DOCKETED	
Docket Number:	19-SB-100
Project Title:	SB 100 Joint Agency Report: Charting a path to a 100% Clean Energy Future
TN #:	230749
Document Title:	Mary Ann Piette - Demand Flexibility
Description:	Presentation by Mary Ann Piette, Lawrence Berkeley National Laboratory
Filer:	Harinder Kaur
Organization:	California Energy Commission
Submitter Role:	Commission Staff
Submission Date:	11/15/2019 3:09:37 PM
Docketed Date:	11/15/2019

Demand Flexibility

CEC Workshop on 100% Clean Energy

Mary Ann Piette
Lawrence Berkeley National Laboratory

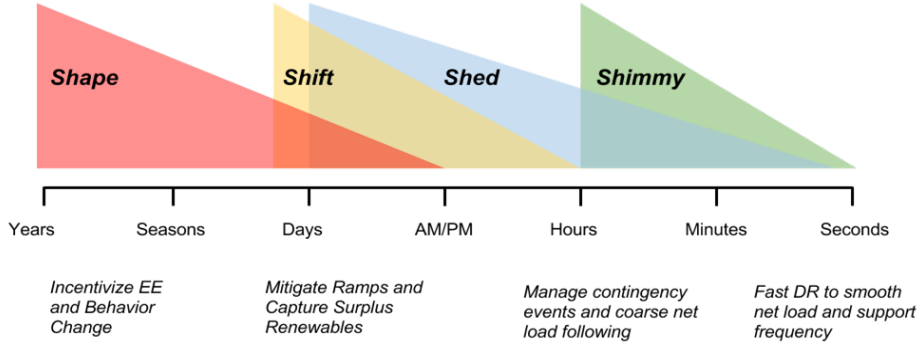
Nov 18, 2019

Brian Gerke, Peter Schwartz, Sarah Smith, Shuba Raghavan, Ronxgin Yin
Lawrence Berkeley National Laboratory

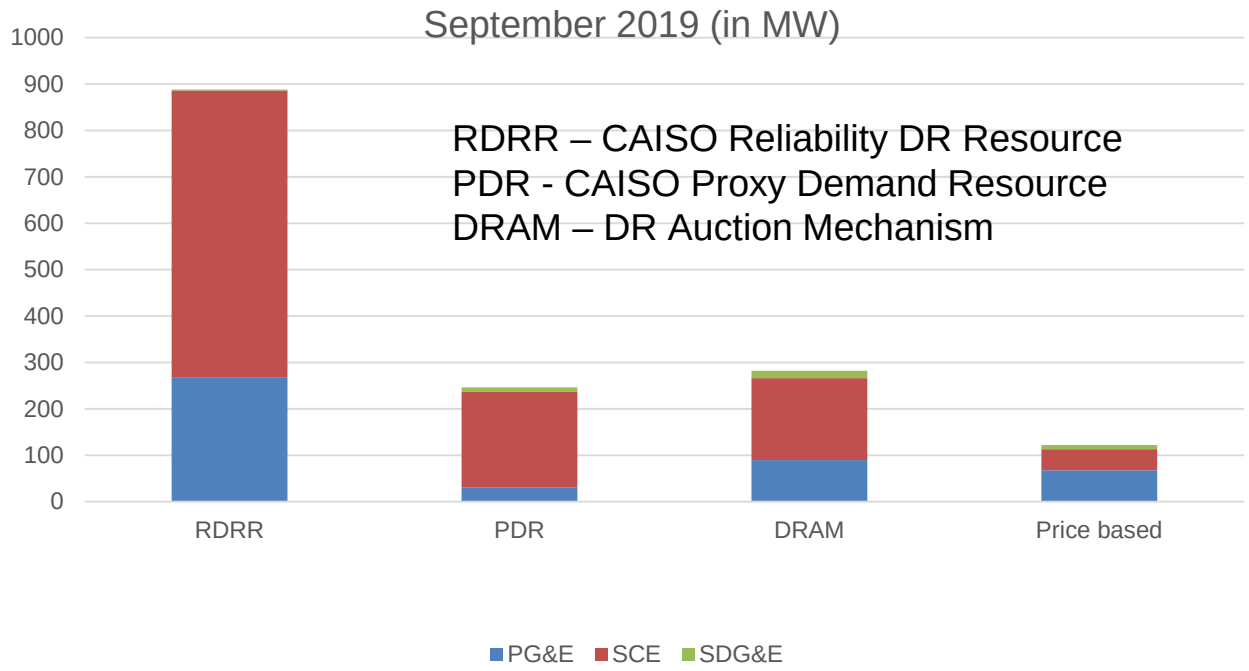
Peter Alstone
Schatz Energy Research Center – Humboldt State University

