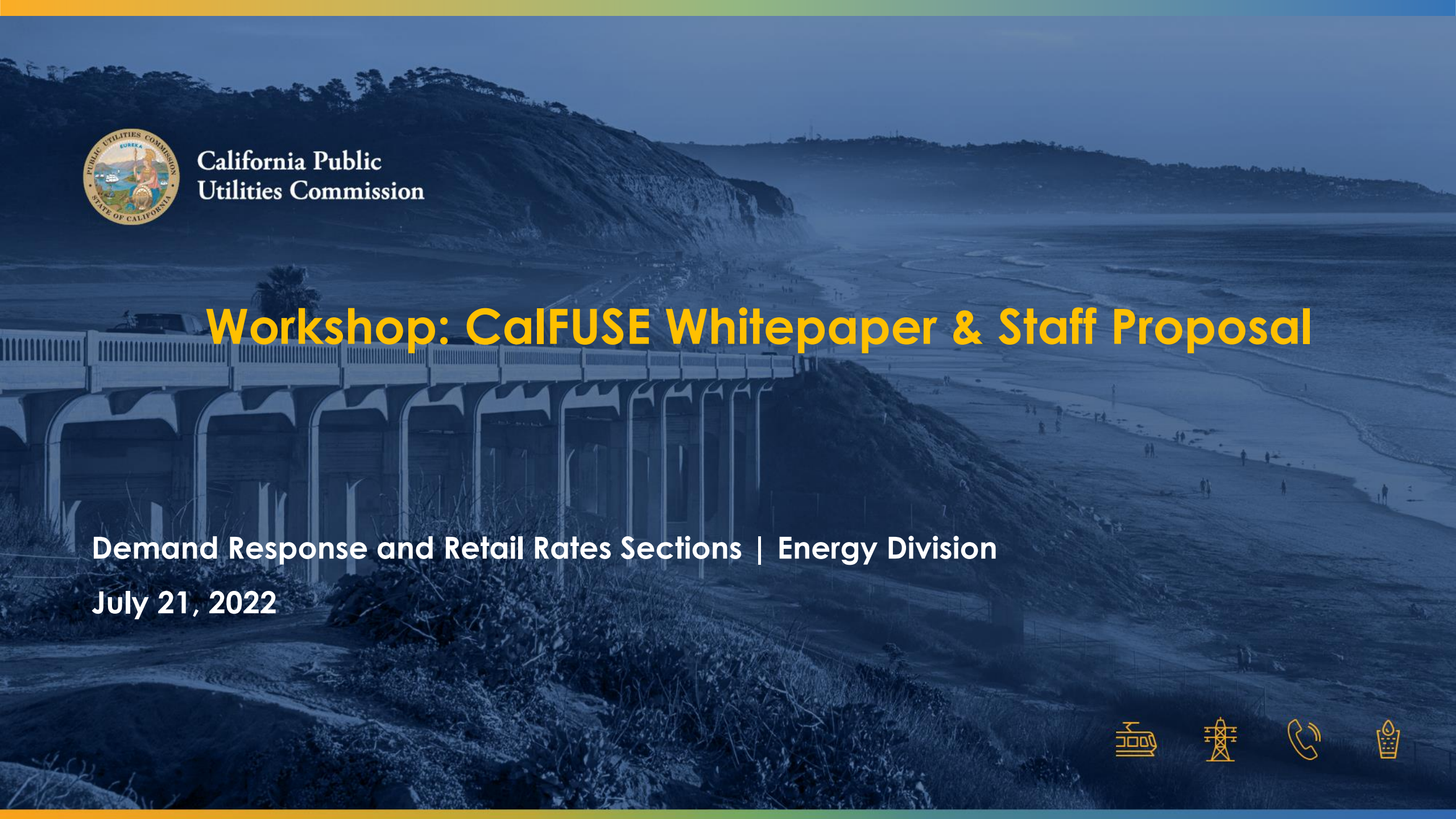


California Public Utilities Commission

Workshop: CalFUSE Whitepaper & Staff Proposal

Demand Response and Retail Rates Sections | Energy Division

July 21, 2022

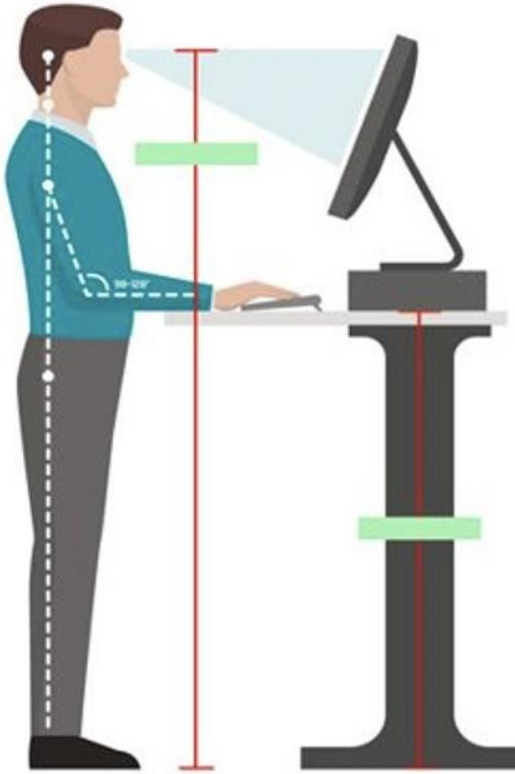
Workshop Agenda

Time	Agenda Item
9:30	Opening, Logistics, and Safety – Andrew Magie, Energy Division
9:40	Opening Remarks and Introduction - Commissioner Houck - Aloke Gupta, Energy Division
10:00	Presentation by Energy Division Staff on Demand Flexibility Management (CalFUSE) whitepaper/proposal - Jean Lamming, Achintya Madduri
12:00	Lunch
1:00	Q&A – Whitney Richardson, Energy Division
2:00	Break
2:10	Comments, Discussion – Paul Phillips & Aloke Gupta, Energy Division
3:40	Closing Remarks – Paul Phillips
4:00	Close Workshop

Logistics

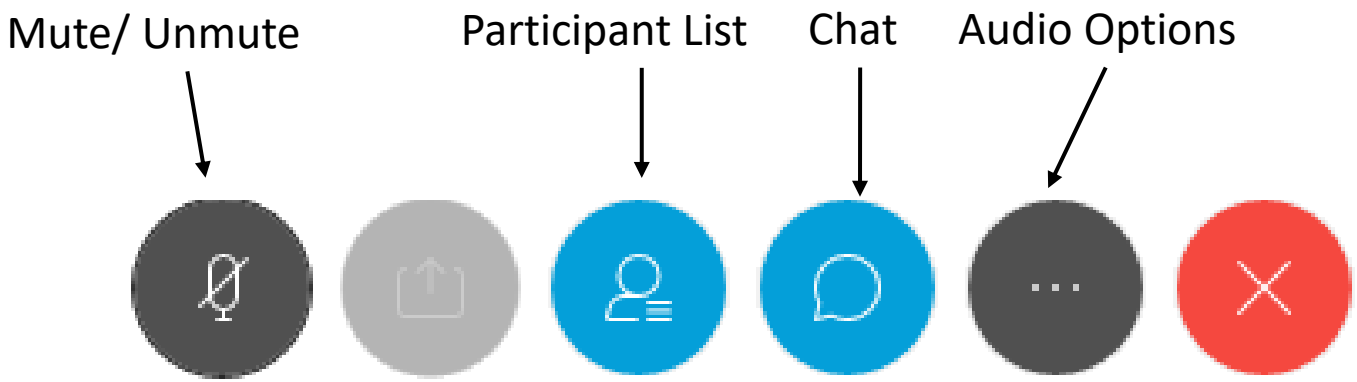
- Online and morning session will be recorded

- Today's presentations & recording will be uploaded onto DR Workshops website
    - Advanced DER and Demand Flexibility Management Workshop (ca.gov) (link dropped in chat)
- Hosts (Energy Division Staff)
    - Andrew Magie
    - Whitney Richardson
- Safety
    - Note surroundings and emergency exits
    - Ergonomic check
    - Call 9-1-1 or use chat

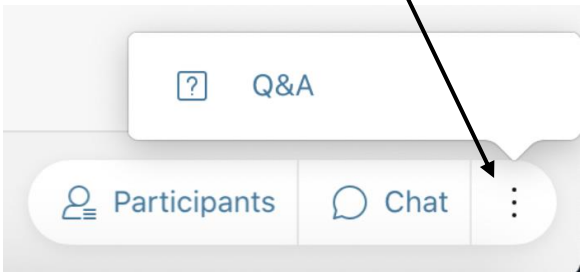


Logistics

- All attendees have been muted
- If using the chat, make sure it is sent to “everyone”
- To ask questions, please ‘raise your hand’ and host will unmute you so you can ask your question. If you would rather type, use the “Q&A” function (send to “all panelists”)
- Questions will be read aloud by staff; attendees may be unmuted to respond to the answer. (Reminder: Mute back!)



"Q&A": on the bottom right of screen, click "3 dots"



Ground Rules

- Workshop is structured to stimulate dialogue and engage different perspectives.
- Keep comments friendly and respectful.
- Please use Q&A feature only for questions, or technical issues.
- Please only ask clarifying questions during morning session. Comments and discussion will be held in afternoon session.
- Do NOT start or respond to sidebar conversations in the Chat.
- Refrain from discussing any matters related to open proceedings while any Commissioner or their advisors are in attendance.

California Public Utilities Commission

Opening Remarks

Commissioner Houck

July 21, 2022

California Public Utilities Commission

Workshop Introduction

Aloke Gupta, Demand Response Section | Energy Division

July 21, 2022

Workshop Scope

- **Workshop focused on providing an overview of the recently released* CalFUSE whitepaper / staff proposal and seeking feedback**
  - This workshop is not directly associated with any current or future proceeding
  - The information and discussion at this workshop will not be part of any proceeding record
  - No written comments are expected on this workshop
- **CalFUSE whitepaper recommended:**
  - "…the CPUC initiate a Rulemaking…
  - to take up this paper's [staff] proposal."

*Advanced DER and Demand Flexibility Management Workshop (ca.gov), released June 22, 2022.

