ET Summit 2024

Presented by

Flexible Load Telecommunication Pathways and Protocols

Options for “Price to Device”

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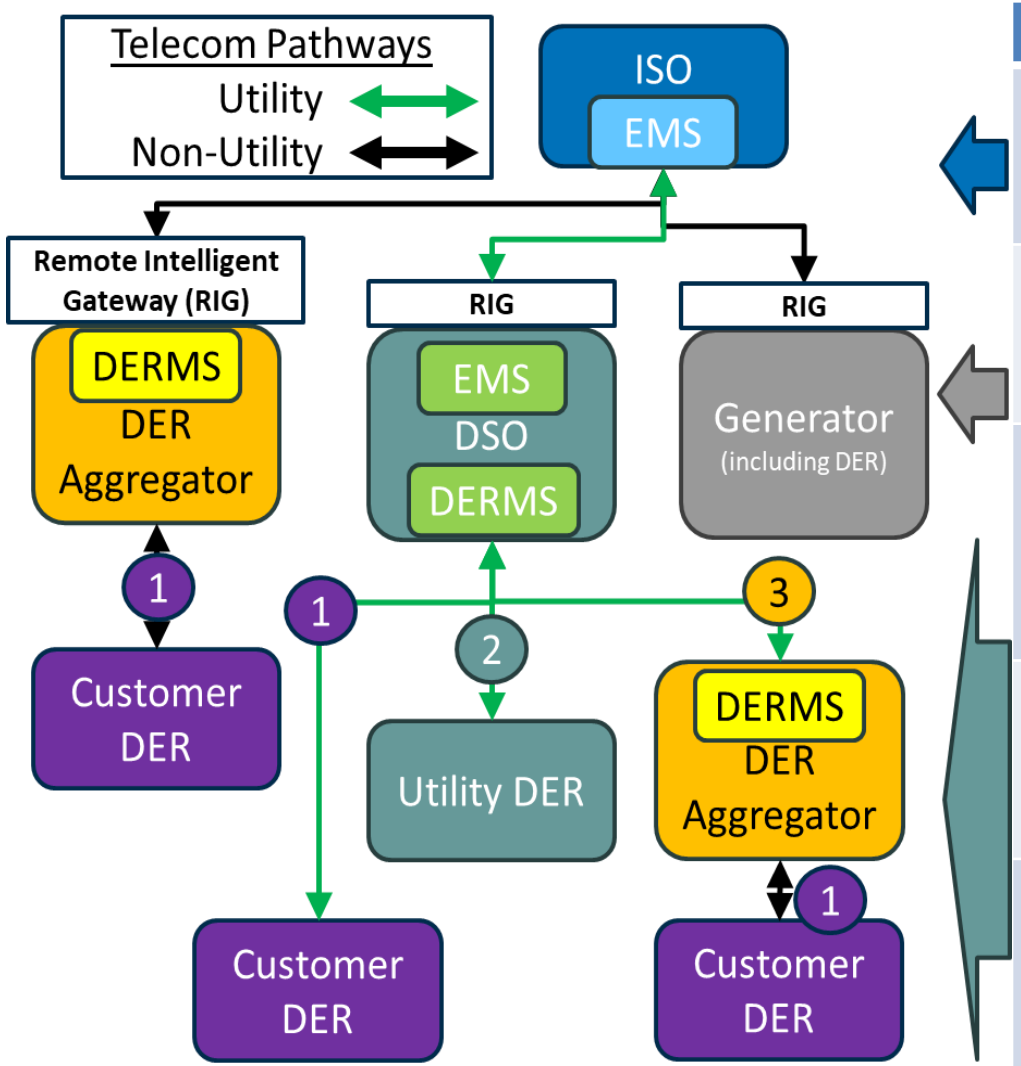
A CESI Company

Telecommunication Pathways and Protocols



Source: ©2024 EnerNex, LLC

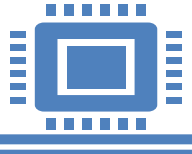
Telecom Pathway	Messaging Protocol		
AT&T Energy Communications Network (ECN).	**DNP 3.0** (ISO Standard) • ICCP • Modbus (+)	• CDC Type I • Conitel 2020/2100H • PGAE	Market
Utility IT and OT Networks	**DMS** • DNP 3.0	**DERMS** • OpenADR • MultiSpeak • IEEE 2030.5	Utility
1. Customer's Internet Service Provider • Dedicated cellular (for larger DER) • Advanced Metering Infrastructure (AMI) IEEE 802.15.4g mesh network*	**1. IEEE 2030.5** • Sun-Spec / Modbus • MESA-DER map of IEC 61850 to DNP3 • OpenADR • MultiSpeak		Utility to DER and Aggregators
2. Utility Field Area Network (FAN) • Cellular • WAN SONET (CCTN)	**2. IEEE 2030.5** • MESA-DER Specification mapping of IEC 61850 to DNP3		
3. VPN Internet	**3. OpenADR 3.0** • IEEE 2030.5 • MESA-DER Specification mapping of IEC 61850 to DNP3 • Sun-Spec / Modbus • MultiSpeak		