Demand Flexibility and Response
Status and Opportunities

1. Current market size and planned development
2. DF and DR characteristics, market potential and barriers
3. Cost trends
4. New and emerging technical innovation
5. Future directions

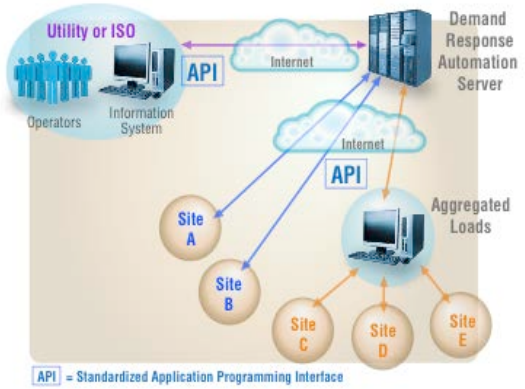


1. Current Market - 1.5 GW of DR in IOU and CAISO Programs



DR Opportunities and Programs (Near Term)

- **Deemed incentives** - to small/medium businesses to facilitate ADR – focus on HVAC and lighting
- **2 way communication -** to support advanced DR and transactive energy options
- **Rebates/incentives** - encourage use of pre-selected list of smart or programmable Tstats
- **Integrated Demand Side Management**
- **Title 24** Automated DR with OpenADR



2. DF and DR Characteristics, Market Potential and Barriers

DR Potential Study Overview

- Phase 1 and 2 study created supply curves for Shape, Shift, Shed and Shimmy – Shift is most valuable
- Phase 3 is addressing three broad questions:
  - **How big** is the Shift resource?
  - **Where** is the Shift resource and **when** is it available?
  - How can we get **more** Shift?
- Key takeaway: Shift can play an important role in supporting California's renewable **present**—and we can start trying it now!
- Phase 4 will include more technologies and grid linkages

3. DF Characteristics

End use	Sector	Approach/technology
Space cooling	Res	Pre-cooling with PCT
Space heating	**Res**	**Pre-heating with PCT**
HVAC	Com	Pre-cooling with PCT/EMS; **Thermal storage**
Ventilation	Res/Com	Advanced controls
Water heating	**Res**	**Pre-heating and scheduling**
	Com	Pre-heating and scheduling
Pool pumps	Res	Dynamic scheduling
Irrigation pumping	Ind (Ag)	Dynamic scheduling
Wastewater pumping	Ind	Dynamic scheduling
Water supply pumping	Ind	Dynamic scheduling/pumped storage
Industrial process	Ind	Dynamic scheduling
Refrigeration	Com	Warehouse pre-cooling
	Res/Com	On-board thermal storage, smart cycling
EV charging	**Res/Com**	**Dynamic scheduling**
	Res/Com	Two-way charging
Battery (whole building)	**All**	**Storage, two-way charging**
Battery (distributed/point of use)	All	Storage, two-way charging
Plug Loads/Appliances	Res/Com	Dynamic scheduling (eg, dishwashing)
Lighting	Ind (Ag)	Indoor photoperiod shifting (grow lights)

