Forward Looking Vision:
Advanced DERs & Demand Flexibility Management

Aloke Gupta
DR Section, Energy Division
May 25, 2021
Agenda

- **System Needs**
- Opportunity
- Current Approach
- Forward Looking Vision
- Proposed Roadmap
- Discussion
Executive Summary

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.

Staff Proposal

Jointly pursue reforms of DR programs and Rate structures to Promote *Unified Strategies for Demand (Load) Management and Grid Optimization* to achieve *widespread demand flexibility.*
Anticipated Issues 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
2019 IRP* Reference System Plan Implications

System trends by 2030:

• 60% increase in evening ramp
• Substantial increase (15x) in renewables curtailment

IRP analysis:

• DR can be a cost-effective alternative for renewables integration resources
• But highly scalable, low-cost deployment strategies are needed to realize that potential

Graphic from CAISO “Briefing on Post 2020 Grid Operational Outlook,” Mark Rothleder, VP, @ CAISO BOG, December 19, 2019
Agenda

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• **Opportunity**
• Current Approach
• Forward Looking Vision
• Proposed Roadmap
• Discussion
Opportunity: Proliferation of DERs & Electrification ➔ Demand Flexibility

- 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 capacity
  - ~ 4.5x utility storage
- Building decarb: Substantial growth of smart, flexible end uses
  - Smart devices & plugs
  - Smart thermostats/heat pumps,
  - Smart electric (heat pump) water heaters
- Growth of microgrids and other flexible emerging end uses

Opportunity or Threat
Agenda

• System Needs
• Opportunity
• **Current Approach**
• Forward Looking Vision
• Proposed Roadmap
• Discussion
Current Approaches to Achieving DR (Demand Flexibility)

- **Time-Differentiated Rates (Load Modifying DR)**
  - 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 DR)**
  - Multiple programs focused on load shed as resource adequacy
  - Challenges in CAISO market integration, measurement & verification
  - Considering new programs for load shift DR
  - Administratively & technically complex, inefficient, high transaction costs

**Current Procurement Options**
- IOU DR programs
- IOU LCR DR contracts
- DRAM
- CCA DR contracts
Issues with Market Integrated Pathway  
(Per Joint Solar/Storage Parties in Resource Adequacy Rulemaking*)

All BTM DERs providing capacity should have the option to forgo market integration, as the **market-informed pathway is simpler and avoids obstacles impeding DER providers**, such as the following:

1. Issues surrounding interconnection of exporting resources are eliminated as Rule 21 clearly governs.
2. Complexity and cost associated with market integration and dispatch are also eliminated.
3. Issues associated with visibility at the T&D interface, necessitating communication and visibility of resource performance by both the distribution operator and the CAISO, are eliminated.
4. Concerns associated with double payment for electricity from NEM systems - wholesale market revenue for settled resource export vs. retail bill credits for NEM - are eliminated.
5. Aggregators are better able to dispatch resources to meet specific local needs, rather than rely entirely on system-level CAISO dispatch, which may be inconsistent with local needs.
6. Thorny issue of deliverability to the transmission system is avoided entirely.
7. The only CAISO tariff for Rule 21 connects DERs is PDR, which does not credit energy exported to the grid.

Current Approaches to Achieving Demand Flexibility

- **Time-Differentiated Rates (Load Modifying Demand Response [DR])**
  - 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 DR)**
  - Multiple programs focused on load shed as resource adequacy
  - Challenges in CAISO market integration, measurement & verification
  - Considering new programs for load shift DR
  - Administratively & technically complex, inefficient, high transaction costs

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

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

Current Procurement Options
- IOU DR programs
- IOU LCR DR contracts
- DRAM
- CCA DR contracts
Path Forward: Consolidation

**Present**
- Basket of Rates (cost recovery / allocation, equity)
- Basket of Supply-Side Programs (market integrated)
- + TBD: Load Shift Programs
- Distribution Level DR

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

**Future**
- Demand Side: Unified, universal, dynamic, economic (UNIDE) signal
- Reduced complexity, Single point focus
- Highly scalable, widespread adoption
- Reduced cost of controls, automation
Agenda