Workshop Scope

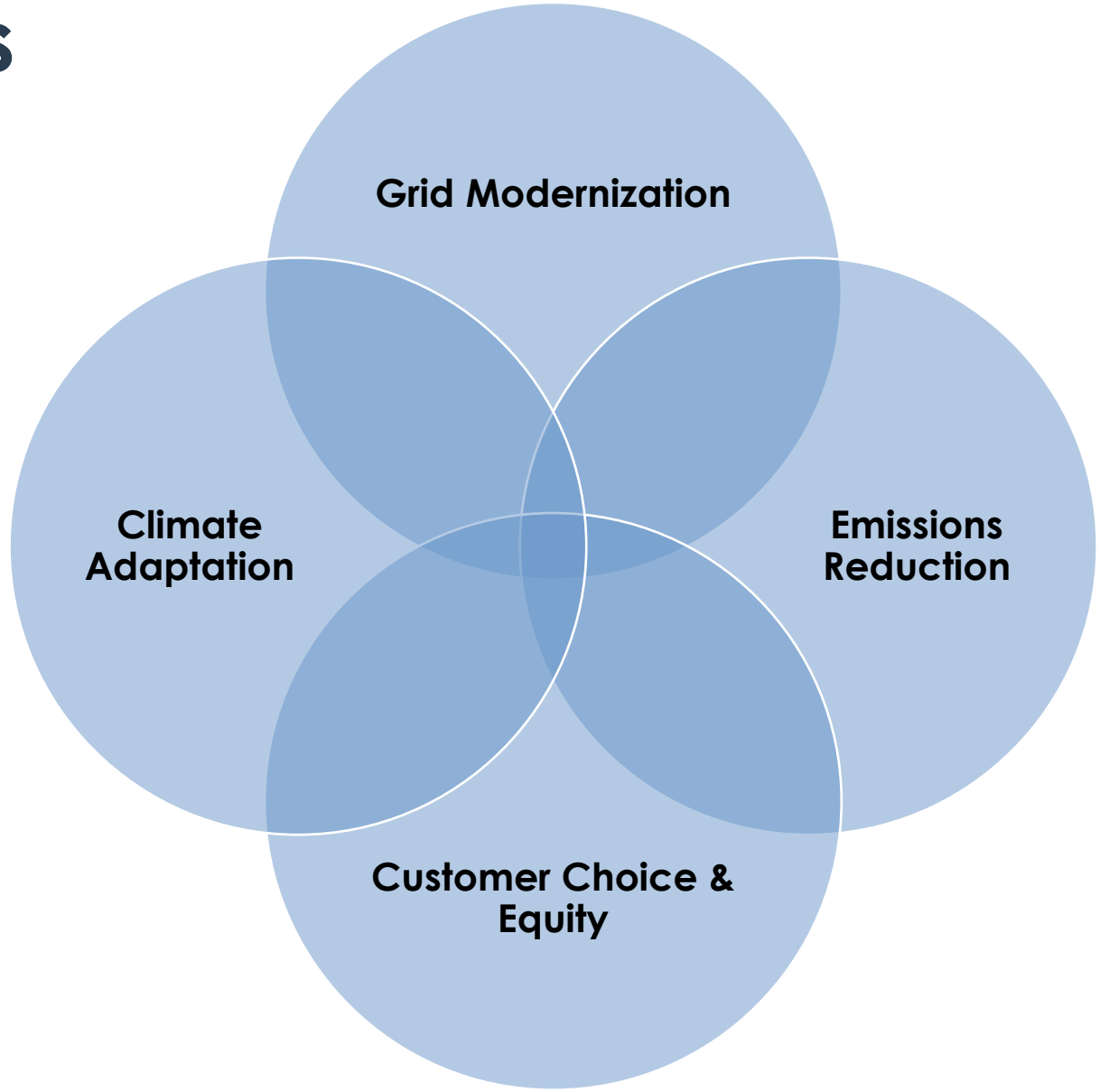
- **Workshop intended to provide an overview of the recently released CalFUSE whitepaper / staff proposal and seek feedback**
  - This workshop is not directly associated with any current or future proceeding
  - The information and discussion at the workshop will not be part of any proceeding record
  - No written comments expected on this workshop
- **CalFUSE whitepaper recommended:**
  - "…the CPUC initiate a Rulemaking…
  - to take up this paper's [staff] proposal."
- **CPUC voting meeting on July 14, 2022:**
  - "Order Instituting Rulemaking to Advance Demand Flexibility Through Electric Rates", voted out 4-0.
- **Demand Flexibility Rulemaking (R.22-07-005)*:**
  - "The Commission anticipates that this proceeding will also consider: …(iii) establishing policies and programs to advance demand flexibility pursuant to strategies identified in the Demand Flexibility Whitepaper or by a working group; …"
- **The Rulemaking Decision includes a preliminary scoping memo with preliminary issues:**
  - Opening comments due "Within 30 days of the effective date of this OIR."

*492688471.PDF (ca.gov)

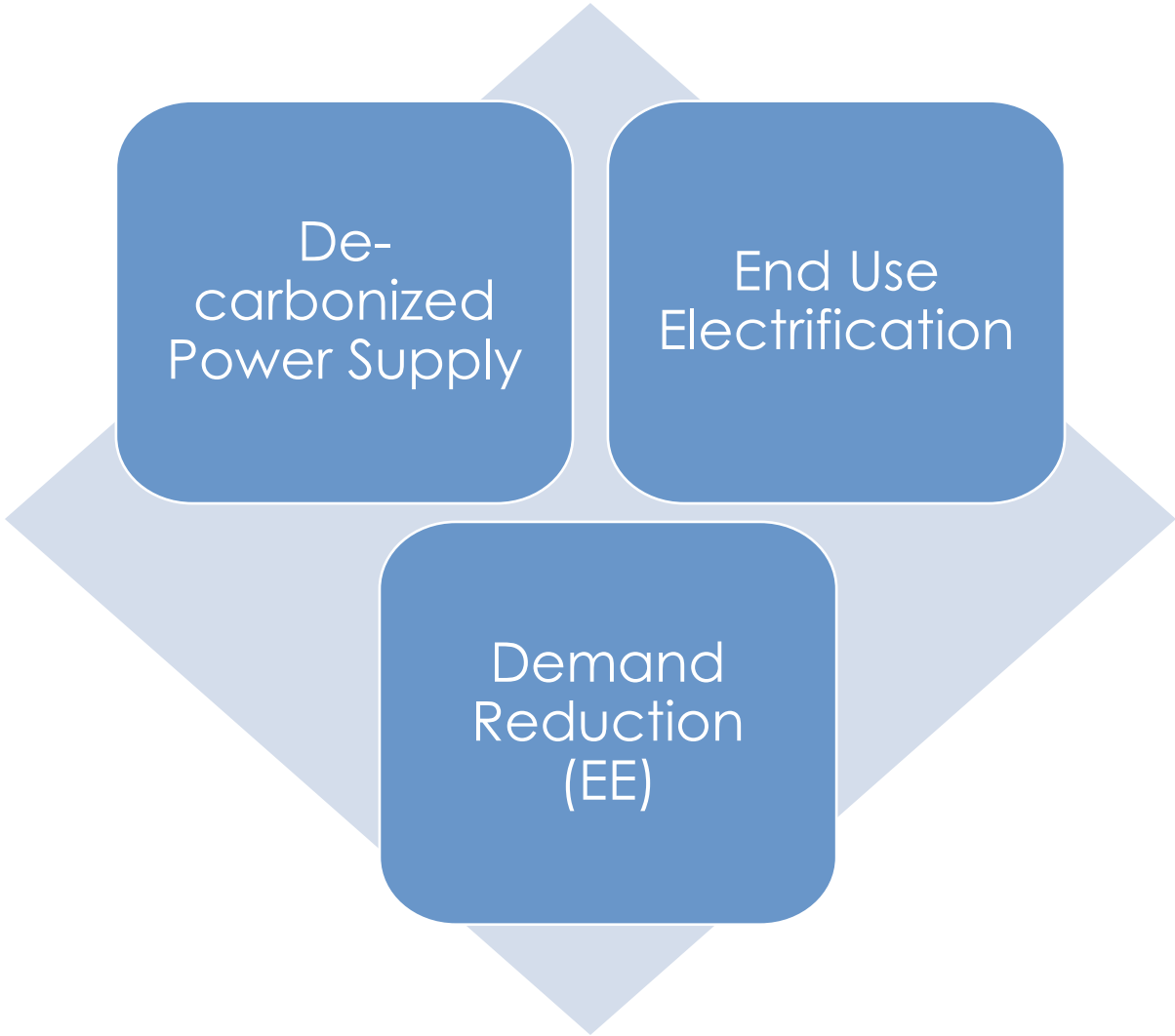
Core Mission

- Safe
- Reliable
- Affordable
- Clean

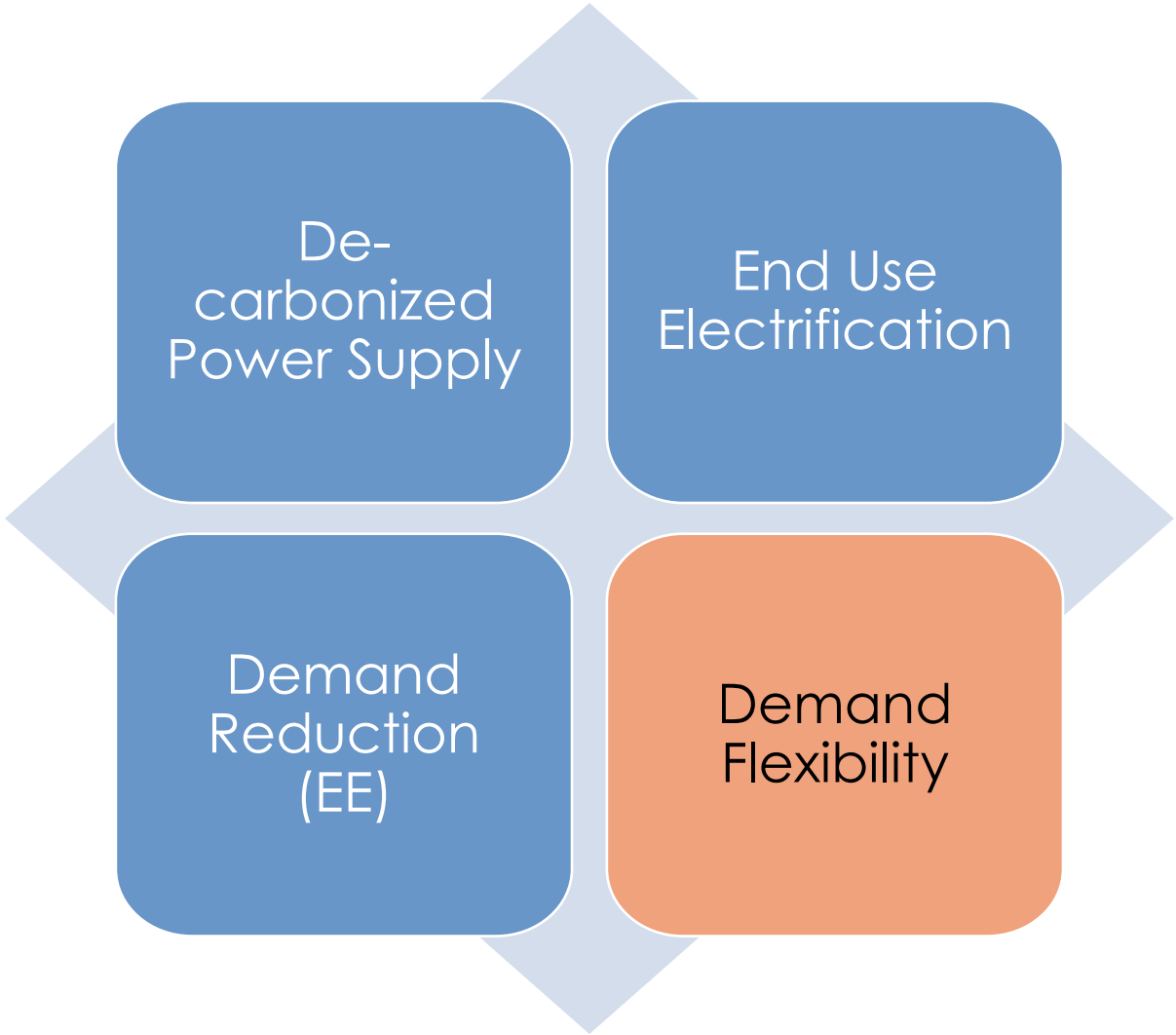
Key Policy Drivers



Key Strategies for *Reducing Emissions*



Key Strategies for Reducing Emissions



CalFUSE Proposal

- **Enable widespread adoption of demand flexibility solutions**

- **Three-part policy framework proposed**
  - Standardized price access
  - Dynamic electricity prices linked to real-time grid conditions & economics
  - Customer options to manage and optimize energy usage and bills

*492688471.PDF (ca.gov)

California Public Utilities Commission

Overview: CalFUSE Whitepaper

Energy Division |

- Jean Lamming, Demand Response Section
- Achintya Madduri, Retail Rates Section

July 21, 2022

Executive Summary

Staff Proposal

Pursue joint reforms of DR programs and Rate structures to

Promote *Unified Strategies* for Demand Management and Grid Optimization to

Achieve widespread adoption *of demand flexibility solutions*.

Policy Objective: Improve demand-side resource management…

- Through more effective demand response (DR) and retail rate structures,
- That leverage opportunities enabled by long term electrification and DER deployment,
- To better address grid issues associated with the growth of renewables, electrification, and DER adoption, and support California's clean energy goals.