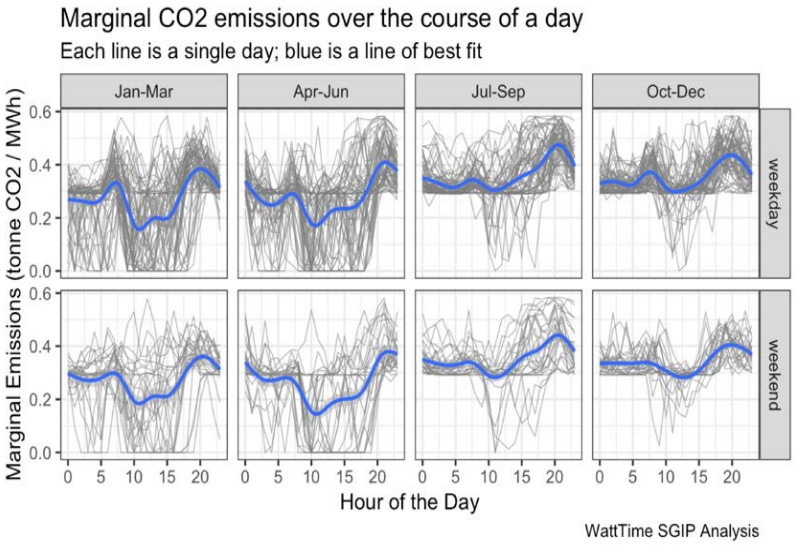
Key
Included in Phase 2
New in Phase 3
Major update in Phase 3
Under consideration Phase 4

Shift & GHG - Load Modifying DR CO_2 Savings Ranges From 0.10 - 0.25 tons/MWh

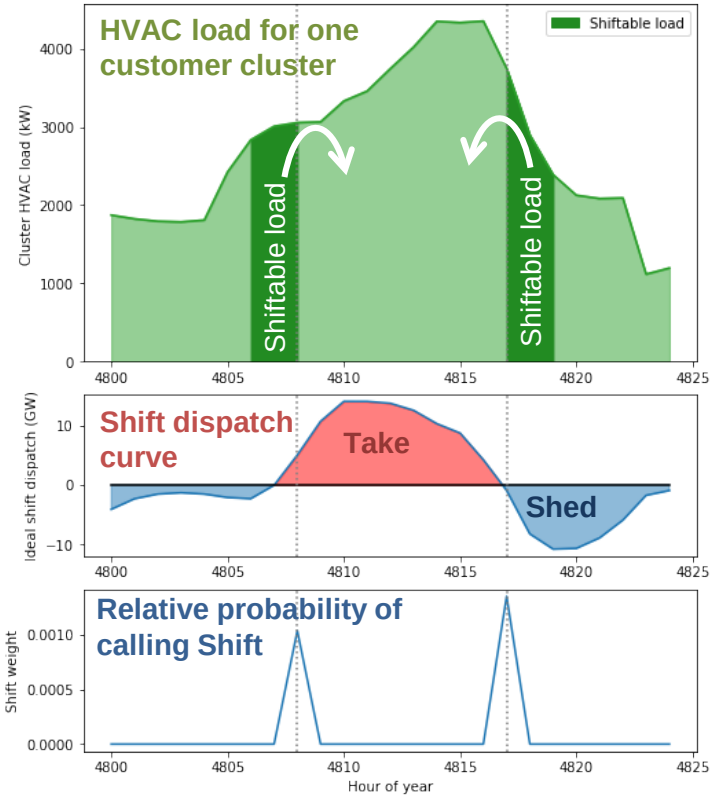
How shift reduces GHG

- **Compliance frame:** avoids curtailment enabling RPS targets at lower cost avoiding uneconomic RPS build-out.
- **Operations frame:** arbitrage to reduce emissions from differences in marginal emissions during shed and take times.
- **Reducing load during evening peak** can lower need to run power plants

Load Shift Working Group evaluated net loads, prices, estimated marginal emissions to test effectiveness of Shift strategies.



LBNL DR-Path Model Evaluates Shift



DR supply curve for Shift as function of levelized cost of procurement ($/kWh-yr).