*AMI 2.0 Discussed further on following slide

Advanced Metering Infrastructure (AMI) 2.0

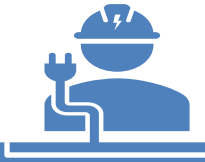
The most common deployments utilize IEEE 802.15.4g for Neighborhood Area Network (NAN) mesh telecommunication to the meters

- The data will hop from mesh node to mesh node until it finds a mesh gateway
- Common to have a cellular enabled gateway on a utility pole
- Less common to use a utility Wide Area Network (WAN) gateway at a substation
- Point-to-Multipoint solutions are also available
- Some utilities are exploring Private LTE for the Field Area Network (FAN)



Mesh networks with three or less hops can support distribution automation and DER/DR communications

- More than three hops can introduce signal latency



Latest generation of AMI Home/Premise Area Network (HAN/PAN) uses Wi-Fi (IEEE 802.11) for telecommunication and IEEE 2030.5 for messaging protocols.

- Customer can add the meter as a device on their Wi-Fi network
- Will enable customer to interface with their meter through a smart phone application just like interfacing with other smart home devices.
- Enables communication between IEEE 1547-2018 advanced inverters and the meters using IEEE 2030.5.
- Vendors are developing distributed intelligence applications with partners for both grid analytics as well as customer engagement

Market Informed Demand Automation Server (MIDAS)

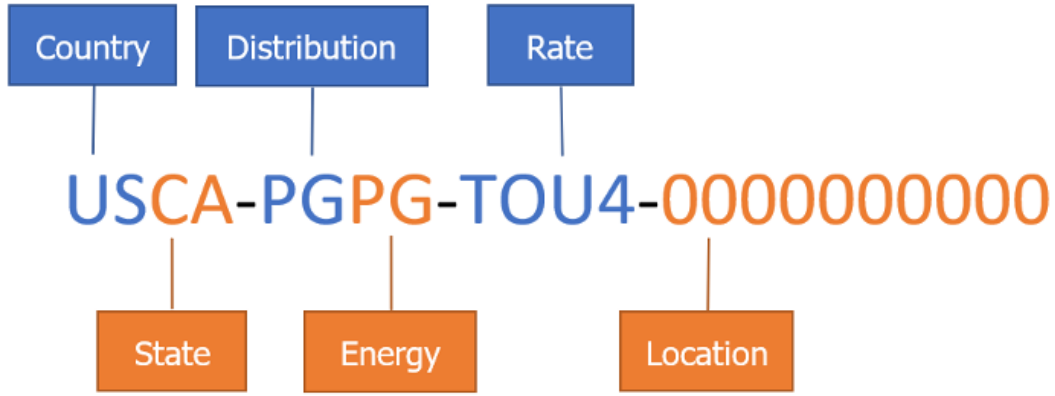
- California Energy Commission (CEC) MIDAS provides access to utilities' time-varying rates, greenhouse gas emission signals, and California Independent System Operator FlexAlerts. When connected to flexible loads (appliances or programs), it can increase efficiency and support decarbonization efforts.
- **Goal**: use MIDAS time-dependent rate data and other signals to lower GHG emissions and utility bills for all CA customers and communities, while supporting electricity grid reliability and response to emergency events.
  - A CEC-commissioned study demonstrated heat pump water heater can respond to MIDAS price signals, with results indicating 15 percent savings time-of-use price response and double the savings (29 percent) for real-time price response
- CEC issued Request for Information (RFI) and Feedback: on Consultant Report "Expanding Flexible Demand in California through Statewide MIDAS Data Delivery: A Comparison of Signaling Options" in Docket # 24-FDAS-02

https://www.energy.ca.gov/proceedings/market-informed-demand-automation-server-midas

MIDAS Database and API

- "**MIDAS is designed to provide energy users with electricity price information they need to optimize when they use energy**."
- Most information in the database is tied to a Rate Identification Number (RIN)
- Users register to use the API, then request a token which enables queries for 10 minutes
- The API consists of six endpoints to provide relevant information (e.g., ValueData, HistoricalData, HistoricalList)
- Energy users get information with API calls:
  - List of available RINs
  - Rate information for a specific RIN
  - List of holidays

RIN Structure



Code Example from API Documentation

Python Example

```
import requests
import json

# SignalType 1 returns electricity rates
signaltype = '1'

headers = {'accept': 'application/json', 'Authorization': "Bearer " + token}
url = base_url + '/valuedata?signaltype=' + signaltype
list_response = requests.get(url, headers = headers)
```

CEC Market Informed Demand Automation Server (MIDAS): https://www.energy.ca.gov/proceedings/market-informed-demand-automation-server-midas

Statewide MIDAS Data Delivery

- CONSULTANT REPORT: Expanding Flexible Demand through Public Broadcast of Greenhouse Gas Emissions and Electricity Prices - Costs and Benefits of Potential Appliance Standards
  - "…the California Energy Commission is exploring options for delivering price and greenhouse gas emissions forecasts to appliances from California's Market Influenced Demand Automation Server, commonly known as MIDAS.
  - The purpose of the envisioned MIDAS signaling system is to enable the coordination of appliance operations with grid conditions, lowering greenhouse gas emissions and utility bills for all electricity customers, including those in settings without access to broadband internet.
  - This paper evaluates broadcast radio, cellular radio, and smart meters for use in transmitting MIDAS signals to California appliances.
  - After excluding smart meters due to the absence of universal availability, we determine that broadcast and cellular radio technologies have the technical capacity to reliably deliver MIDAS data messages statewide.