Anticipated Challenges over the Next Decade

Increasing renewables penetration

- Increased curtailment
- Steeper ramps ➔ reliability challenge
- Increased reliance on intermittent, use-limited supply ➔ reliability challenge

Increasing electrification of end uses (buildings, transportation)

- Increased cost of service due to higher load, if unmanaged

Increasing DER deployment

- Grid instability and increased cost of service, if unmanaged
- Fair compensation and cross-subsidy challenges

Opportunity: Growing Demand Flexibility Potential (2030)

- **Doubling of rooftop solar** — 20 GW
- **3.5x growth in BTM storage** — 5.5 GWh storage capacity
- **Transportation electrification** — 5M EVs ~ 250 GWh aggregate storage
  ~ 4x utility storage
- **Building decarbonization** — Growth of smart, flexible end uses
  - Smart thermostats/heat pumps,
  - Smart electric (heat pump) water heaters
  - Smart devices & plugs
- **Growth of microgrids and other flexible, emerging end uses**

Opportunity or Threat

Current Approaches to Achieving Demand Flexibility

- **Time-Differentiated Rates (Load Modifying Demand Response)**
  - Increasing number of special purpose IOU rates: TOU, CPP, EV, SGIP GHG signal …
  - Increasing number of CCAs & Rates!
  - Lengthy ratemaking process, generally lagging (out of date), sometimes conflicting
  - Administratively complex & confusing to customers/industry

- **Market-Integrated, Incentive-based DR Programs (Supply Side Demand Response)**
  - Multiple programs focused on load shed as resource adequacy
  - Challenges in CAISO market integration, measurement & verification
  - Administratively & technically complex, inefficient, high transaction costs

- **Distribution level DR**
  - Additional localized, temporary rate/incentive tariffs or
  - Incremental DER procurement contracts

Present

Basket of Rates
(cost recovery / allocation, equity)

Basket of Supply-Side Programs
(market integrated)

Distribution Level DR

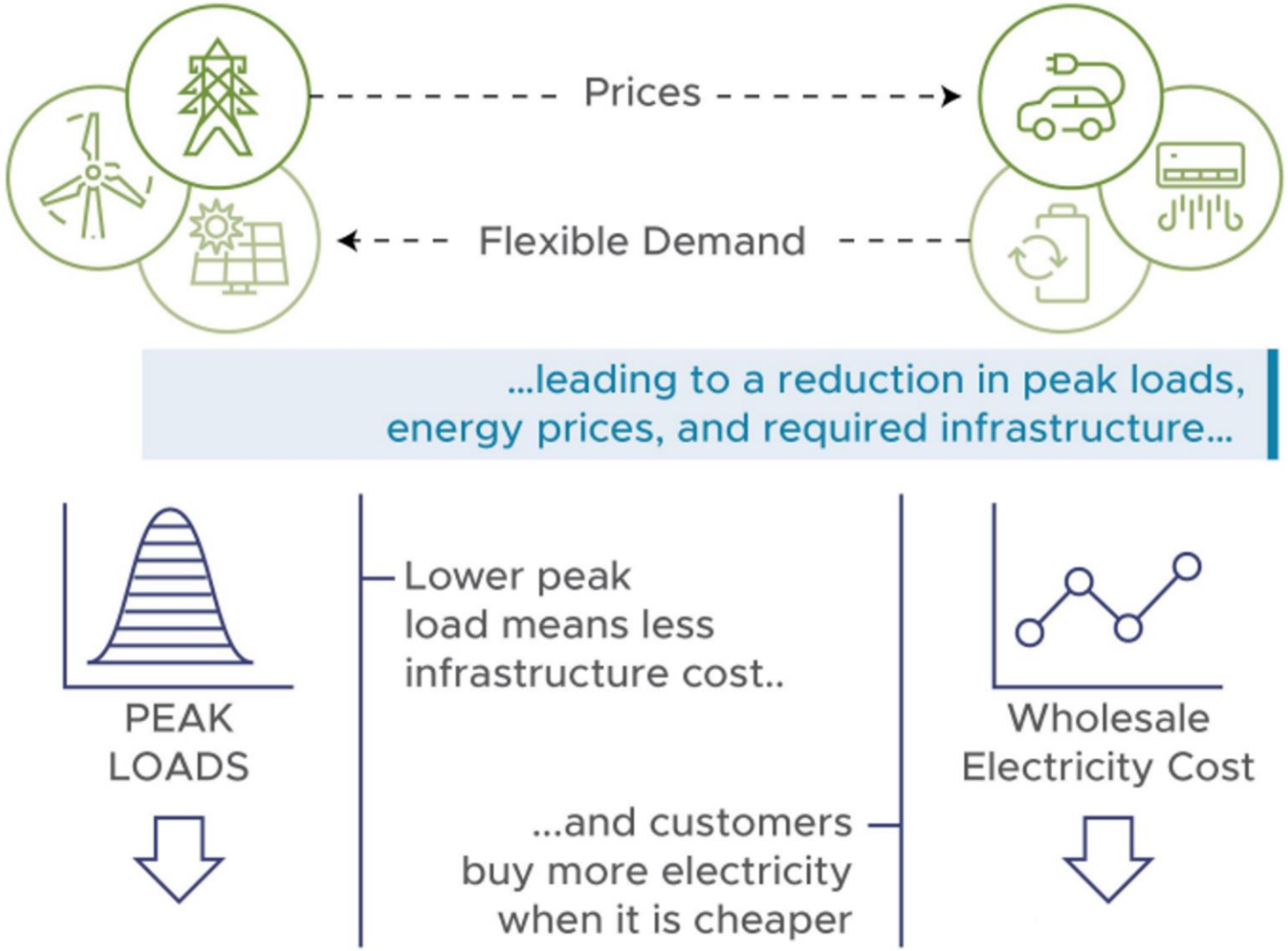
Future

Demand Side: Flexible Unified Signal for Energy in California (CalFUSE)

- ➔ Complex, inefficient, expensive, confusing
- ➔ Difficult to scale, Limited adoption
- ➔ High cost of controls, automation

- ➔ Reduced complexity, Single point focus
- ➔ Highly scalable, widespread adoption
- ➔ Reduced cost of controls, automation

The "CalFUSE" Vision



➔ *Widespread adoption of demand flexibility solutions*

➔ Reduced peak loads, energy prices, infrastructure needs

➔ Reduced cost of service

Image Source: PNNL "DSO+T Study", January 2022

The "CalFUSE" Staff Proposal

Three Pillars of CalFUSE Policy Roadmap

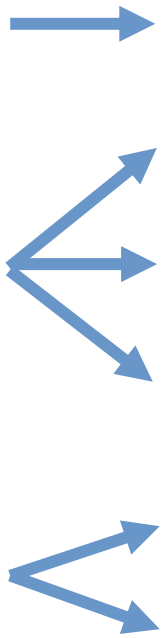
Price Presentation

Rate Reform
(Three-prong strategy)

Customer Options for Energy Optimization

The CalFUSE "Framework"

Three Pillars	Six Elements
Price Presentation	Element 1: Standardized price access
Rate Reform (Three-prong strategy)	Element 2: Real-time energy prices
	Element 3: Real-time capacity prices
	Element 4: Bi-directional prices
Customer Options for Energy Optimization	Element 5: Subscription option
	Element 6: Transactive option



Six Elements of CalFUSE Framework (Opt-in)

1: Develop **standardized, universal access** to current electricity price

2: Introduce dynamic prices based on **real-time, wholesale energy** cost

3: Incorporate **dynamic capacity charges** based on real-time grid utilization

4: Transition to **bidirectional prices** (import & export)

5: Offer **subscription option** (historic load shape & energy quantity at OAT price)

6: Introduce **transactive features** (ability to lock in price in advance)

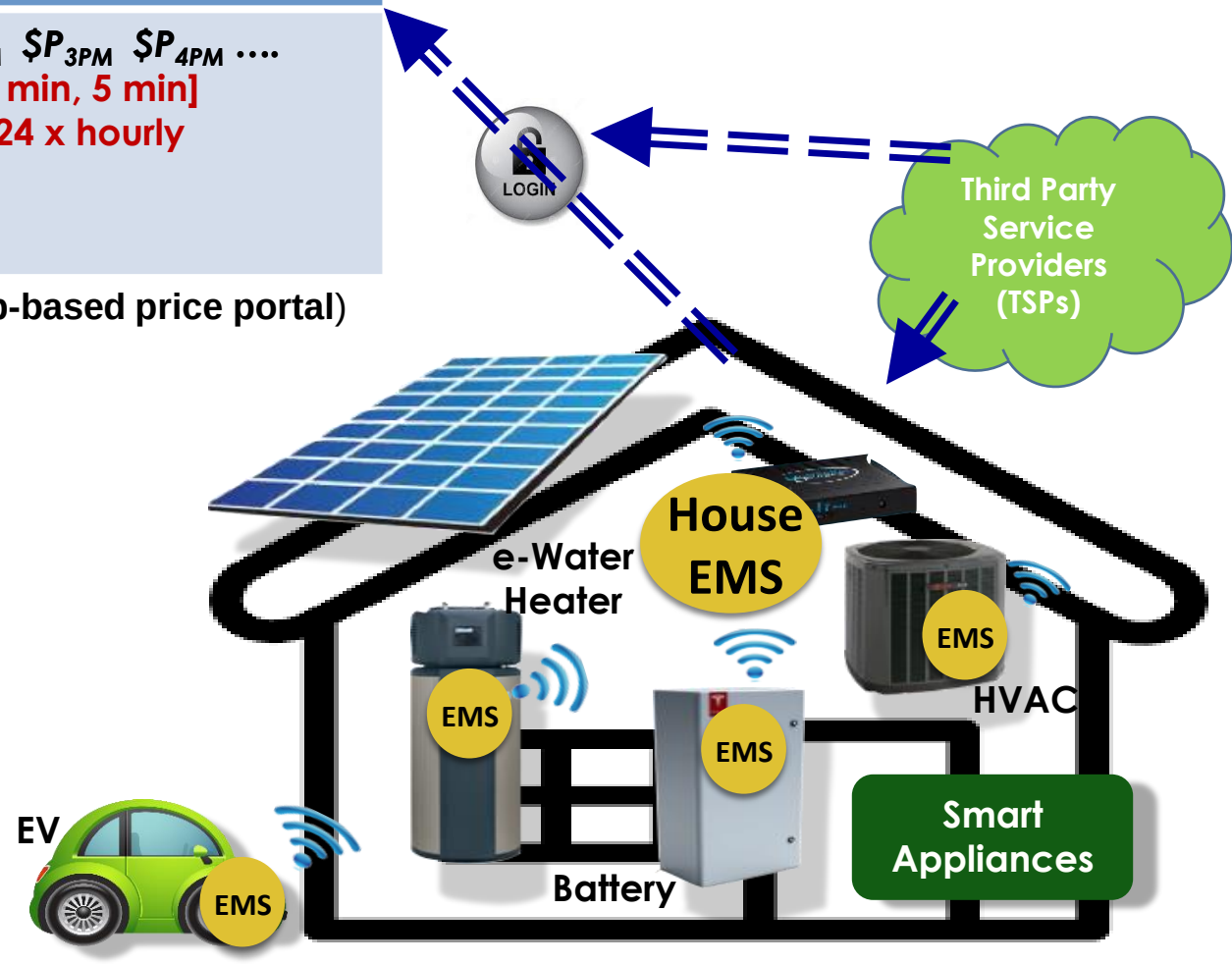
Element 1: Standardized, Universal Access to Electricity Price