- Computes idealized **dispatch curve** with potential Shift events on zero-pts.
- Combines **shiftable load** and **probability** of dispatch at each potential event, yields max weighted avg Shift per cluster.
- Pairs customer load clusters with **DR-enabling tech** and **incentives** to estimate supply of Shift enabled at given price.

DR-Path
Example technology inputs

Residential PCT

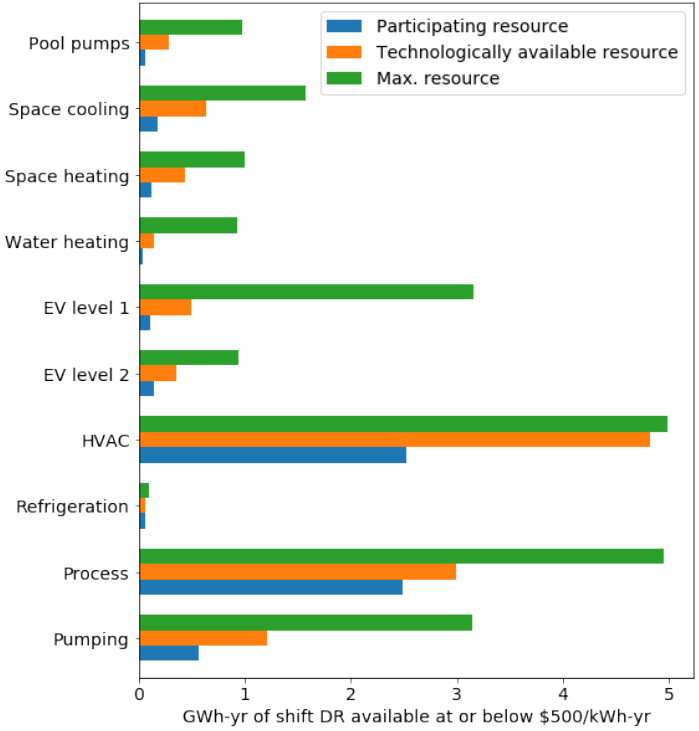
- **1 tstat** per house
- Fixed costs tstat + installation: **~$300**
- Fixed operating costs for software: ~$15/yr.
- No variable costs
- **Co-benefits- energy savi**ngs defray 30% of costs
- **Shift**: **75%** of load in 4-hr window.
- **10% energy penalty** for shifted load.

Commercial Controls for HVAC

- System **costs assumed to scale** with size.
- Variable initial cost **~$250/kW.**
- No significant **fixed** costs.
- No significant **operating** costs.
- **Co-benefits - energy savings** defray 30% of costs.
- Shift : **60%** of load in an 8-hour window.
- **10% energy penalty** for shifted load.