Docket: 24-FDAS-02 https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=24-FDAS-02

CONSULTANT REPORT: https://efiling.energy.ca.gov/GetDocument.aspx?tn=256582&DocumentContentId=92391

Foundational principles that guided the feasibility assessment of the different technologies

1. Demand flexibility capability should be **ubiquitous** and available to every customer in the state.
2. A customer should not be required to sign up for, or participate in, a third-party program to receive flexibility signals or take flexibility actions.
3. Flexibility standards should not preclude existing or future utility-specific DR programs.
4. Flexibility standards should **leverage market forces** to make demand flexibility low-cost and customer responsive.
5. Where possible, flexibility standards should be agnostic to the underlying technology used to accomplish these goals.
6. When necessary to establish a statewide standard for technology, this should be a "default" rather than "exclusive" solution that does not eliminate or preclude any existing or prospective technology.

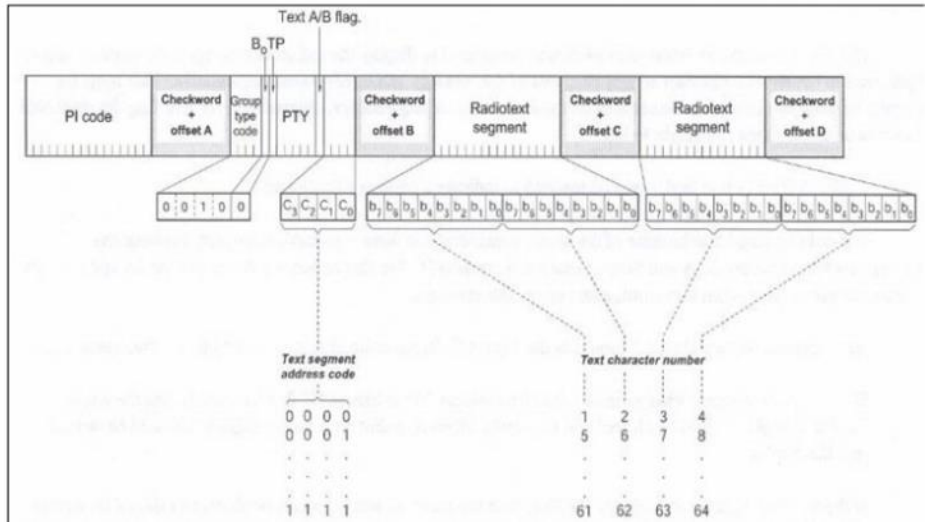
Docket: 24-FDAS-02 https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=24-FDAS-02

CONSULTANT REPORT: https://efiling.energy.ca.gov/GetDocument.aspx?tn=256582&DocumentContentId=92391

Radio Data System (RDS)

- "**After excluding smart meters due to the absence of universal availability, we determine that broadcast and cellular radio technologies have the technical capacity to reliably deliver MIDAS data messages statewide.**"
  - Note: Not all utilities offer Time of Use (TOU) rates, so MIDAS would provide limited benefit
- RDS specifies a method for using standard audio broadcasts to transmit text up to 64 characters long.
  - The standard describes a physical layer, data-link layer, and message format.
  - Each message can deliver 64 usable characters at 1.2 kbps.
- **The consultant report suggest at least one Rate Identification Number data steam would be needed, but eleven would be more useful.**
  - **One stream for statewide GHG emissions data and one for each of the ten default load aggregation points (DLAPs).**

Figure 7. RDS Data Frame Structure



Source for Figure 7: Consumer Technology Association, National Association of Broadcasters. United States RBDS Standard. NRSC-4-B: National Radio Systems Committee, 2011