https://MyElectricityPrice.com

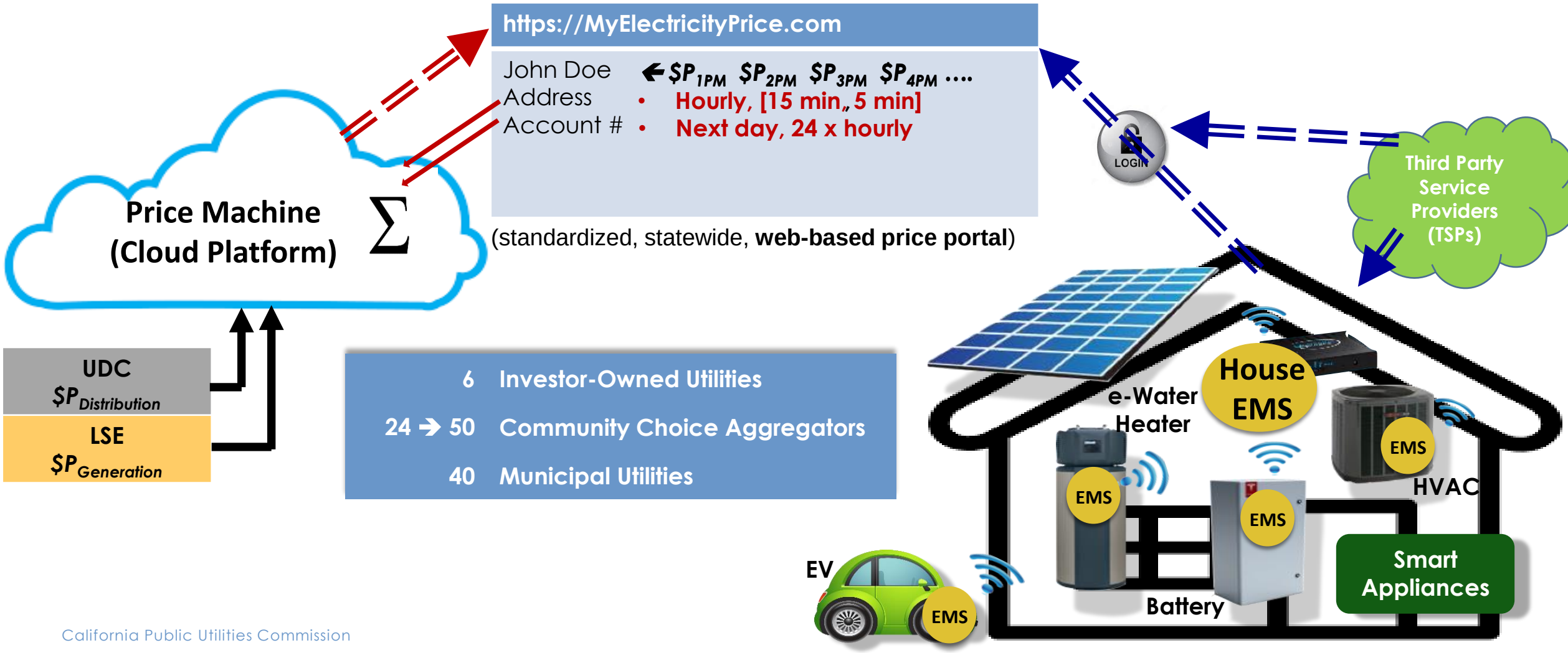
John Doe ← SP_{1PM} SP_{2PM} SP_{3PM} SP_{4PM} ….
Address
Account #

- **Hourly, [15 min, 5 min]**
- **Next day, 24 x hourly**

(standardized, statewide, **web-based price portal**)



Flexible Architecture (Accommodate LSEs, POUs)



Role of Third Parties

Third parties expected to play a major role in the implementation of CalFUSE.

The CalFUSE "ecosystem" could include:

- **Application developers** focused on making the CalFUSE price signal accessible to customers and devices,
- **Device manufacturers** integrating the necessary functionality to enable the devices to interact with the CalFUSE signal,
- **Automation service providers** layering intelligent algorithms or artificial intelligence to optimize device behavior in response to the CalFUSE signal,
- **Energy management service providers** offering services to customers for managing multiple smart devices and optimize customer's bills, and
- **DER operators or aggregators** pooling together and leveraging multiple customers and their devices as a resource and offering services to LSEs or UDCs, etc.

Element 1: Key Implementation Questions

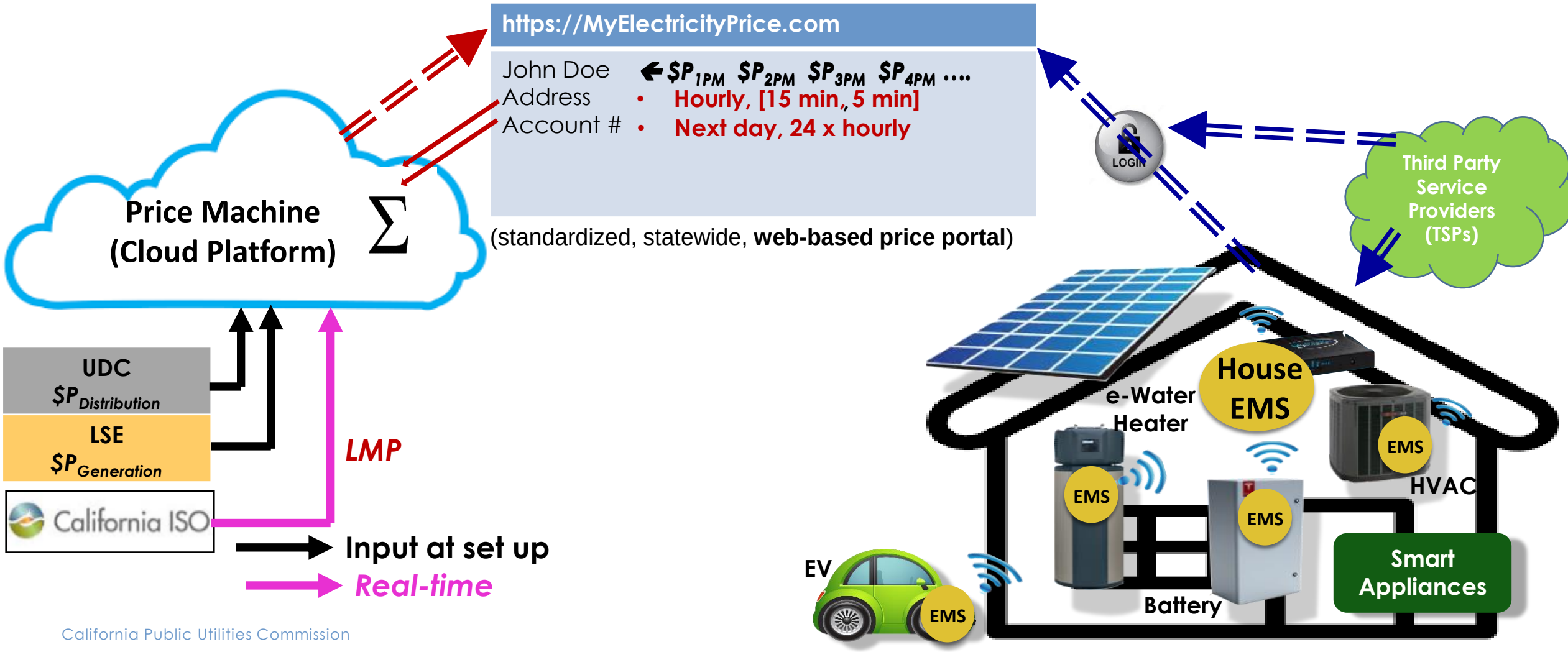
1. What processes, systems, or entities are necessary to facilitate the development and maintenance of the statewide price portal as described?
2. What should be the timeline to implement the statewide price portal?
3. Should the price portal be available by default to all customers of all LSEs in the state?
4. What processes, systems, or entities are necessary to facilitate the development, operation, and maintenance of the price machine?

CalFUSE Framework: Element 2

1: Develop **standardized**, **universal access** to current electricity price

2: Introduce dynamic prices based on **real-time**, **wholesale energy** cost

Element 2: Locational Dynamic Prices per Wholesale Energy Cost



Benefits: Real-Time Locational Prices Linked to CAISO Market

1. Reflects CAISO market conditions, encourages load shift
2. Reduces curtailment, evening ramp, emissions
3. Enhances reliability
4. Reduces energy procurement costs for all customers
5. Complements anticipated proposed amendments to CEC's Title 20 (Load Management Standards)

Element 2: Key Implementation Questions

1. What should be the time base for the LMP component of the CalFUSE signal that represents the variable commodity energy cost?
2. What locational granularity should be used for the LMP component of the CalFUSE signal?

5-Min Stretch Break :)

Image Source: iamthinks.blogspot.com
https://www.showeet.com/19/06/2016/templates/title-slide-templates-for-powerpoint-and-keynote/

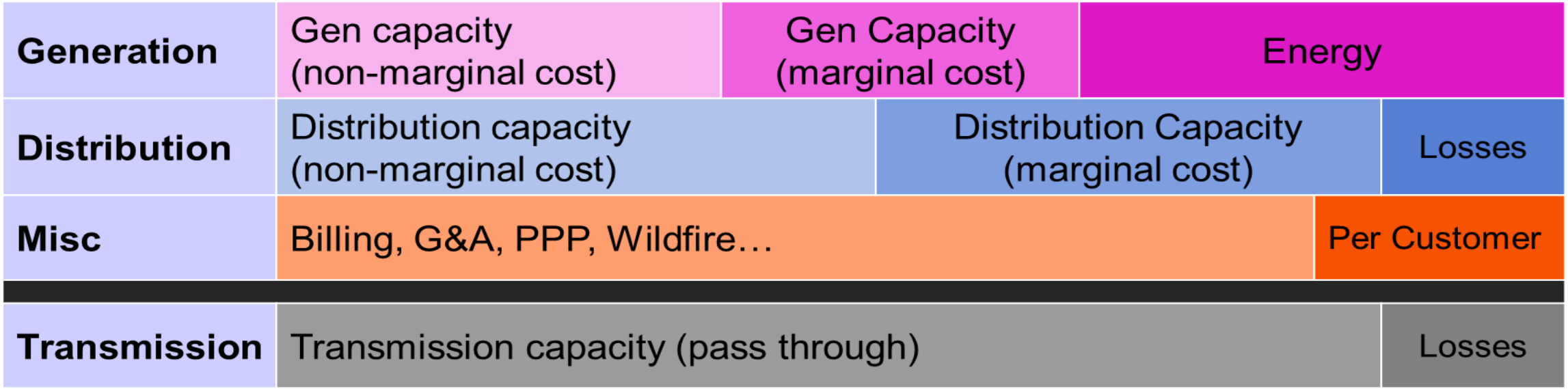
CalFUSE Framework: Element 3

1: Develop **standardized, universal access** to current electricity price

2: Introduce dynamic prices based on **real-time, wholesale energy** cost

3: Incorporate **dynamic capacity charges** based on real-time grid utilization

Utility Costs Dissected



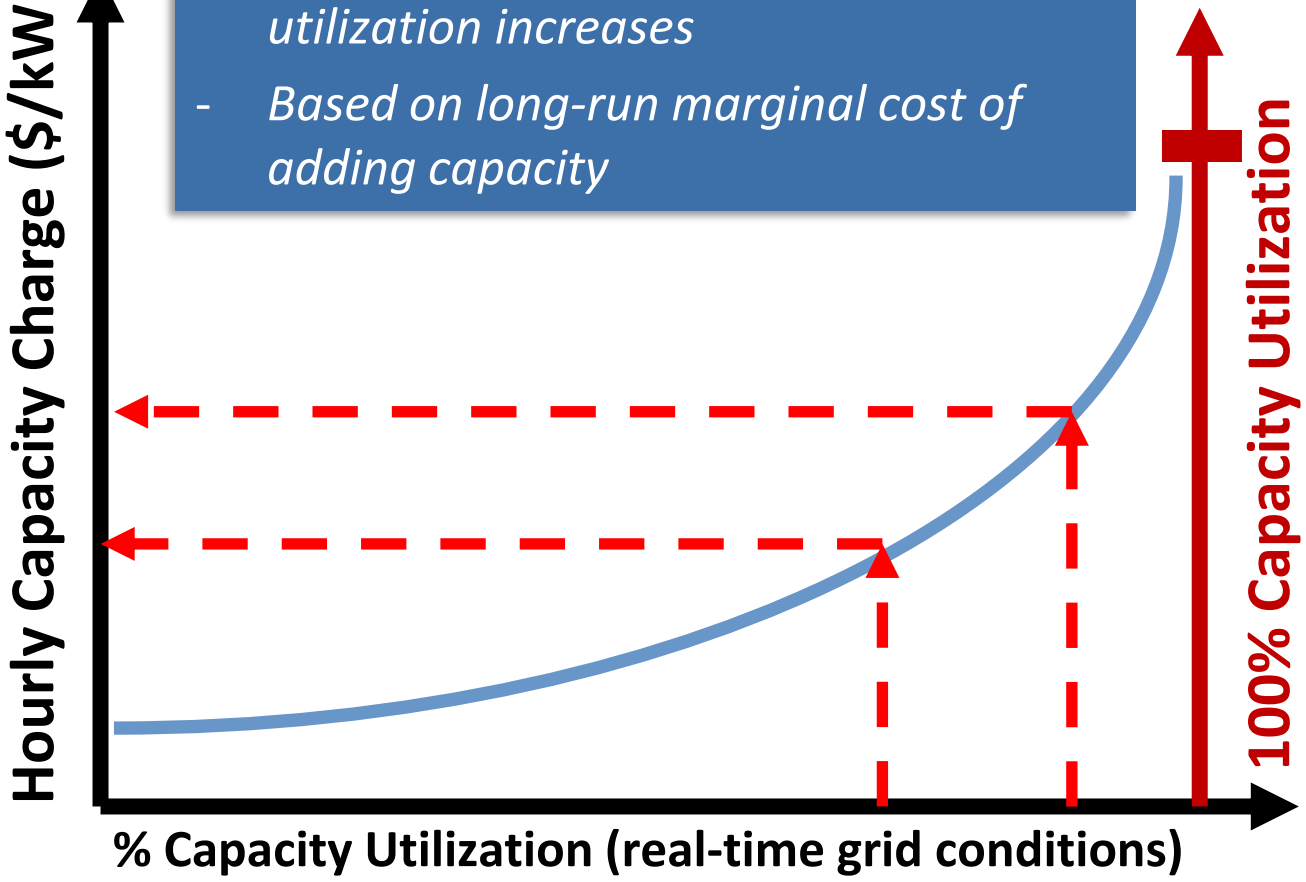
- **Capacity prices should be dynamic, linked to utilization, and volumetric: $/kWh**
  - Not based on individual customer factors such as the peak customer demand during a billing period (i.e., $/kW such as, monthly demand charges)
  - Should incentivize usage when it benefits the generation and distribution system AND will reduce long-term infrastructure costs

