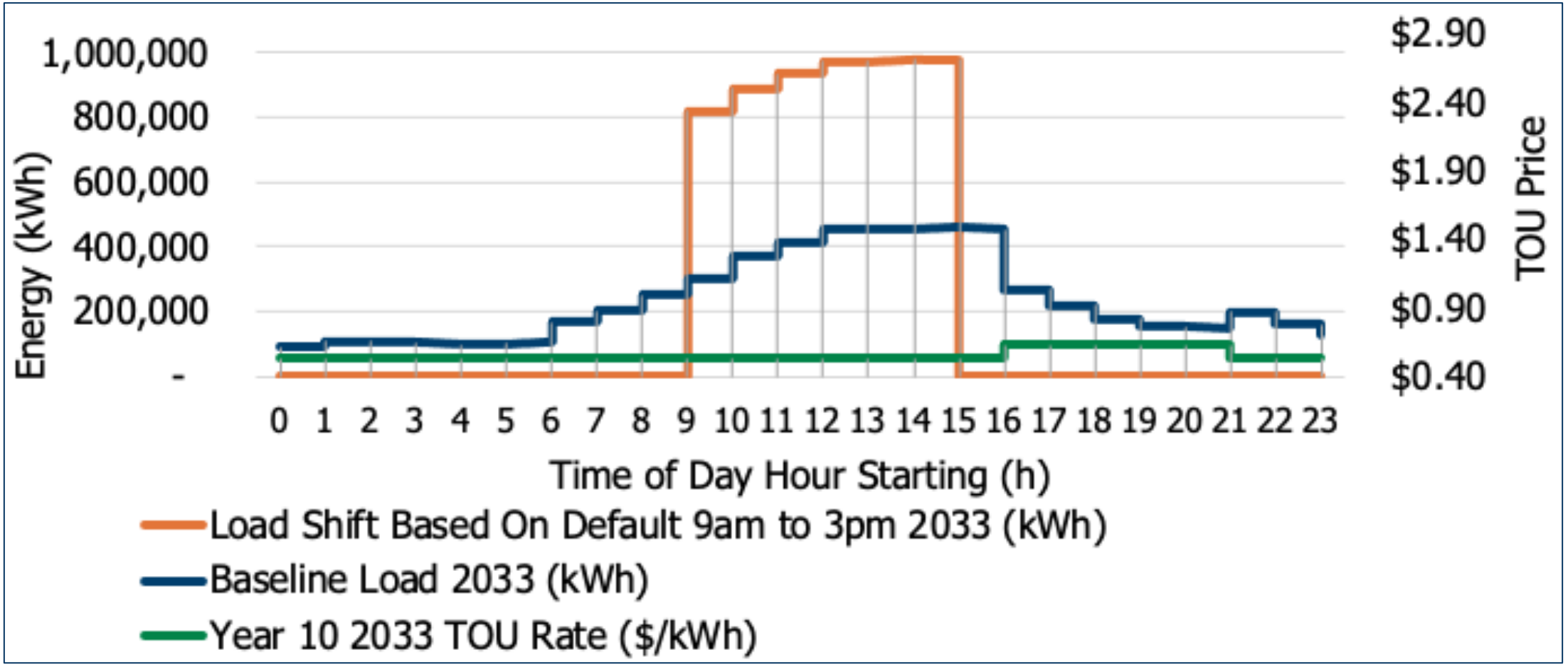
*To be revisited

Pool Load Shapes and TOU Rates



Proposed Load Shift Strategy

Load shift based on default schedule 9 a.m. to 3 p.m.



CPUC efforts

- UNIDE staff workshop (May 2021)
- CalFUSE staff paper (July 2022)
- DER Action Plan 2.0 (June 2022)
- Dynamic rates for demand flexibility R.22-07-005 (July 2022)
- Pilots
  - VCE/PG&E agricultural pumping dynamic rate (2022)
  - SCE “RATES” phase 2 pilot – open to all residential and C&I customers (2022)
  - PG&E Commercial Day-ahead RTP (late 2023)
  - PG&E RTP rate for multiple customer classes (late 2023)
  - SDG&E RTP and EV RTP rates

Societal Benefits from DR and LM

- Environmental Benefits:
  - Avoided air pollutants
  - Avoided GHG emissions
- System Reliability and Resilience
- Customer Bill Savings
- Avoided Costs
  - T&D
  - Ancillary services
  - Generation
  - Curtailment

Thank You!

LMS Information

- CEC Staff Contacts
  - Technical analysis: Stefanie Wayland
  - Economic analysis: Gavin Situ
  - MIDAS: Morgan Shepherd
- Relevant Documents and Websites
  - CEC Staff Analysis of Proposed Amendments
  - 2021 Load Management Rulemaking website
  - Load Management Standards: CCR Title 20 §1621-1625
  - Flexible Demand Appliance Standards: PRC 25402
  - Warren-Alquist Act: PRC 25403.5