• System Needs
• Opportunity
• Current Approach
• **Forward Looking Vision**
• Proposed Roadmap
• Discussion
Three Part Vision ➔ UNIDE

Presentation of Rates

Rate Reforms

Customer Options: Optimize Energy

Demand-side: unified, universal, dynamic, economic (UNIDE) signal
Goal: Achieve Widespread Demand Flexibility

Leverage significant opportunity resulting from electrification, DER adoption

**Challenges**

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

**Opportunities**

- Enhance renewables integration & reduce emissions
  - Reduce curtailment

- Enhance reliability
  - Reduce system ramp
  - Intermittent supply balanced by dispatchable demand
  - Managed coordination of DER operations

- Minimize cost of service
  - Managed load growth and DER operations

- Provide fair compensation of DER services stack
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  - **Proposed Roadmap**
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Three Part Vision → UNIDE

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Demand-side: unified, universal, dynamic, economic (UNIDE) signal
Proposed Roadmap

Step 1

Step 2

Step 3

Step 4

Step 5

Step 6

Demand Side: unified, universal, dynamic, economic (UNIDE) signal
Electricity Price Presentation to Customers (Today)

- Practically non-existent information on “current” electricity price
- Price discovery ~ difficult process
- “Manual” EMS configuration in field ➞ expensive
Step 1: Standardized, Universal Access to Electricity Price

https://MyElectricityPrice.com

John Doe
Address
Account #

(standardized, statewide, web-based price portal)

1. Consume @ Current Price

$P_{1PM}$ $P_{2PM}$ $P_{3PM}$ $P_{4PM}$ ….
Step 1: Standardized, Universal Access to Electricity Price

<table>
<thead>
<tr>
<th>DO $P_{Distribution}$</th>
<th>LSE $P_{Generation}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 Investor-Owned Utilities</td>
<td>24 ➔ 50 Community Choice Aggregators</td>
</tr>
<tr>
<td>40 Municipal Utilities</td>
<td></td>
</tr>
</tbody>
</table>

https://MyElectricityPrice.com

John Doe
Address
Account #

$P_{1PM}$ $P_{2PM}$ $P_{3PM}$ $P_{4PM}$ ....

1. Consume @ Current Price

Price Machine (Cloud Platform)

Third Party Service Providers (TSPs)

Input at set up
Auto-Configuration of Smart Devices

- Buy and install smart device
- Embedded EMS automatically connects (via internet) to...
  https://www.MyElectricityPrice.com
  - Access real-time price time series (hourly, sub-hourly)
  - Day-ahead forecast, hour-ahead forecast
- Remote upgrade of EMS as needed for changes, new features

⇒ Enable Scalability, Wide-scale Adoption
Step 1: Standardized, Universal Access to Current Electricity Prices

1. Provides current, localized, composite electricity price specific to a service territory and customer

2. Accommodates pricing inputs from regulatory entities (DO, LSE)

3. Leverages large “ecosystem” to educate and help customers manage energy and DERs

4. Facilitates widespread adoption ← → cost reduction of demand (load) management automation
Proposed Roadmap: Step 1

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

Demand Side: unified, universal, dynamic, economic (UNIDE) signal
Three Part Vision → UNIDE

- Presentation of Rates
- Rate Reforms
- Customer Options: Optimize Energy

Demand-side: unified, universal, dynamic, economic (UNIDE) signal

- Staff Proposals
- Opt-in!
- UNIDE Goal
Proposed Roadmap: Step 2

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

Step 2: Introduce dynamic prices based on real-time, wholesale energy cost (opt-in)

Demand Side: unified, universal, dynamic, economic (UNIDE) signal
Step 1: Standardized, Universal Access to Electricity Price

https://MyElectricityPrice.com

John Doe
Address
Account #

$P_{\text{Distribution}}$

LSE

$P_{\text{Generation}}$

DO

$LMP$

Input at set up

Real-time

1. Consume @ Current Price

Third Party Service Providers (TSPs)

(standardized, statewide, web-based price portal)

• Hourly, [15 min, 5 min]
• Next day, 24 x hourly
Step 2: Introduce Dynamic Price per CAISO Wholesale Energy Cost

https://MyElectricityPrice.com

John Doe
Address
Account №

(standardized, statewide, web-based price portal)