Element 3: Scarcity Pricing for Capacity Cost Recovery

- **Current approach**
  - ***Non-Residential***: Demand charge based on *customer's* peak load
  - ***Residential***: Volumetric prices
- **Issues with current approach**
  - Encourages non-economic behavior
  - No signal to reduce peak system load
  - Increase in cost of service with misalignment between supply and demand
- **➔ Hourly capacity charges ($/kWh) to recover cost of fixed capacity**
  - Distribution capacity
  - Generation capacity (Resource Adequacy)
  - Ramping capacity (Flex RA)

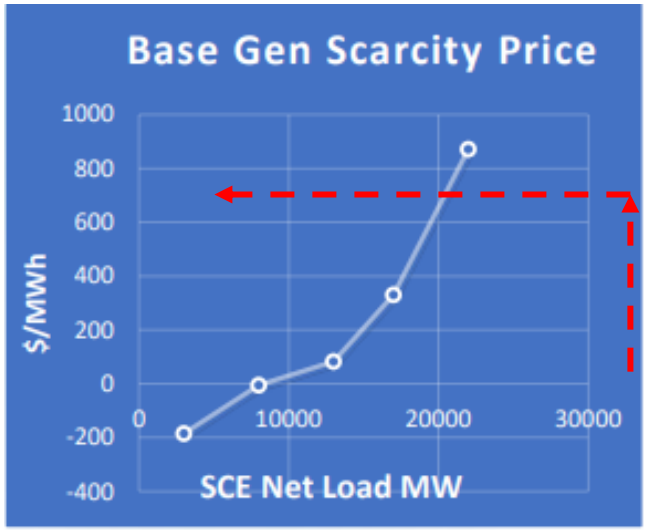
Proposed: Scarcity Price Function

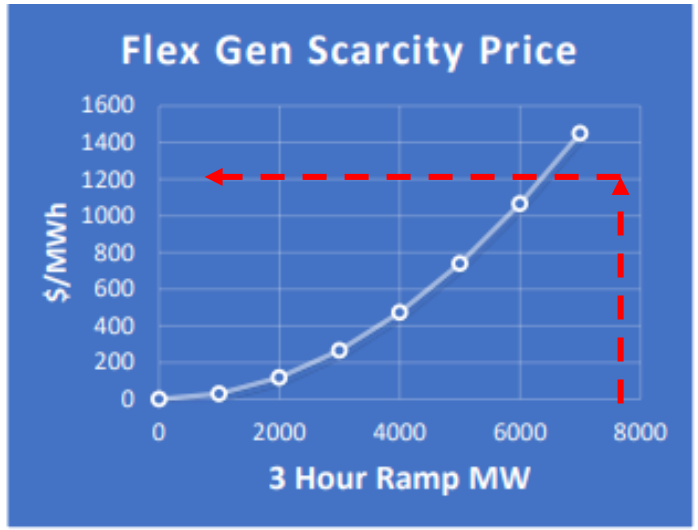
- *Recover more fixed costs as system utilization increases*
- *Based on long-run marginal cost of adding capacity*

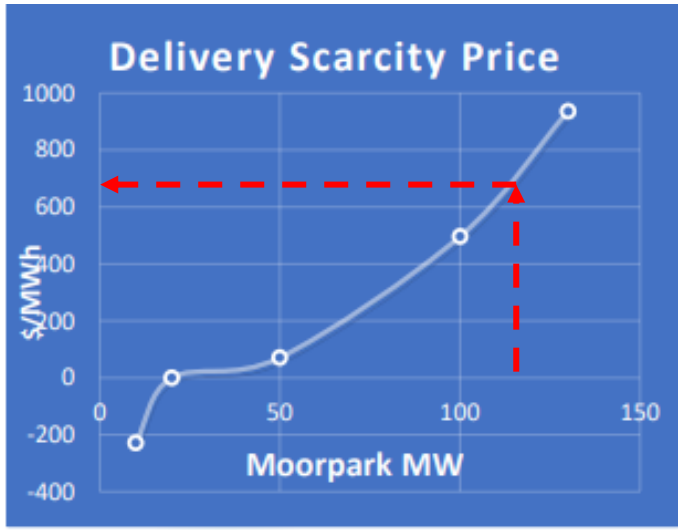


Example: Scarcity Pricing for Capacity Costs

- **Scarcity prices based on grid conditions determine Delivery, Gen, and Flex Gen prices:**
  - Revenue = Sum-product of test year hourly load and hourly scarcity prices (for each capacity element)
  - Scaled to recover the appropriate annual revenue (same as OAT) for each "section" of the system







LSE: $\$P_{Gen\ RA} = g(y)$

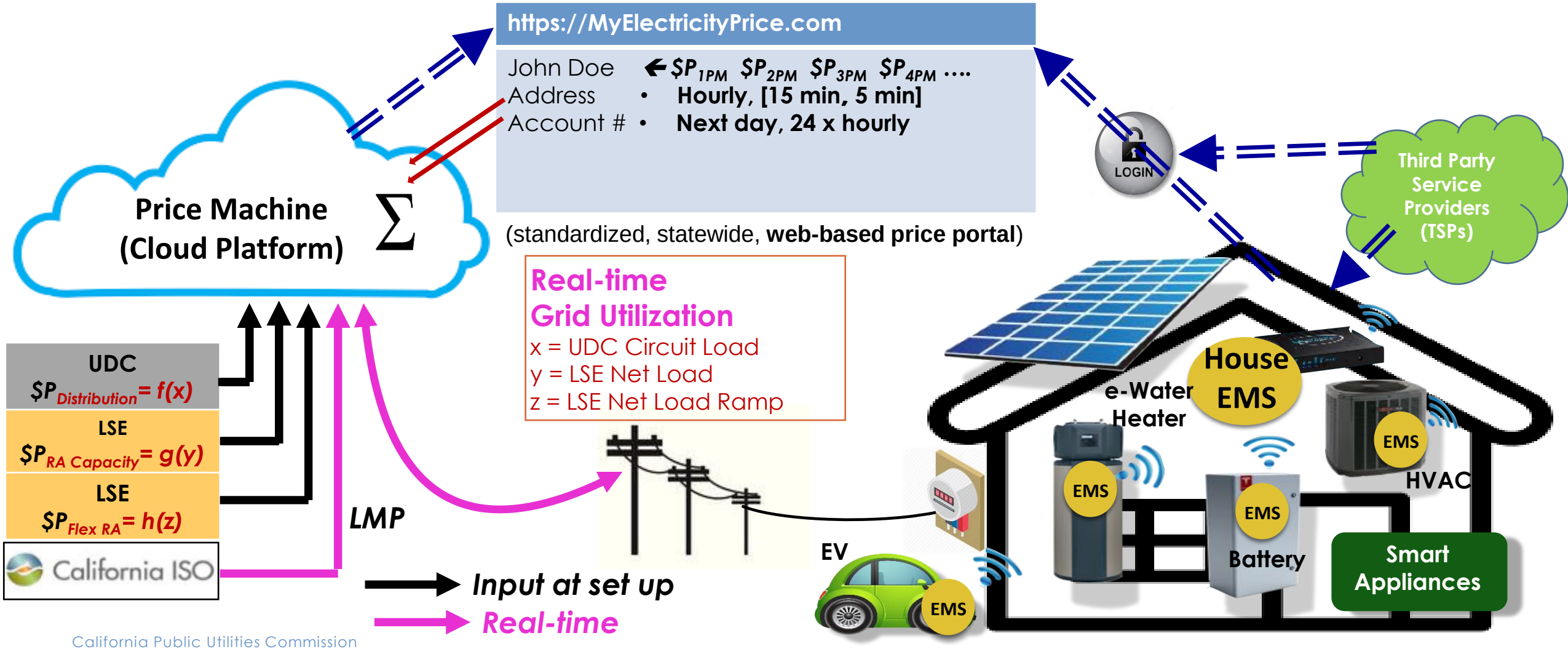
LSE: $\$P_{Flex\ RA} = h(z)$

UDC: $\$P_{Distribution} = f(x)$

Price Machine computes composite price = $\$P_{Distribution} + \$P_{RA\ Capacity} + \$P_{Flex\ RA} + \$LMP$

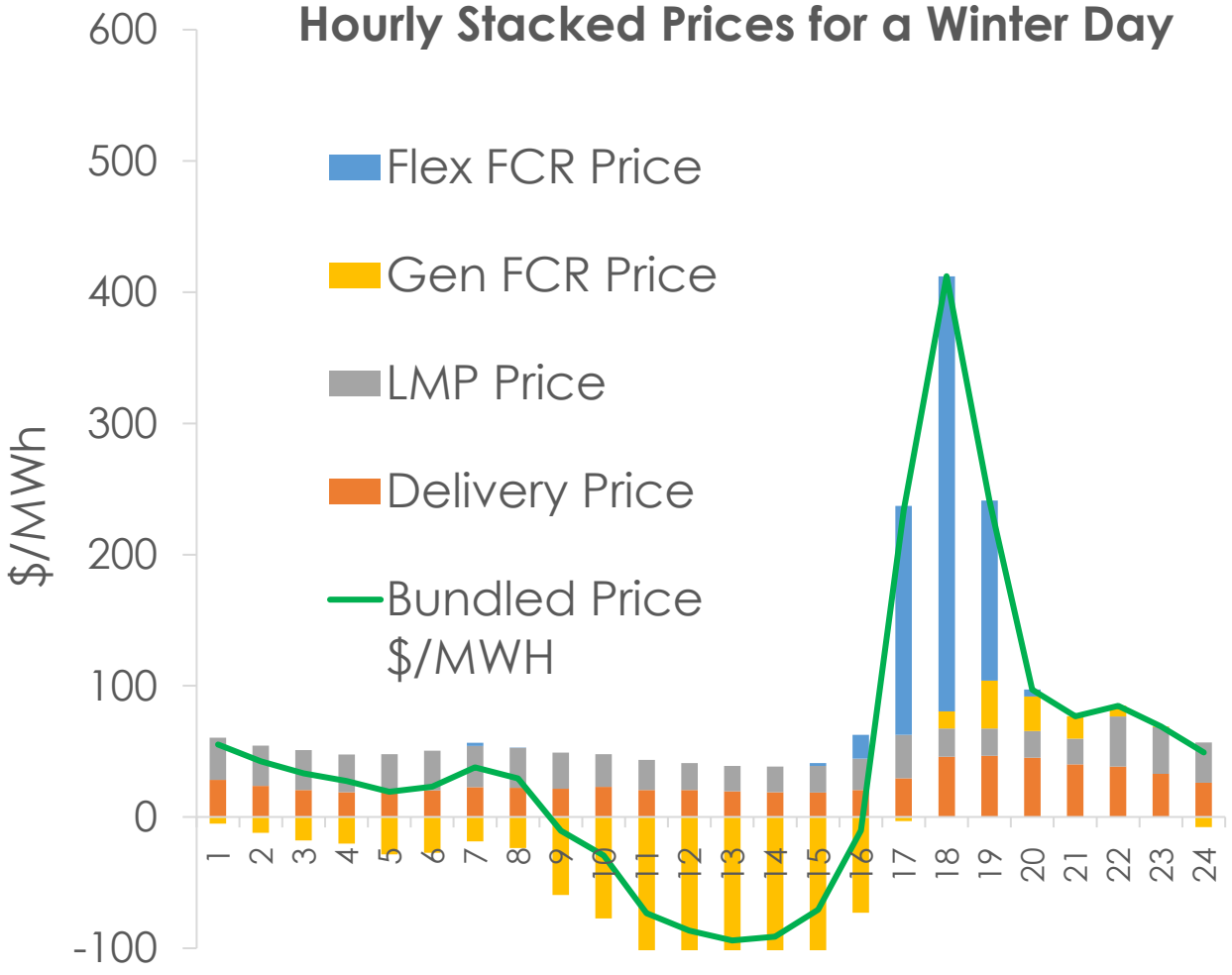
*Based on design used in SCE/TEMIX RATES Pilot (2016-2019)