Participating vs. Total Shift potential

The importance of customer participation rates

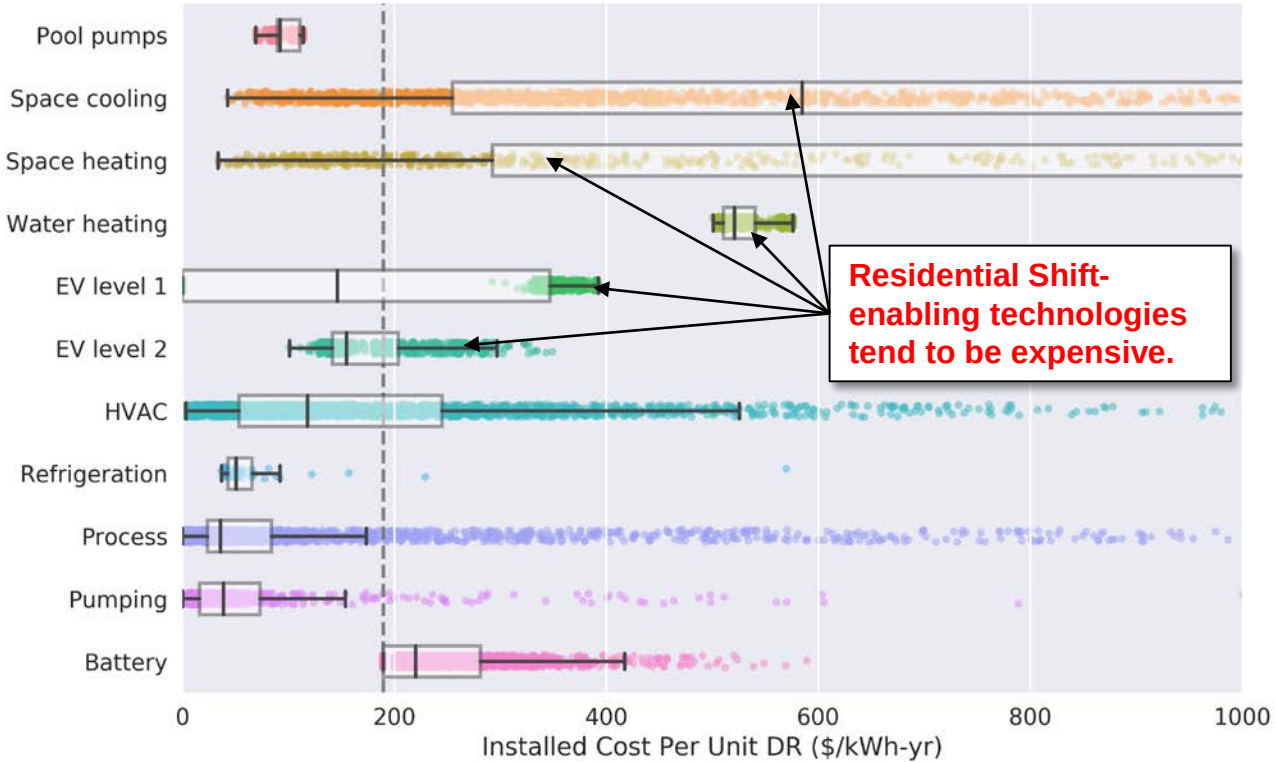


Technology cost and performance levels constrain how much of the total shiftable load can be made accessible.

DR-Path includes a customer participation model based on historical participation rates, which sharply curtails residential participation. New engagement models may help.