Table 1. Estimated RDS Capacity for MIDAS Messaging

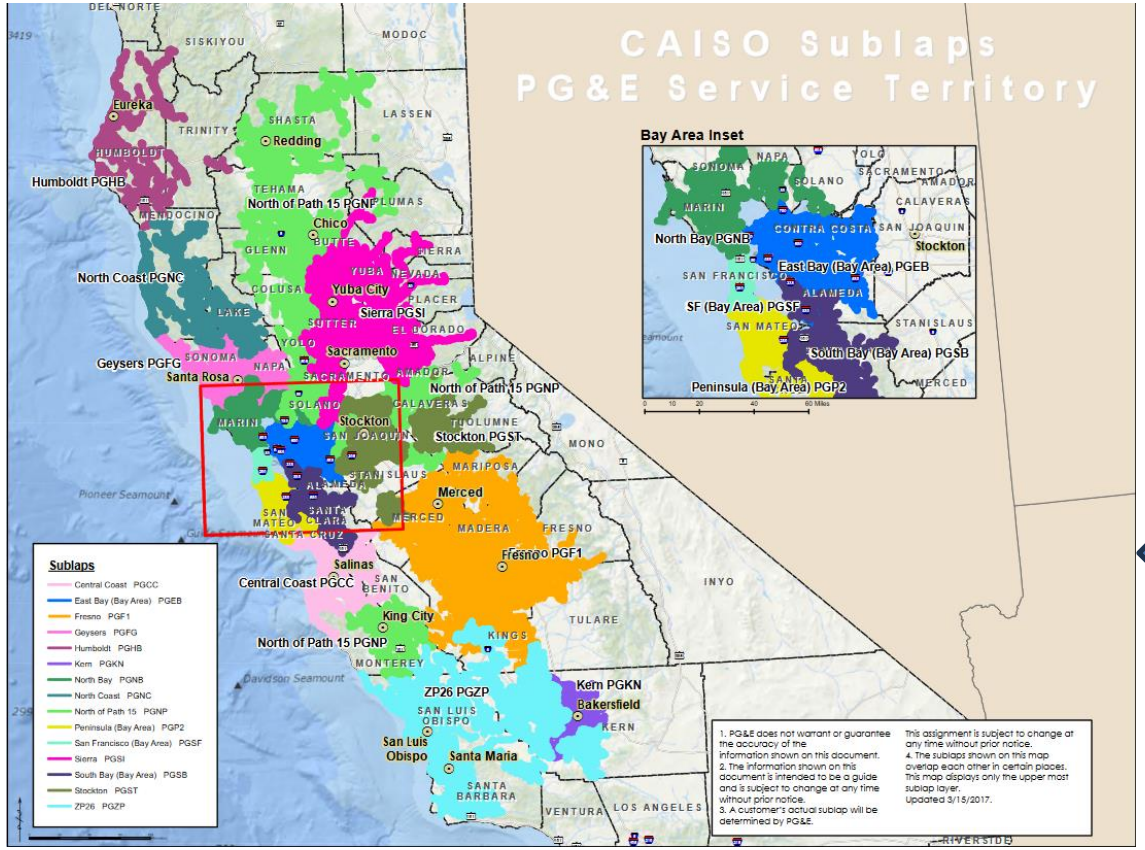
Message Content	Effective MIDAS RINs Delivered per Hour
12-hour forecast of hourly values	1,937
24-hour forecast of hourly values	1,356
48-hour forecast of hourly values	847

NRSC-4-A, United States RBDS Standard Specification of the Radio Broadcast Data System (RBDS)

CONSULTANT REPORT: https://efiling.energy.ca.gov/GetDocument.aspx?tn=256582&DocumentContentId=92391

Deciphering Zonal Pricing (Load Aggregation Point)

CAISO Sub-LAPs for PG&E Service Territory (NP15)