1. Consume @ Current Price

$P_{distribution}$

LSE

$P_{generation}$

LMP

Input at setup

Real-time

Third Party Service Providers (TSPs)
### CAISO Energy Day-Ahead Market (DAM): Price Statistics*

<table>
<thead>
<tr>
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<th>Units</th>
<th>2018</th>
<th>2020</th>
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</thead>
<tbody>
<tr>
<td><strong>Weighted average DAM price (WADP)</strong></td>
<td>¢/kWh</td>
<td>4.4</td>
<td>3.9</td>
</tr>
<tr>
<td>% annual hours below WADP</td>
<td></td>
<td>71.8%</td>
<td>76.4%</td>
</tr>
<tr>
<td>% annual hours below 2 x WADP</td>
<td></td>
<td>96.4%</td>
<td>97.5%</td>
</tr>
<tr>
<td># annual hours above 2 x WADP</td>
<td>Hours</td>
<td>315</td>
<td>222</td>
</tr>
<tr>
<td><strong>Lowest DAM Price</strong></td>
<td>¢/kWh</td>
<td>-1.6</td>
<td>-1.0</td>
</tr>
<tr>
<td># hours below $0</td>
<td>Hours</td>
<td>75</td>
<td>41</td>
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<tr>
<td><strong>Highest DAM Price</strong></td>
<td>¢/kWh</td>
<td>93.5</td>
<td>101.9</td>
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<tr>
<td>Highest DAM price to WADP ratio</td>
<td></td>
<td>21.2x</td>
<td>26.2x</td>
</tr>
<tr>
<td><strong>Price Range in Top 10% of Net Load</strong></td>
<td>¢/kWh</td>
<td>11.8 – 93.5</td>
<td>8.8 – 101.9</td>
</tr>
<tr>
<td># hours responsible for Top 10% of net load</td>
<td>Hours</td>
<td>30</td>
<td>29</td>
</tr>
</tbody>
</table>

*Preliminary estimates – not peer reviewed
Step 2: Real-Time Locational Price Linked to CAISO Markets

1. Reflects CAISO market conditions, encourages load shift or increase
2. Helps reduce curtailment, evening ramp, emissions
3. Helps enhance reliability
4. Helps reduce energy procurement costs (reduces hedging cost)
5. Complements anticipated updates to CEC’s Title 20 (Load Management Standards)
<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Fixed</th>
<th>Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generation</td>
<td>Fixed - generation capacity</td>
<td></td>
<td>Variable - energy</td>
</tr>
<tr>
<td>Distribution</td>
<td>Fixed - distribution grid capacity</td>
<td></td>
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<tr>
<td>Misc</td>
<td>Metering, Billing, Legal, G&amp;A…</td>
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</tr>
<tr>
<td>Transmission</td>
<td>Fixed - transmission grid capacity</td>
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</table>
## Electricity Price Dissected - Capacity

<table>
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<tr>
<th>Category</th>
<th>Fixed - capacity</th>
<th>Variable - energy</th>
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Proposed Roadmap: Step 3

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

Step 2: Introduce dynamic prices based on real-time, wholesale energy cost \((opt-in)\)

Step 3: Modify prices per real-time, localized grid conditions \((opt-in)\)

Demand Side: unified, universal, dynamic, economic \((UNIDE)\) signal
Electricity Price Dissected - Capacity

1. Composite and component prices must be time-dependent, volumetric: $/kWh
   - Not based on capacity: $/kW (such as, monthly demand charges)
   - Not based on historical consumption (such as, stepped tiers)

2. Recover more fixed cost when system utilization is higher
   - aka “scarcity price function”
Current approaches
- **Non-Residential**: Non-coincident demand charge based on customer’s peak load
- **Residential**: Constant volumetric charge

Issues with current design
- Encourages non-economic behavior
- No signal to reduce high coincident peaks
- Increase in cost of service with higher load

Fixed Capacity Constraints
- Distribution capacity
- Generation capacity (Resource Adequacy)
- Ramping capacity (Flex Resource Adequacy)

**Proposed: Scarcity Price Function**
- Recover more fixed cost as system utilization increases
- Linked to long-run marginal cost of adding capacity
Step 2: Introduce **Dynamic Price** per CAISO Wholesale Energy Cost