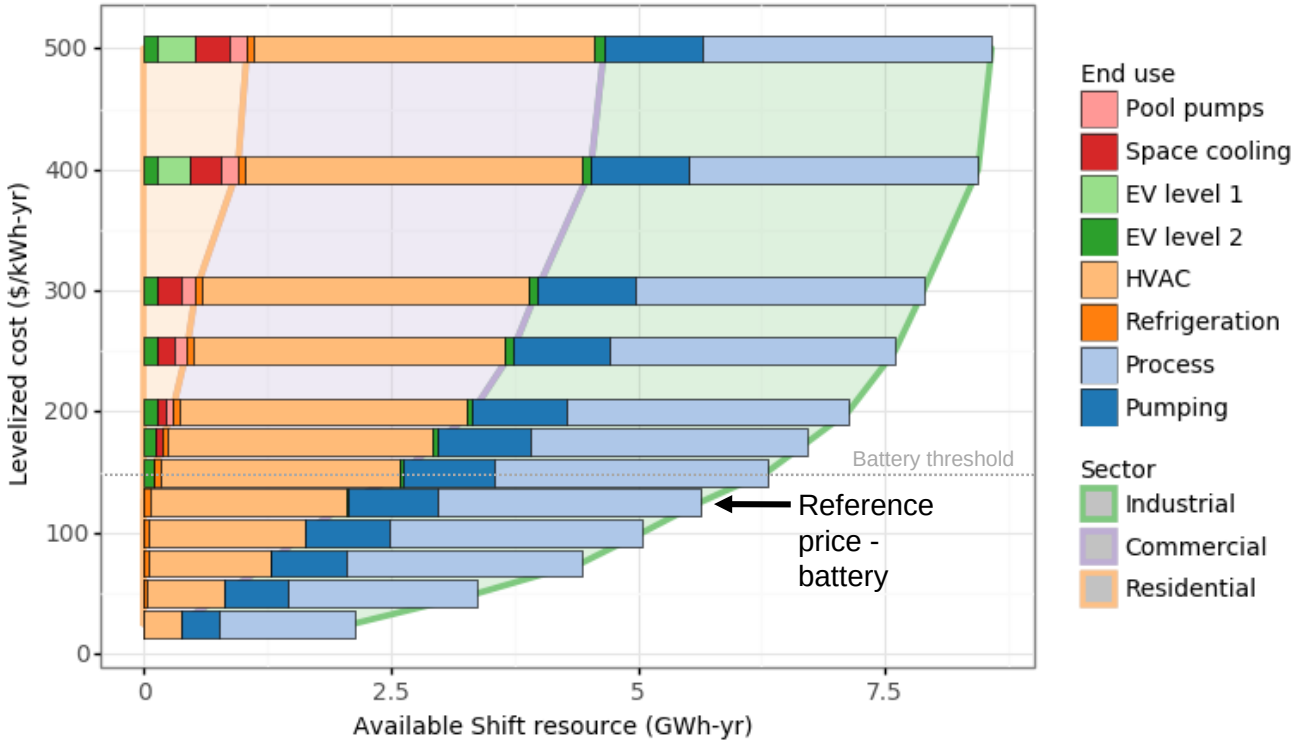
3. Costs trends - To Enable Shift

Reducing technology costs can unlock new resources



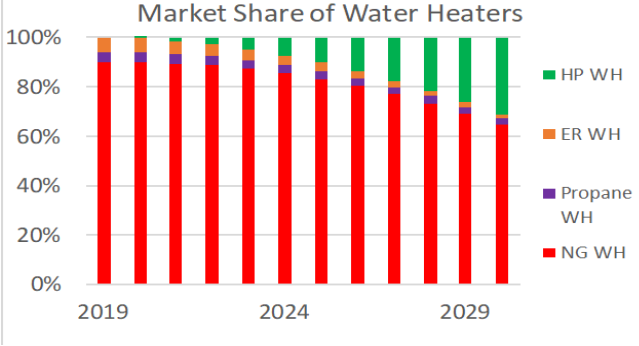
Shift Supply Curve for 2030

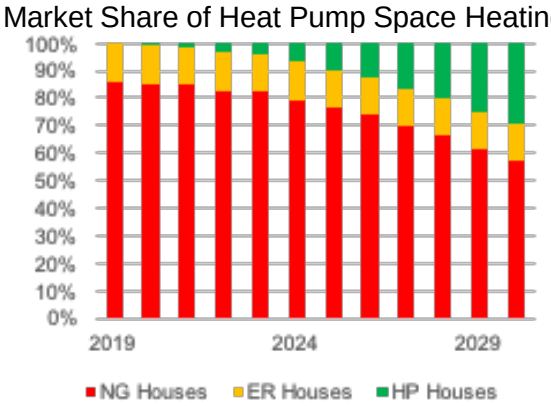
By sector and end use