CAISO Regions

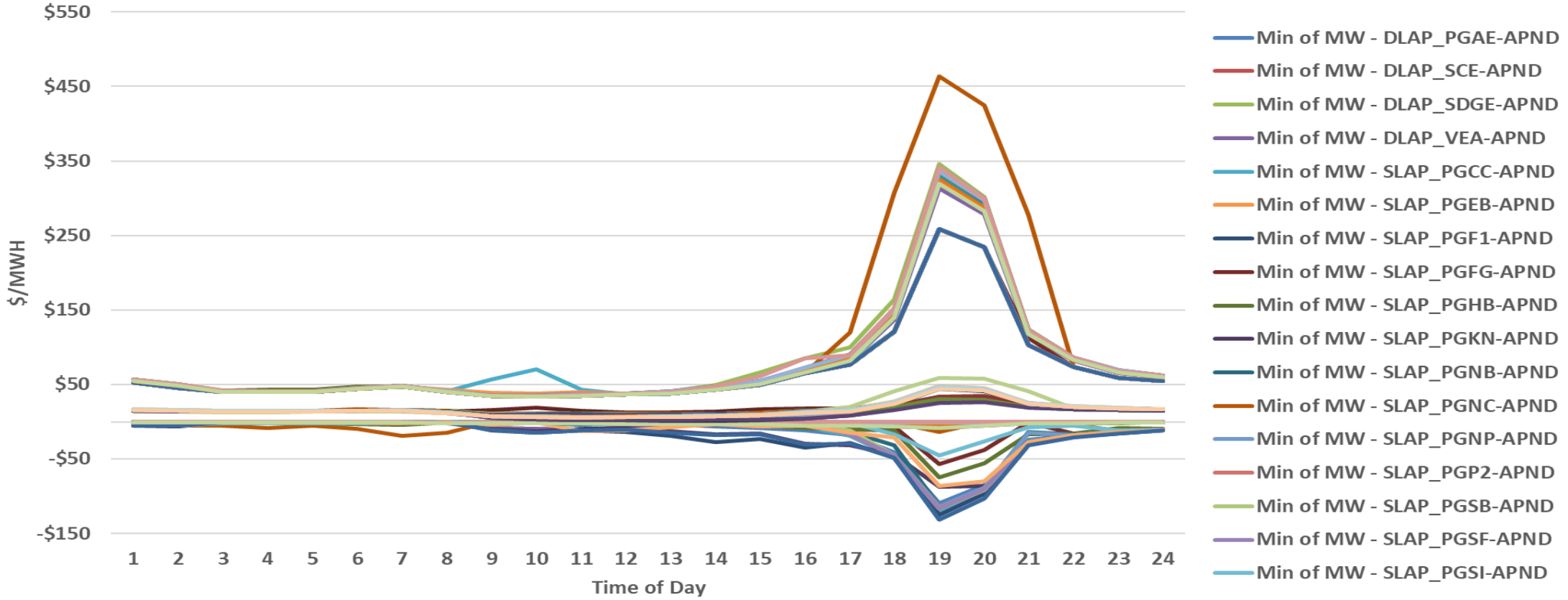
CAISO Territory

Each LAP has a Locational Marginal Price (LMP)

https://www.renewableenergyworld.com/policy-regulation/grid-operators-must-follow-caisos-approach-to-multi-nodal-aggregation/

http://oasis.caiso.com/mrioasis/logon.do

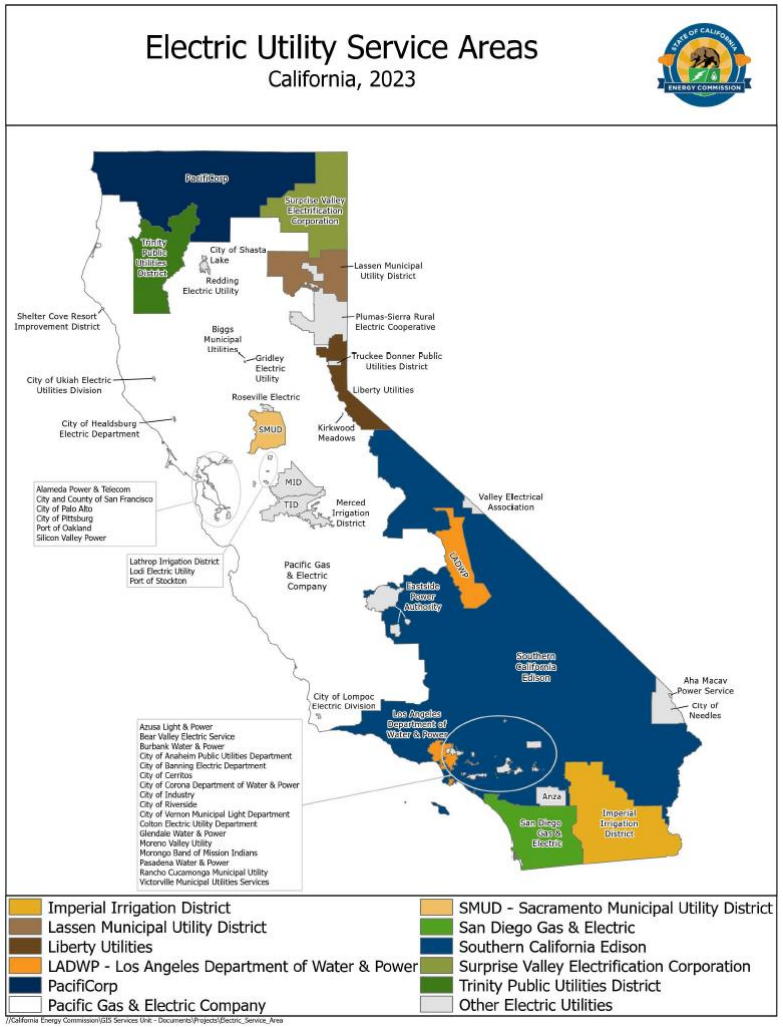
CAISO Sub-LAP and D-LAP Day Ahead Pricing Sep 1-15, 2024



- The retail rates paid by customers of different utilities bear little resemblance to the CAISO pricing that is being considered for broadcast through the CEC MIDAS RDS.
- **Both the highest and lowest pricing for this 15-day period occur at 7pm – when many TOU rates are high. Therefore, encouraging customers to use more electricity when prices are negative at 7pm would significantly increase their bill.**

http://oasis.caiso.com/

Load Serving Entities in California



Different tariffs (retail rates) paid by customers of different utilities.