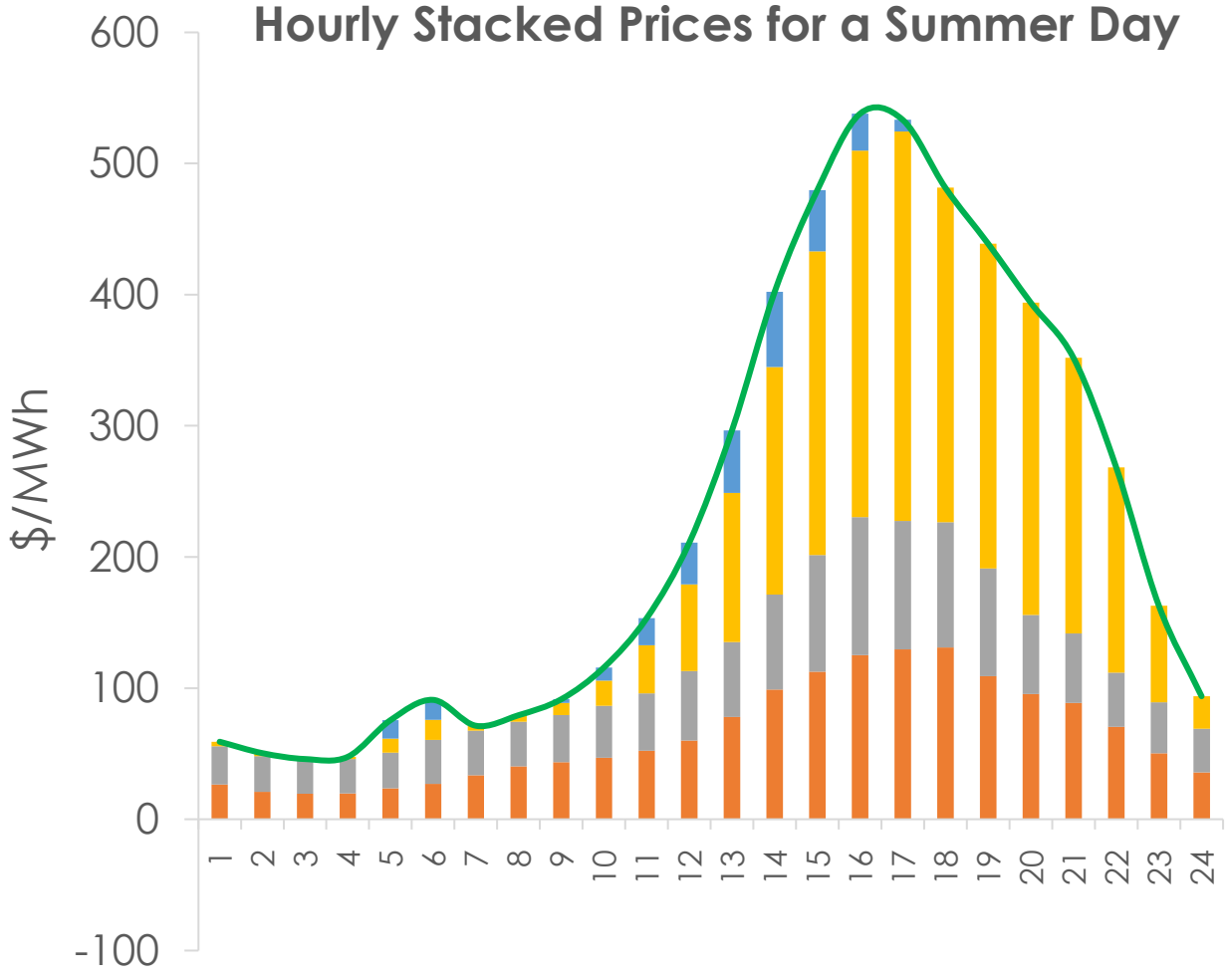
Element 3: Dynamic Capacity Charges based on Local Grid Utilization



Example: SCE/TeMix "RATES" Pilot

Composite Hourly Prices based on Hourly Capacity Utilization & CAISO LMP





FCR = Fixed Cost Recovery

Source: SCE / TeMix "RATES" Pilot funded by CEC (EPIC)

Objectives Achieved via Hourly Capacity Prices

1. Encourage load shift complementary to grid-based economics
2. Shift fixed cost recovery burden onto load driving high system utilization and capacity upgrades
3. Ensure full recovery of revenue requirements
   - Prices can be scaled to recover same revenue as OAT for various segments of the distribution system (ensures fairness across a service territory)
4. Minimize long-term infrastructure costs
5. Allow flexible rate design options to reflect policy choices
   - Different cost allocations and recovery by customer class
6. More frequent and granular updates to prices to stabilize revenues AND incorporate system efficiency gains from demand flexibility into rates

Element 3: Key Implementation Questions

1. What geographical scope should be used to define the "localized" available infrastructure (that serves as the basis for determining real-time utilization level) for the different capacity elements of CalFUSE?
2. Should all fixed costs be recovered via dynamic volumetric prices or only marginal generation and distribution capacity costs?
3. Should the scarcity price curves be customer class specific?

CalFUSE Framework: Element 4

1: Develop **standardized, universal access** to current electricity price

2: Introduce dynamic prices based on **real-time, wholesale energy** cost

3: Incorporate **dynamic capacity charges** based on real-time grid utilization

4: Transition to **bidirectional prices** (import & export)

Benefits of Symmetric, Bidirectional Prices

1. **Easily discoverable, transparent, predictable economic value**
   - Simplifies DER Valuation & Operations
2. **Distributed, economically-driven self-dispatch of DERs**
   - Removes need for supervisory control/coordination of BTM devices
3. **Scarcity prices ensure that export (and import) prices are linked to cost causation**
   - Reduces unintended cost-shift
4. **Improved monetization of DER services to the grid (locational, temporal)**
   - Transparent capacity value of exports to the distribution system
5. **Enable full V2G integration**
   - Mobile storage used to enhance grid resiliency
   - e.g., season use of electrified school busses

Analysis: Simulation of Energy Storage Dispatch

- Storage dispatch optimized to SCE TOU rates vs. CalFUSE price signal
- Result: Bill and GHG savings significantly higher with CalFUSE

All Amounts Annualized	Retail Rate	Bill w/o Storage	Bill with Storage	Bill Savings with Storage	GHG Emissions Reduced (metric tons)	Number of Cycles
Residential	TOU-D-Prime	$1,849	$1,397	$447	**0.25**	150
	CalFUSE	$1,644	$725	$919	**0.36**	201
Commercial	TOU-8 (with NCDC)	$543K	$513K	$33K	**3.78**	332
	CalFUSE	$590K	$523K	$66K	**28.43**	393

Note: Results were generated by ED Staff using OSESMO (Open-Source Energy Storage Model). This tool has been used to evaluate CPUC's SGIP (Self-Generation Incentive Program)

Element 4: Key Implementation Questions

1. Are the existing customer data access policies, systems, processes (in conjunction with the Element 1 price portal) adequate to allow third-party service providers of BTM DERs and automated energy management tools to fully leverage a CalFUSE signal and maximize customer benefits?

CalFUSE Framework: Element 5

1: Develop **standardized, universal access** to current electricity price

2: Introduce dynamic prices based on **real-time, wholesale energy** cost

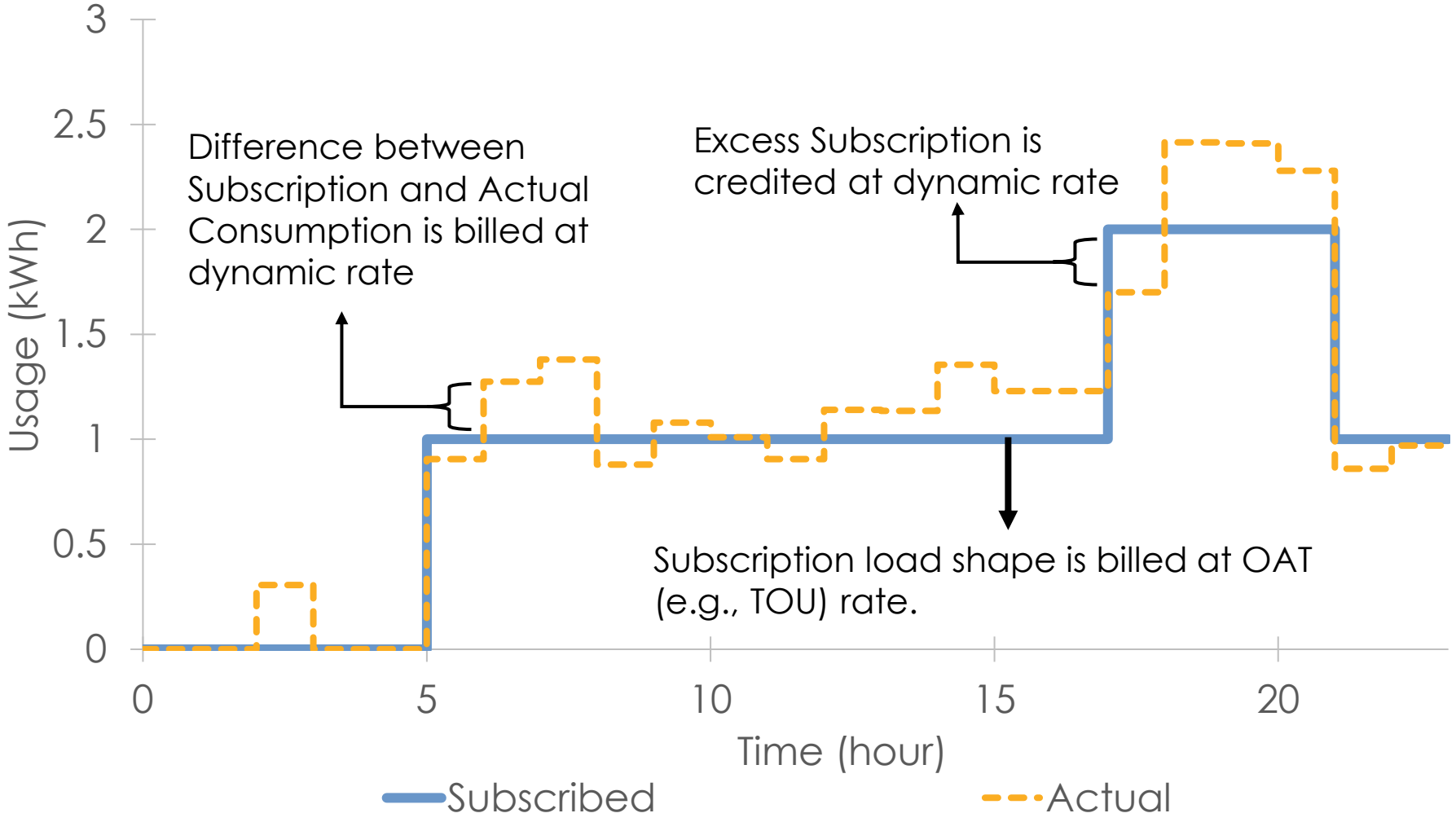
3: Incorporate **dynamic capacity charges** based on real-time grid utilization

4: Transition to **bidirectional prices** (import & export)

5: Offer **subscription option** (historic load shape & energy quantity at OAT price)

Customer-Specific Baseline Subscriptions: Historic Load Shape & Energy Quantity at OAT Price

Stabilizing Element (Hedge) for Both Customers and Utilities



- Quantity should be based on historical usage.
- Using the OAT ensures that customer bills are similar to prior years
- Options for subscriptions shape include: Customer-specific, class-averaged, climate-zone weighted.