4. Emerging Tech Innovation - Loads from Electrification

Electrified Residential Space & Water Heating



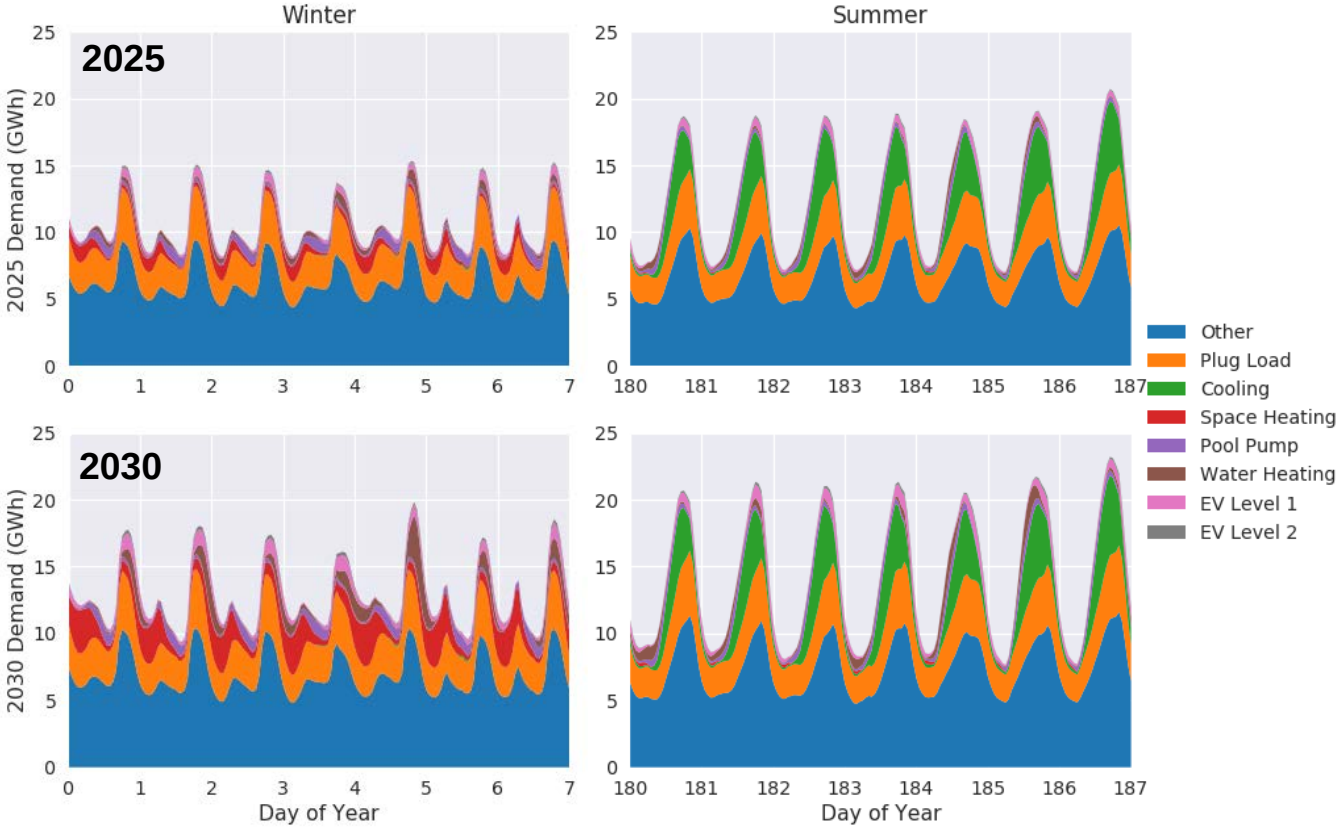


Assumed adoption of electrified space & water heating rate that can meet carbon neutrality mandate.

Only resid sector modeled in Phase 3 (non-residential more complex).