1. Consume @ Current Price

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

(standardized, statewide, web-based price portal)

https://MyElectricityPrice.com

John Doe
Address
Account #

DO
$P_{Distribution}$

LSE
$P_{Generation}$

California ISO

LMP

Real-time

Input at set up

Third Party Service Providers (TSPs)
Step 3: Modulate Electricity Price Per Local Grid Conditions

https://MyElectricityPrice.com

John Doe
Address
Account #

Real-time Grid Conditions
x = Circuit Aggreg Load
y = LSE Aggreg Load
z = LSE Net Load Ramp

Step 3: Modulate Electricity Price Per Local Grid Conditions

1. Consume @ Current Price

Real-time, 5 min
Next day, 24 x hourly

Third Party Service Providers (TSPs)
Developing a Composite Economic Signal based on Grid Utilization*

- **Scarcity pricing functions & grid conditions determine Delivery, Generation and Flex prices:**
  - Based on long-run marginal cost of adding new capacity
  - Designed to recover the required annual revenue in the target year

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

*Based on design used in SCE/TEMIX EPIC Pilot (2016-2019)
EPIC Pilot: Composite Hourly Prices
(based on Hourly Capacity Utilization & CAISO LMP)

Source: SCE / Temix Pilot
Alternate Example: SDG&E “Power Your Drive” Rate

System-level CPP - an energy rate option that provides a “capacity” price signal.

Circuit-level CPP provides a locational price signal while preserving customer equity by still charging all customers the same price.

Illustrative Hourly Dynamic Rate

- CPP Hourly Adders applied to the top 150 System Load Hours for the recovery of generation capacity costs to serve system peak load.
- Circuit-CPP Adder applied to the top 200 Circuit Load Hours for the recovery of distribution circuit peak capacity costs.
- CAISO Day-Ahead Hourly LMP to approximate real-time cost of electricity.
- Flat base energy rate for the recovery of all other utility costs.

Base Energy Rate □ CAISO Day-ahead Energy □ Circuit Adder □ System Adder
Step 3: Rate Reform Objectives via Hourly Capacity Charge

1. Encourage load shift / increase complementary to grid-based economics - avoid uneconomical arbitrage
2. Shift fixed cost recovery burden onto load driving high system utilization and capacity upgrades
3. Ensure full recovery of revenue requirements
4. Minimize long-term infrastructure upgrades & investment with electrification and related cost of service
5. Allow flexible rate design options to reflect policy choices and accommodate:
   - Different decisions by different regulatory entities
   - Different cost allocations and recovery by customer class
   - More frequent and granular updates to maintain revenue collection on target
Issues with Market Integrated Pathway
(Per Joint Solar/Storage Parties in Resource Adequacy Rulemaking*)

All BTM DERs providing capacity should have the option to forgo market integration, as the market-informed pathway is simpler and avoids obstacles impeding DER providers, such as the following:

1. Issues surrounding interconnection of exporting resources are eliminated as Rule 21 clearly governs.
2. Complexity and cost associated with market integration and dispatch are also eliminated.
3. Issues associated with visibility at the T&D interface, necessitating communication and visibility of resource performance by both the distribution operator and the CAISO, are eliminated.
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6. Thorny issue of deliverability to the transmission system is avoided entirely.
7. The only CAISO tariff for Rule 21 connects DERs is PDR, which does not credit energy exported to the grid.

Proposed Roadmap: Step 4

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

Step 2: Introduce dynamic prices based on real-time, wholesale energy cost (opt-in)

Step 3: Modify prices per real-time, localized grid conditions (opt-in)

Step 4: Transition to bi-directional prices

Demand Side: unified, universal, dynamic, economic (UNIDE) signal
Step 4: Transition to Bi-directional Prices

1. Consume / Export @ Current Price

https://MyElectricityPrice.com

<table>
<thead>
<tr>
<th>John Doe</th>
<th>$P_{1PM}$, $P_{2PM}$, $P_{3PM}$, $P_{4PM}$, …</th>
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</thead>
<tbody>
<tr>
<td>Address</td>
<td>• Hourly, [15 min, 5 min]</td>
</tr>
<tr>
<td>Account #</td>
<td>• Next day, 24 x hourly</td>
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Price Machine (Cloud Platform)