60 Different Utility Service Areas Identified

CCAs (25 and counting) are municipalities that become Electricity Service Providers (ESPs) within an Investor Owned Utility (IOU) service territory (PG&E, SCE, SDG&E)

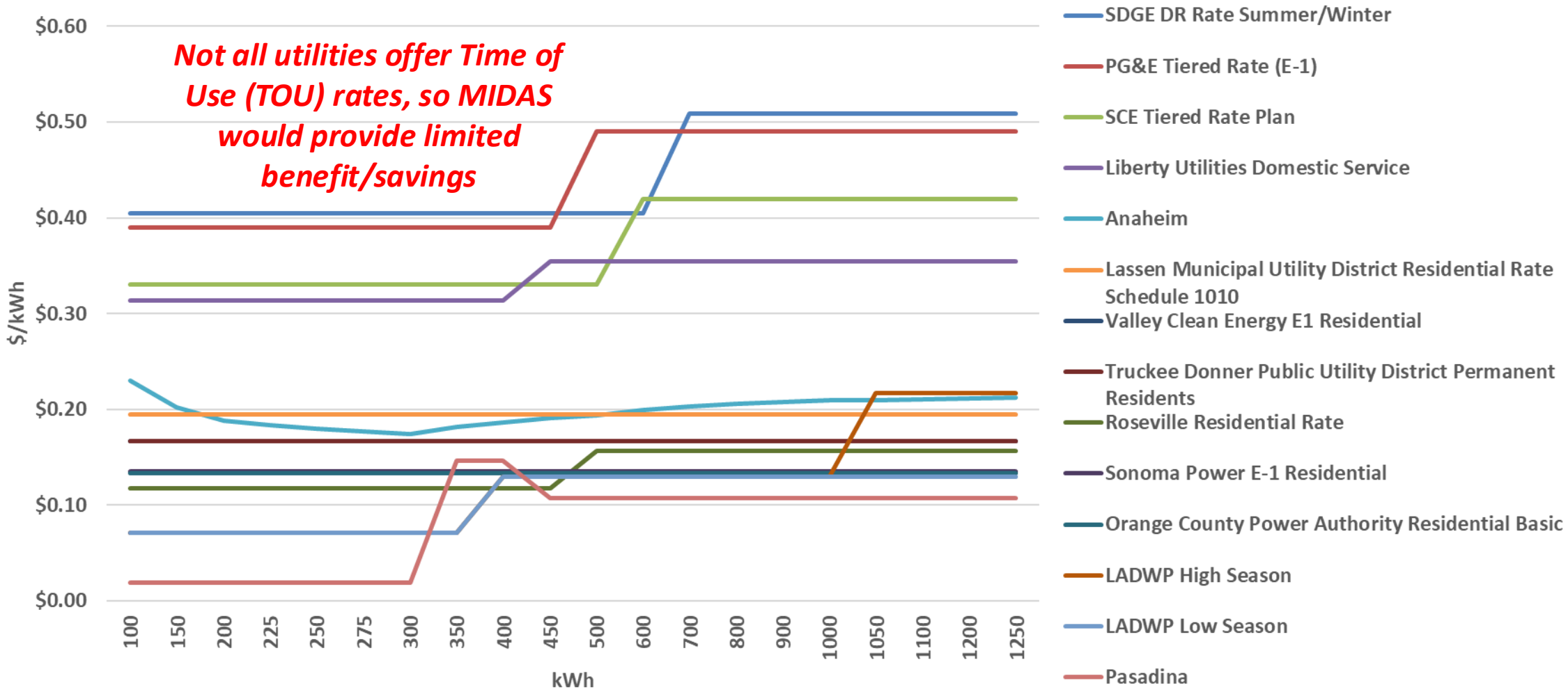
https://cecgis-caenergy.opendata.arcgis.com/documents/c69c363cafd64ad2a761afd6f1211442