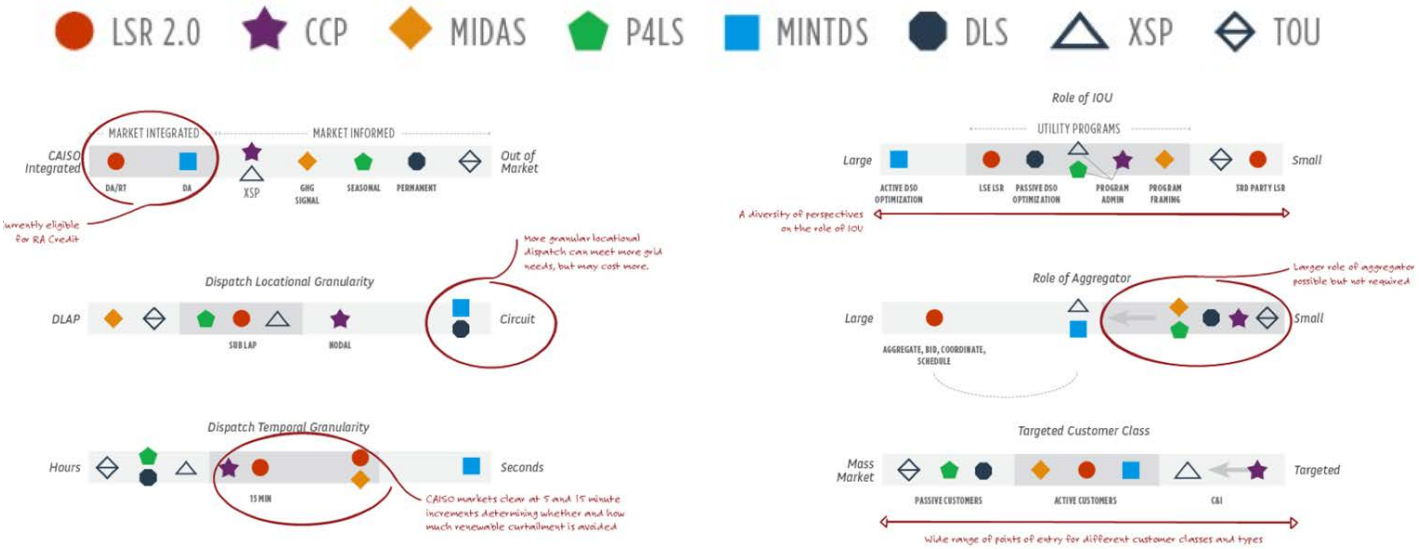
New Loads from Electrification

Statewide Residential Demand with Electrification



Pathways to Shift as a Resource:
Diverse Pilot Options to Try

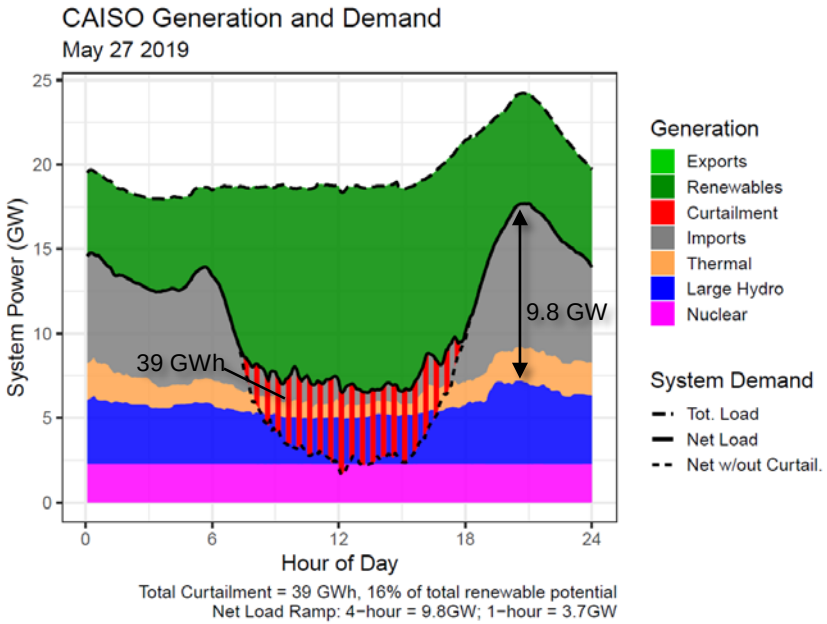
- **Load Shift Working Group Identified 6 pilot concept**.
- Data from pilots are needed to chart a course for Shift resource



Read more at: https://gridworks.org/initiatives/initiatives-archive/load-shift-working-group/

5. Summary and Future – Demand Side can be Lowest Cost Path – California Needs to Innovate Quickly

- **New Shift-enabling technologies (thermal storage)**
- **New Shiftable loads (electrification)**
- **Enhancing Shape - automating TOU response + Digital Tariff**
- **Multi-year programs**
- **Need State wide Pricing Pilot 2.0!**



Source: CAISO

Thank You

Thank you to Our Sponsors

The California Public Utilities Commission and the California Energy Commission

Principal Investigator: Mary Ann Piette mapiette@lbl.gov

Technical Lead: Brian Gerke bfgerke@lbl.gov