Real-time Grid Conditions
- $x =$ Circuit Aggreg Load
- $y =$ LSE Aggreg Load
- $z =$ LSE Net Load Ramp

Input at set up

Real-time

Third Party Service Providers (TSPs)

Third Party Service Providers (TSPs)

- $P_{1PM}$, $P_{2PM}$, $P_{3PM}$, $P_{4PM}$, …
- Hourly, [15 min, 5 min]
- Next day, 24 x hourly

Real-time, 5 min

Real-time, 24 x hourly

Third Party Service Providers (TSPs)

(standardized, statewide, web-based price portal)
EPIC Pilot: Composite Hourly Prices
(based on Hourly Capacity Utilization & CAISO LMP)

Source: SCE / Temix Pilot
Step 4: Simplified Framework for DER Valuation & Operations

1. Easily discoverable, rational, fair, transparent, and predictable economic value
Step 4: Simplified DER Valuation & Operations

1. Easily discoverable, rational, fair, transparent, and predictable economic value

2. Full monetization of DER services to the grid (locational, temporal), including exports to the distribution grid (embedded capacity value)

3. Distributed, economically driven, coordinated, self-dispatch of DERs

4. Enables contracts between DER service providers and LSE or Distribution Operator (based on the embedded capacity value), with dispatch driven by UNIDE
Step 4: Avoided Complexities

1. Avoids complexity and constraints of CAISO market integration
2. Avoids distribution level “command & control” of DER operations
3. Avoids one-off, DER-specific point solutions
4. Avoids counterfactual Measurement requirements (direct metering data)
5. Avoids reliance on Avoided Cost framework for valuation
6. Straightforward integration into the planning & forecast framework

• To do: Streamline, standardize, simplify the Rule 21 export permit process
Three Part Vision ➔ UNIDE

Presentation of Rates

Rate Reforms

Customer Options: Optimize Energy

Demand-side: unified, universal, dynamic, economic (UNIDE) signal
Proposed Roadmap: Step 5

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

Step 2: Introduce dynamic prices based on real-time, wholesale energy cost (opt-in)

Step 3: Modify prices per real-time, localized grid conditions (opt-in)

Step 4: Transition to bi-directional prices (buy & sell)

Step 5: Offer subscription option

Demand Side: unified, universal, dynamic, economic (UNIDE) signal
Step 5: Offer Subscription Option

1. Consume / Export at Current Price
   - Real-time Grid Conditions
     - $x = \text{Circuit Aggreg Load}$
     - $y = \text{LSE Aggreg Load}$
     - $z = \text{LSE Net Load Ramp}$

2. [Fixed Price Subscriptions]
   - Hourly, [15 min, 5 min]
   - Next day, 24 x hourly

https://MyElectricityPrice.com

- John Doe
- Address
- Account #

- $P_{\text{Distribution}} = f(x)$
- $P_{\text{RA Capacity}} = g(y)$
- $P_{\text{Flex RA}} = h(z)$

Real-time Grid Conditions

Third Party Service Providers (TSPs)
Step 5: Purchase Average Load Shape & Energy Quantity @ Fixed Monthly Price
Step 5: Purchase Average Load Shape & Energy Quantity @ Fixed Monthly Price

- Protect bill volatility while still encouraging opportunistic load shift
## Benefits of “Shaped Subscription”

<table>
<thead>
<tr>
<th>Protection</th>
<th>Flexibility</th>
<th>Predictability</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Protect customers against bill volatility</td>
<td>• Accommodate changed home conditions</td>
<td>• Stabilize revenue recovery for distribution operators, LSEs</td>
</tr>
<tr>
<td>• Ease customers transition</td>
<td>• Encourage opportunistic load shift</td>
<td></td>
</tr>
</tbody>
</table>
Proposed Roadmap: Step 6

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

Step 2: Introduce dynamic prices based on real-time, wholesale energy cost (*opt-in*)

Step 3: Modify prices per real-time, localized grid conditions (*opt-in*)

Step 4: Transition to bi-directional prices (buy & sell)

Step 5: Offer subscription option (average load shape & energy quantity)

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

Demand Side: unified, universal, dynamic, economic (*UNIDE*) signal
Step 6: Introduce Transactive Features

**Transactive System**

Price Machine (Cloud Platform)

**Real-time Grid Conditions**

- x = Circuit Aggreg Load
- y = LSE Aggreg Load
- z = LSE Net Load Ramp

**Forward Buy/Sell Contracts**

- Week-ahead, 7x24 x hourly
- Additional forward prices...