https://cal-cca.org/cca-city-county-lookup/

Every Utility Is Different and Utility Customers have Rate Choices

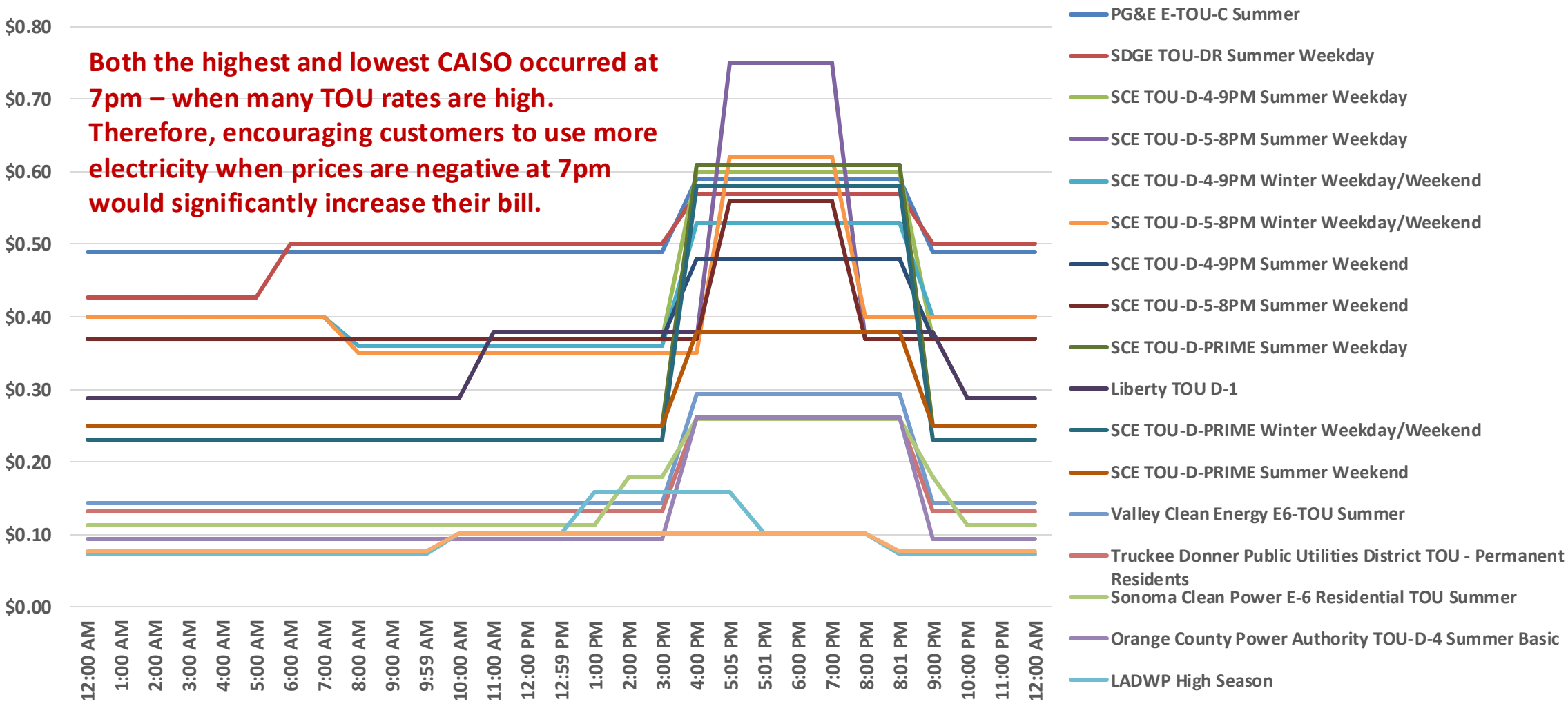
- A **ubiquitous signal** fails to recognize that different customers of a utility have different tariffs and a choice of tariffs and programs.
  - Without customer specific pricing aligning with that customer's rate, a ubiquitous signal will likely provide a signal that does not align with the customer's cost of electricity
  - Some customers have more than one rate/tariff. E.g., One for the residence and another for the separately metered electric vehicle
  - If I purchase an appliance at a retailer in Davis, CA it cannot be pre-programmed to know what Electricity Service Provider (ESP) I purchase my electricity from (SMUD, Roseville, PG&E, etc.), if they are a CAISO market participant, or what CAISO SLAP/DLAP I reside in.
    - *This makes Principle 2 (A customer should not be required to sign up for, or participate in, a third-party program to receive flexibility signals or take flexibility actions) impossible because some level of programming or configuration will be required to receive the customer's specific pricing*

Example Volumetric Electricity Rates



Source: Various. See Presentation Appendix

Example Time-of-Use Electricity Rates



Source: Various. See Presentation Appendix

Foundational Principal Alignment (page 1)

Table 3. Foundational Principles Criteria Comparison

Criteria	AM/FM	AMI
1. Available to every customer in the state.	●	○
2. No need to sign up for a program to receive signals	●	○
3. Does not preclude utility-specific DR programs	●	●
4. Leverages market forces	◐	○
5. Technology agnostic	◐	○
6. Statewide standards are default, not exclusive	●	●
Pass Principles Assessment	Yes	No

Criteria	AM/FM	AMI
1	No – it is no longer common for residences to have antennas to receive TV and radio signals. The appliance would need to be connected to the antenna.	AMI is an enabler for TOU rates. Therefore, customers that would benefit from variable pricing information most likely have AMI .
2	No – each device will need to be programmed to receive the relevant broadcast data for that customer.	The utility knows customer specifics in terms of their rate and energy program participation. Customer just needs to sign up to get their specific information.
3	Doesn't preclude DR programs, but limited enablement for DR other than price response	AMI is an enabler for DR and DER program measurement and validation (M&V)

Foundational Principal Alignment (page 2)

Table 3. Foundational Principles Criteria Comparison

Criteria	AM/FM	AMI
1. Available to every customer in the state.	●	○
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4. Leverages market forces	◐	○
5. Technology agnostic	◐	○
6. Statewide standards are default, not exclusive	●	●
Pass Principles Assessment	Yes	No

Criteria	AM/FM	AMI
4	No – There are no commercially off the shelf products available currently on the market that support the AM/FM broadcast approach.	Yes – device manufacturers have spent the last 15+ years developing Wi-Fi enabled Internet of Things (IoT) and Smart Appliances. The latest generation of AMI meters are Wi-Fi enabled to be a component of the customer's IoT.
5	No – depends on Radio Data System (RDS) as well as the customer having compatible equipment to receive the signal.	No – each AMI product utilizes a different technology stack. Most commonly IEEE 802.15.4g for mesh telecommunication and IEEE 2030.5 over Wi-Fi for Home Area Network