Benefits of "Customer Baseline Subscription"

Protection

- Protects customers against bill volatility
- Eases customers transition
- Non-responsive customers pay similar bills

Flexibility

- Encourages opportunistic load shift
- Accommodates changes in demand (e.g., new DERs)

Predictability

- Stabilizes revenue recovery for distribution operators, LSEs

Fixed Cost Recovery Options

<table>
<tr><th>Cost Component</th><th>CalFUSE Options</th><th>Status Quo</th></tr>
<tr><td>Misc Program Fixed Costs (PPP, EE, etc.)</td><td rowspan="2">1. Embedded in baseline subscription
2. Volumetric, scarcity-based prices
3. Monthly fixed charges</td><td>Fixed Charges (limited), Demand Charges (non-residential)</td></tr>
<tr><td>Non-Marginal Capacity</td><td rowspan="3">Volumetric: Some Time-differentiated + Flat adder</td></tr>
<tr><td>Marginal Capacity</td><td>Volumetric / Scarcity price linked to grid utilization</td></tr>
<tr><td>Energy (including losses)</td><td>Volumetric / Locational marginal price linked to CAISO</td></tr>
</table>

Element 5: Key Implementation Questions

1. How should baseline subscription profiles be updated/revised?
2. What are alternative approaches to bill/revenue stabilization as dynamic rates are offered at wider scale?
3. How can the role of third-party energy managers and service providers be best leveraged for baseline subscriptions?
4. What best practices should be considered for educating customers about CalFUSE price signal and baseline subscriptions?

CalFUSE Framework: Element 6

1: Develop **standardized, universal access** to current electricity price

2: Introduce dynamic prices based on **real-time, wholesale energy** cost

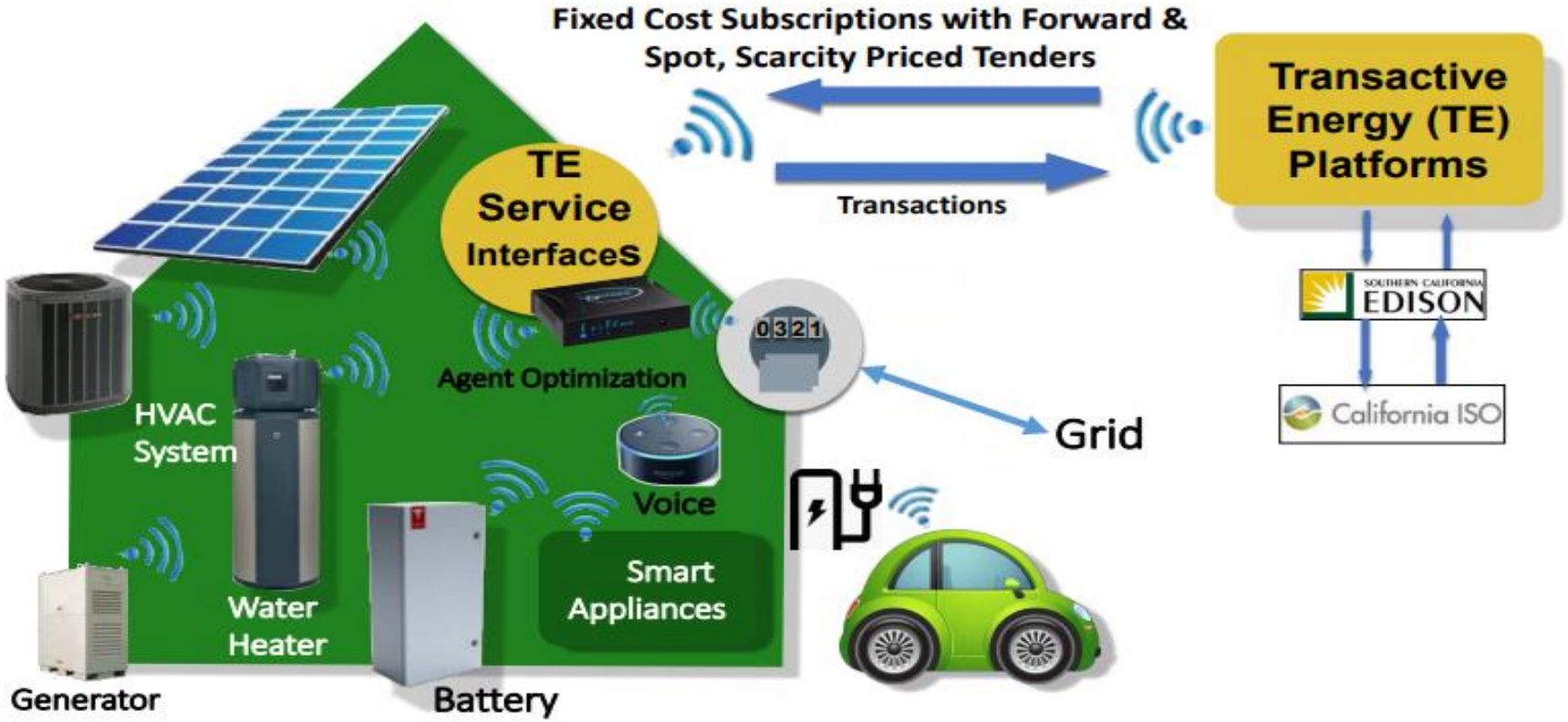
3: Incorporate **dynamic capacity charges** based on real-time grid utilization

4: Transition to **bidirectional prices** (import & export)

5: Offer **subscription option** (historic load shape & energy quantity at OAT price)

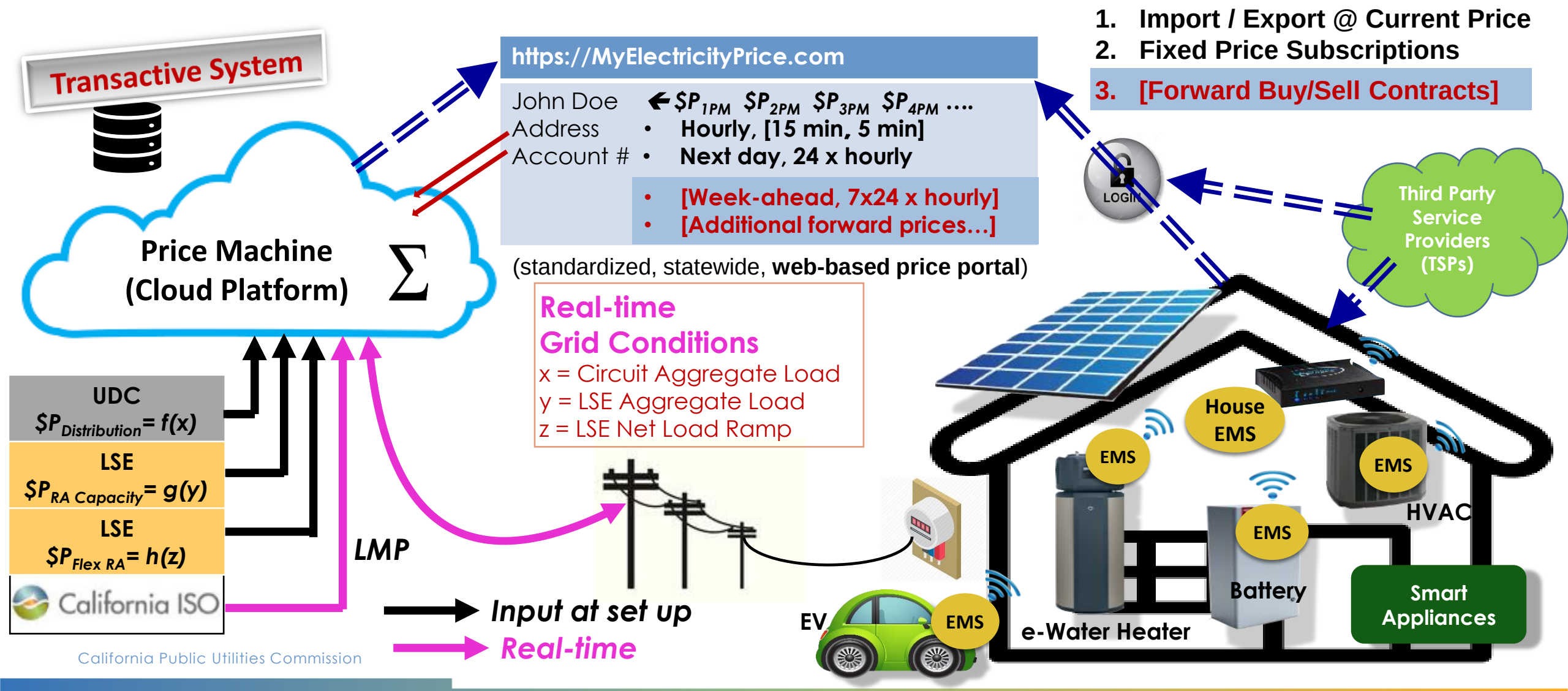
6: Introduce **transactive features** (ability to lock in price in advance)

Element 6: Transactive Features



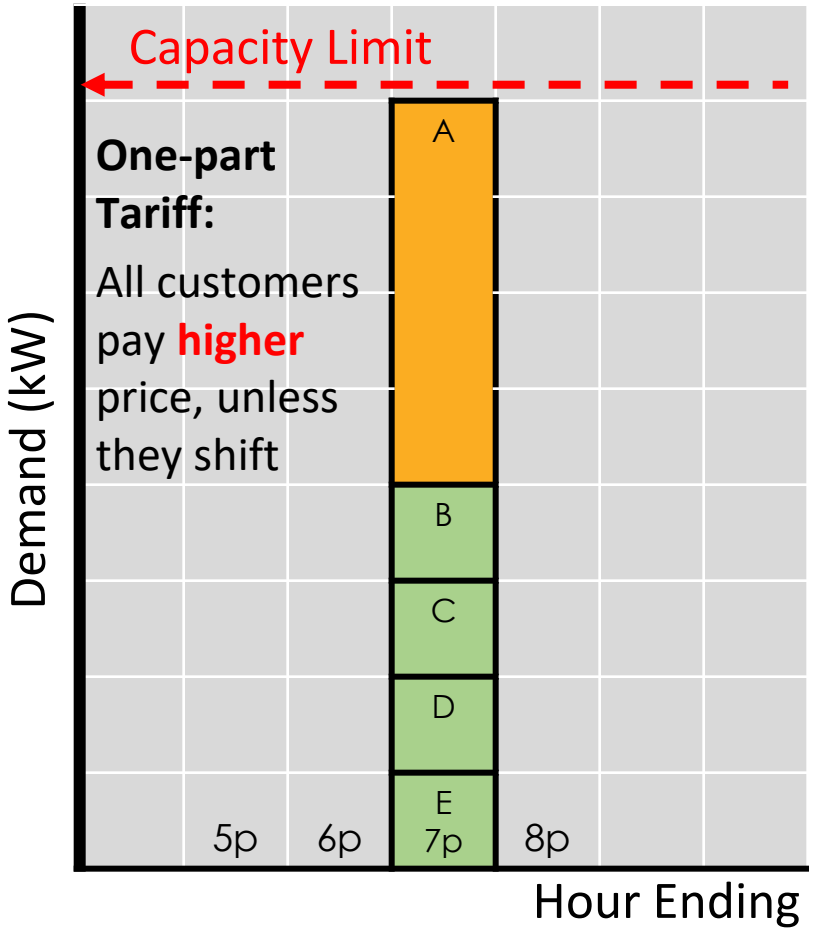
1. Fixed Cost Subscriptions Stabilize Customer Electric Bills
2. Variable Buy and Sell Prices Enable Self-Management & Flexibility
3. TE Platform Communicates Prices and Records Transactions