**LMP**

- $P_{Distribution} = f(x)$
- $P_{RA Capacity} = g(y)$
- $P_{Flex RA} = h(z)$

**DO**

- $PDistribution = f(x)$
- $P_{Bil Generation} = g(y)$
- $PFlex RA = h(z)$

**Third Party Service Providers (TSPs)**

- Consumer / Export @ Current Price
- Fixed Price Subscriptions
- [Forward Buy/Sell Contracts]

**California ISO**

**Input at set up**

**Real-time**

**https://MyElectricityPrice.com**

- John Doe
- Address
- Account #

- Real-time
- [Week-ahead, 7x24 x hourly]
- [Additional forward prices...]

**Step 6: Introduce Transactive Features**

1. Consumer / Export @ Current Price
2. Fixed Price Subscriptions
3. [Forward Buy/Sell Contracts]
Transactive Features are NOT About...

- Peer to peer trading
- DSO market
- Forcing customers to become market traders
- Forcing customers to deal with price variability
- Blockchain
- Eliminating RA capacity markets
- Obsoleting IOUs or LSEs

➡️ Options for customers and devices to optimize energy management
Benefits of Transactive System

LSEs & Distribution Operators
- Improves visibility, planning, operations

CAISO
- More visibility, reduce load forecast error

Customers
- Advanced energy management tools, optimize cost…
Proposed Roadmap - UNIDE

- Step 1: Develop standardized, universal access to current electricity price
- Step 2: Introduce dynamic prices based on real-time, wholesale energy cost *(opt-in)*
- Step 3: Modify prices per real-time, localized grid conditions *(opt-in)*
- Step 4: Transition to bi-directional prices (buy & sell)
- Step 5: Offer subscription option (average load shape & energy quantity)
- Step 6: Introduce transactive features (ability to lock in price in advance)

Demand Side: unified, universal, dynamic, economic *(UNIDE)* signal
**Goal: Achieve Widespread Demand Flexibility**

*Leverage significant opportunity resulting from electrification, DER adoption*

### Challenges

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

### Opportunities

- **Enhance renewables integration & reduce emissions**
  - Reduce curtailment

- **Enhance reliability**
  - Reduce system ramp
  - Intermittent supply balanced by dispatchable demand
  - Managed coordination of DER operations

- **Minimize cost of service**
  - Managed load growth and DER operations

- **Provide fair compensation of DER services stack**
**Q & A**

1. **Consumer / Export @ Current Price**
2. **Fixed Price Subscriptions**
3. **[Forward Buy/Sell Contracts]**

---

**Price Machine (Cloud Platform)**

[Diagram showing various energy systems connected through a cloud platform](https://MyElectricityPrice.com)

- **John Doe**
  - Address
  - Account #

- **Real-time Grid Conditions**
  - \( x = \text{Circuit Aggreg Load} \)
  - \( y = \text{LSE Aggreg Load} \)
  - \( z = \text{LSE Net Load Ramp} \)

- **Input at set up**
  - [Weekly-ahead, 7x24 x hourly]
  - [Additional forward prices…]

- **Output**
  - [Forward Buy/Sell Contracts]

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**DO**

- \( P_{\text{Distribution}} = f(x) \)
- \( P_{\text{RA Capacity}} = g(y) \)
- \( P_{\text{Flex RA}} = h(z) \)

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**Third Party Service Providers (TSPs)**
Discussion / Feedback

1. Consumer Advocates: CalPA, TURN, CLECA...
2. CCAs, NGOs
3. Utilities
4. DER Industry
   a. CESA, CALSSA, CEDMC, CalSEIA
   b. DR/DER Service Providers
   c. Transportation
   d. Building Decarb
5. Consultants / Independents
6. Government, Research
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