Reference Tariff Sources

Utility	Utility Type	Rate Name	Tariff Type	Link
SCE	IOU	SCE Tiered Rate Plan	Volumetric	https://www.sce.com/residential/rates/Standard-Residential-Rate-Plan
SDGE	IOU	SDGE Schedule DR, Domestic Service Summer/Winter	Volumetric	https://tariffsprd.sdge.com/sdge/tariffs/?utilId=SDGE&bookId=ELEC&sectId=ELEC-SCHEDS&tarfRateGroup=Residential%20Rates
PG&E	IOU	PG&E Tiered Rate (E-1)	Volumetric	https://www.pge.com/assets/pge/docs/account/rate-plans/residential-electric-rate-plan-pricing.pdf
Liberty Utilities	Electric Utility Service Area	Liberty Utilities Domestic Service	Volumetric	https://california.libertyutilities.com/uploads/CalPeco%20Tariffs/Schedule%20No.%20D-1.pdf
Roseville Electric	Electric Utility Service Area	Roseville Residential Rate	Volumetric	https://www.roseville.ca.us/government/departments/electric_utility/about_us/rates-1
Lassen Municipal Utility District	Electric Utility Service Area	Lassen Municipal Utility District Residential Rate Schedule 1010	Volumetric	https://www.lmud.org/my-account/rates/#domestic-residential
Truckee Donner Public Utility District	Electric Utility Service Area	Truckee Donner Public Utility District Permanent Residents	Volumetric	https://www.tdpud.org/departments/electric/time-of-use-rate
Sonoma Clean Power	CCA	Sonoma Power E-1 Residential	Volumetric	https://sonomacleanpower.org/uploads/documents/Residential-Rates.pdf
Valley Clean Energy	CCA	Valley Clean Energy E1 Residential	Volumetric	https://valleycleanenergy.org/wp-content/uploads/March2024_ResidentialRates.pdf
Orange County Power Authority	CCA	Orange County Power Authority Residential Basic	Volumetric	https://www.ocpower.org/wp-content/uploads/OCPA-Rates-Schedule-Website-rates_2024Jul-Update_Residential_Final-with-RIN-Key.pdf
SCE	IOU	SCE TOU-D-4-9PM Summer Weekday	TOU	https://www.sce.com/residential/rates/Time-Of-Use-Residential-Rate-Plans
SCE	IOU	SCE TOU-D-4-9PM Summer Weekend	TOU	https://www.sce.com/residential/rates/Time-Of-Use-Residential-Rate-Plans
SCE	IOU	SCE TOU-D-4-9PM Winter Weekday/Weekend	TOU	https://www.sce.com/residential/rates/Time-Of-Use-Residential-Rate-Plans
SCE	IOU	SCE TOU-D-5-8PM Summer Weekday	TOU	https://www.sce.com/residential/rates/Time-Of-Use-Residential-Rate-Plans
SCE	IOU	SCE TOU-D-5-8PM Summer Weekend	TOU	https://www.sce.com/residential/rates/Time-Of-Use-Residential-Rate-Plans
SCE	IOU	SCE TOU-D-5-8PM Winter Weekday/Weekend	TOU	https://www.sce.com/residential/rates/Time-Of-Use-Residential-Rate-Plans
SCE	IOU	SCE TOU-D-PRIME Summer Weekday	TOU	https://www.sce.com/residential/rates/Time-Of-Use-Residential-Rate-Plans
SCE	IOU	SCE TOU-D-PRIME Summer Weekend	TOU	https://www.sce.com/residential/rates/Time-Of-Use-Residential-Rate-Plans
SCE	IOU	SCE TOU-D-PRIME Winter Weekday/Weekend	TOU	https://www.sce.com/residential/rates/Time-Of-Use-Residential-Rate-Plans
SDGE	IOU	SDGE TOU-DR Summer Weekday	TOU	https://tariffsprd.sdge.com/sdge/tariffs/?utilId=SDGE&bookId=ELEC&sectId=ELEC-SCHEDS&tarfRateGroup=Residential%20Rates
PG&E	IOU	PG&E E-TOU-C Summer	TOU	https://www.pge.com/assets/pge/docs/account/rate-plans/residential-electric-rate-plan-pricing.pdf
Liberty Utilities	Electric Utility Service Area	Liberty TOU D-1	TOU	https://california.libertyutilities.com/uploads/CalPeco%20Tariffs/Schedule%20No.%20D-1%20TOU.pdf
Truckee Donner Public Utility District	Electric Utility Service Area	Truckee Donner Public Utilities District TOU - Permanent Residents	TOU	https://www.tdpud.org/departments/electric/time-of-use-rate
Sonoma Clean Power	CCA	Sonoma Clean Power E-6 Residential TOU Summer	TOU	https://sonomacleanpower.org/uploads/documents/Residential-Rates.pdf
Valley Clean Energy	CCA	Valley Clean Energy E6-TOU Summer	TOU	https://valleycleanenergy.org/wp-content/uploads/March2024_ResidentialRates.pdf
Orange County Power Authority	CCA	Orange County Power Authority TOU-D-4 Summer Basic	TOU	https://www.ocpower.org/wp-content/uploads/OCPA-Rates-Schedule-Website-rates_2024Jul-Update_Residential_Final-with-RIN-Key.pdf