Element 6: Transactive Features



Equity Considerations in the CalFUSE Proposal

1. **Opt-in**
2. **CalFUSE signal can be tailored for low-income customers**
3. **Baseline subscription to hedge against extreme outcomes**
4. **Early adopters reduce cost of service for everyone**
   - Drive technology cost reduction
   - Enable wider adoption
5. **Transactive Layer: Savings realized by all (including non-participants)**



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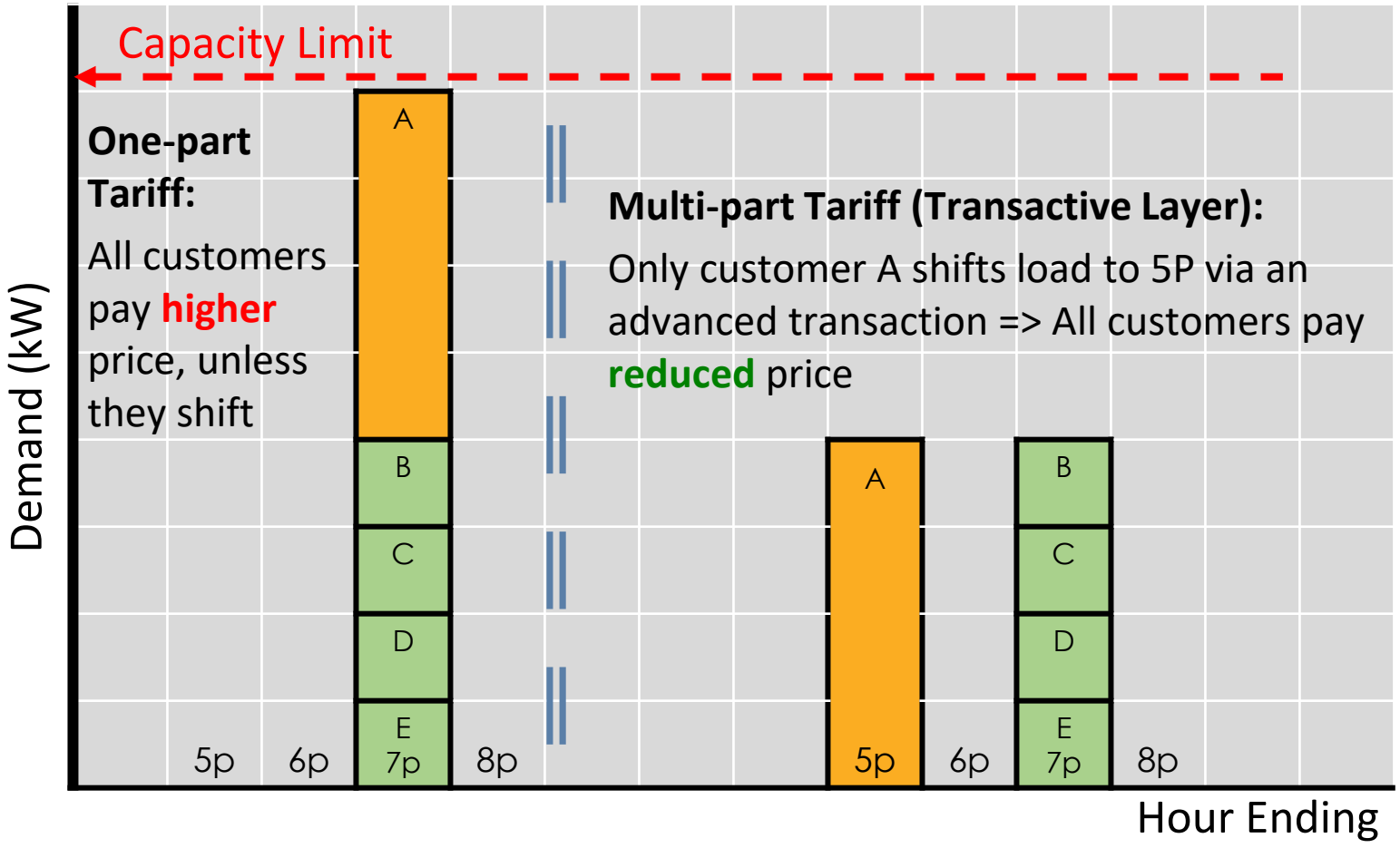

Benefits of a Transactive System

LSEs & Distribution Operators

- Improves visibility, planning, operations
- Feedback loop to manage scheduling, e.g., EV charging

CAISO

- More visibility, reduce load forecast error

Customers

- Transactive energy management tools, optimize cost… *for advanced customers*
- Locks in price savings to all customers

Analysis: Simulation of Transactive System for ERCOT Grid

- Study conducted by PNNL, funded by DOE
  - Slightly more advanced transactive framework: forecasts of available supply and demand bids are used to generate prices
  - Transactive price is bidirectional, symmetric, and "revenue-neutral" (similar to CalFUSE)
- Significant shifting of energy use from high demand periods to low price periods
  - Reduced peak load: 9-15%; Reduced daily load swings: 20-44%
  - Similar reductions in wholesale price variation
- Net annual benefit ~12-19% of total ERCOT system costs ($3.3-5.0 billion)
  - Reduced wholesale energy costs and deferred infrastructure upgrade costs
- Equity: sustained benefits for all customers
  - Participating customers: 14-16% savings; Non-participating customers: 10-14% savings

Element 6: Key Implementation Questions

1. Should there be one system for the whole state, or should there be multiple systems (perhaps one per UDC, or one per LSE)?
2. What are the processes, agreements, and understandings that are necessary between UDCs and LSEs to facilitate the transactive elements of CalFUSE?
3. What standards, rules, and regulations are required to facilitate a robust, secure, and efficient transactive system? What regulatory oversight is required?
4. What factors should an LSE consider in deciding how to formulate bids in a transactive system?

Upcoming IOU Pilots

Upcoming CalFUSE Pilots

- **CalFUSE Pilots authorized by Summer Reliability OIR Phase 2 (D.21.12.05) to launch on May 1**
- **VCE/PG&E "AgFIT" agricultural pumping dynamic rate pilot**
  - Jointly implemented by Polaris, TeMix, VCE, and PG&E
  - Authorized for 5MW (~1MW enrolled)
  - Provides farmers week-ahead prices which they can use to pre-schedule irrigation cycles using TeMix Transactive Layer
- **SCE "RATES Phase 2" dynamic rate pilot**
  - Open to all C&I and residential SCE customers
  - Will be available across SCE service territory

Current and upcoming IOU Dynamic Rate Pilots

- **PG&E Commercial EV Day Ahead RTP (CEV DAHRTP) rate (D.21-11-017) – October 2023**
  - Optional day-ahead, hourly RTP rate for Commercial EV customers.
  - Includes a dynamic MGCC Adder and a time-differentiated Revenue Neutral Adder
  - Distribution rate includes a discounted demand charge-"Subscription"
  - Cost-based export rate-rider (in proceeding: A.20-10-011)
- **PG&E GRC Phase 2 RTP rate (A.19-11-019) – October 2023**
  - Optional DAHRTP generation rate open to multiple customer classes.
  - Joint settlement has been filed regarding the rate design, which mirrors much of the CEV rate
  - Decision is expected in July 2022.
- **SDG&E GRC Phase 2 RTP rate & High-Power EV(HPEV) RTP Rate (A.21-12.006/A.21-12.008)**
  - Applications for C&I RTP pilot and RTP export rate-rider for HPEV customers have been consolidated into a single proceeding.
  - Rate design includes day-ahead hourly market prices, CPP adders for MGCC.
  - SDG&E to revise its applications in supplemental testimony based on ED staff guidelines.

Note: All the above pilots offer dynamic generation rates and do not include dynamic distribution rates.

End of Briefing

Lunch **Break**

Return at 1:00

https://www.slidecamp.io/home

California Public Utilities Commission

Q&A

Whitney Richardson, Retail Rates Section | Energy Division

July 21, 2022

10-Min Stretch Break :)

Please be back at 2:11

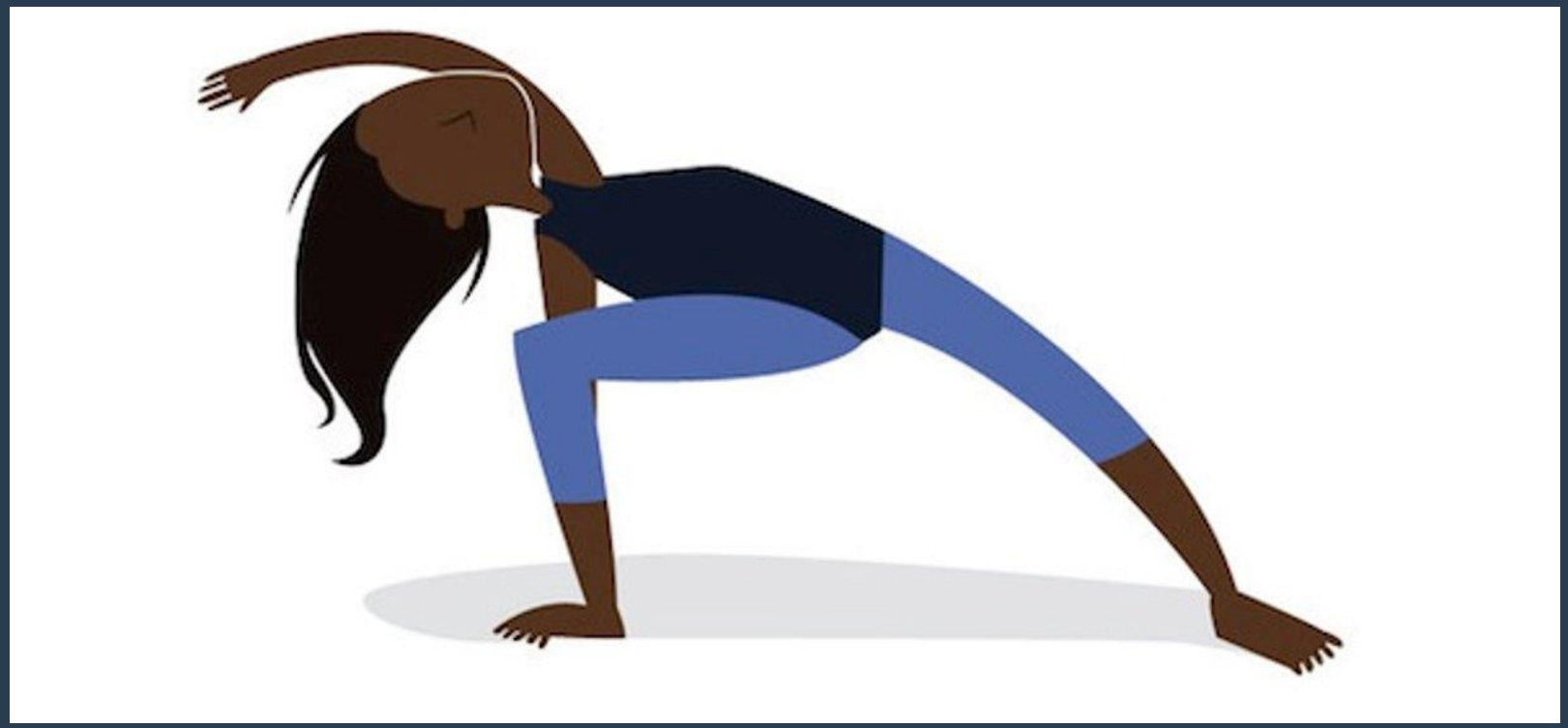

Image Source: iamthinks.blogspot.com
https://www.showeet.com/19/06/2016/templates/title-slide-templates-for-powerpoint-and-keynote/

California Public Utilities Commission

Comments & Discussion

Energy Division |

- Paul Phillips, Retail Rates Section
- Aloke Gupta, Demand Response Section

July 21, 2022

California Public Utilities Commission

Closing Remarks

Paul Phillips, Retail Rates Section | Energy Division

July 21, 2022

California Public Utilities Commission

Thank you for attending today's Advanced DER & Demand Flexibility Management Workshop. Feedback welcome.

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