Clean Coalition

Affordability through **Energy Tetris**:

Implementing Integrated Grid Planning in California

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Clean Coalition (non-profit)

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Mission

To accelerate the transition to renewable energy and a modern grid through technical, policy, and project development expertise.

Renewable Energy End-Game

100% renewable energy; 25% local, interconnected within the distribution grid and ensuring resilience without dependence on the transmission grid; and 75% remote, fully dependent on the transmission grid for serving loads.

Energy Planning in California

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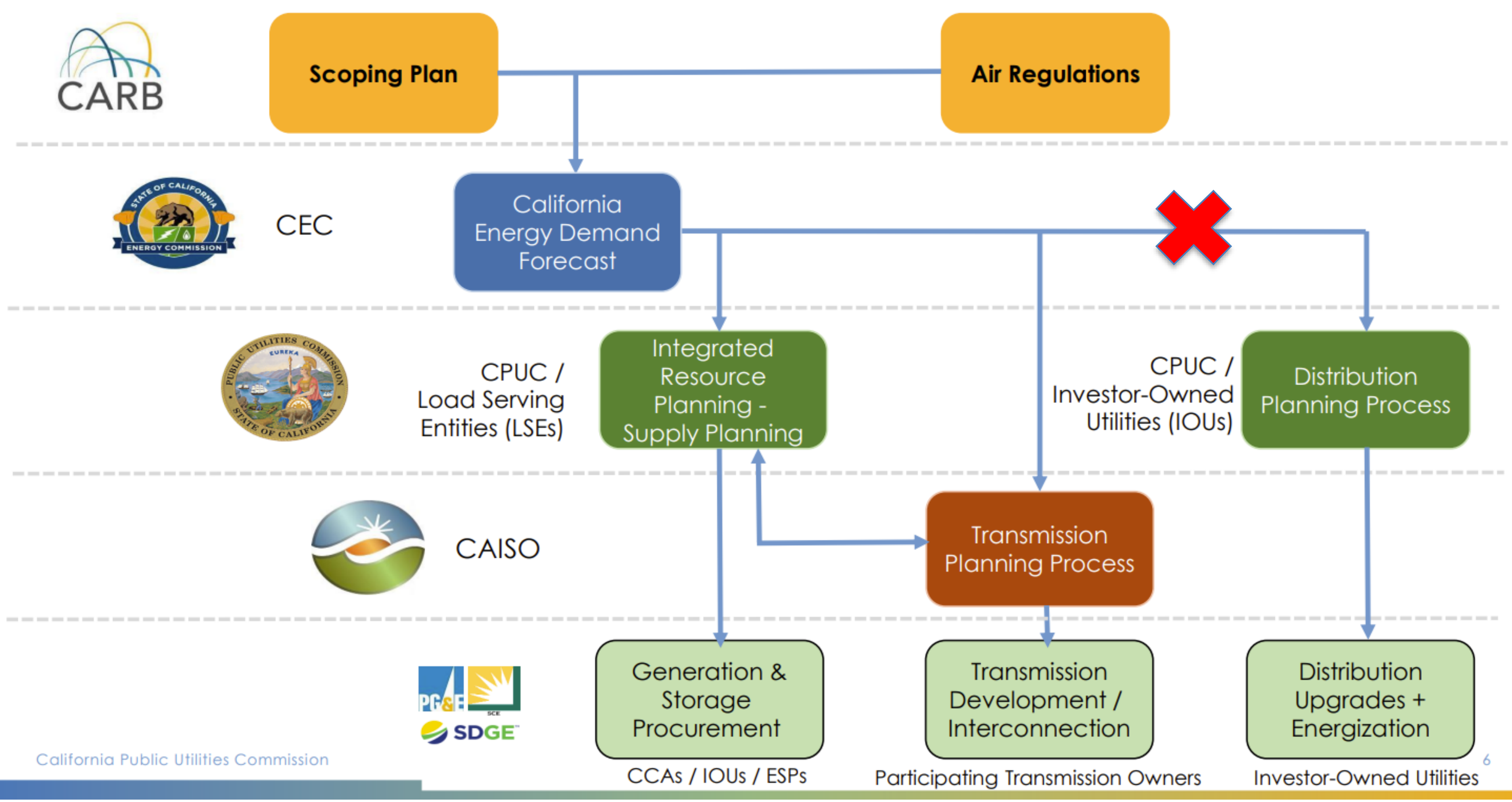
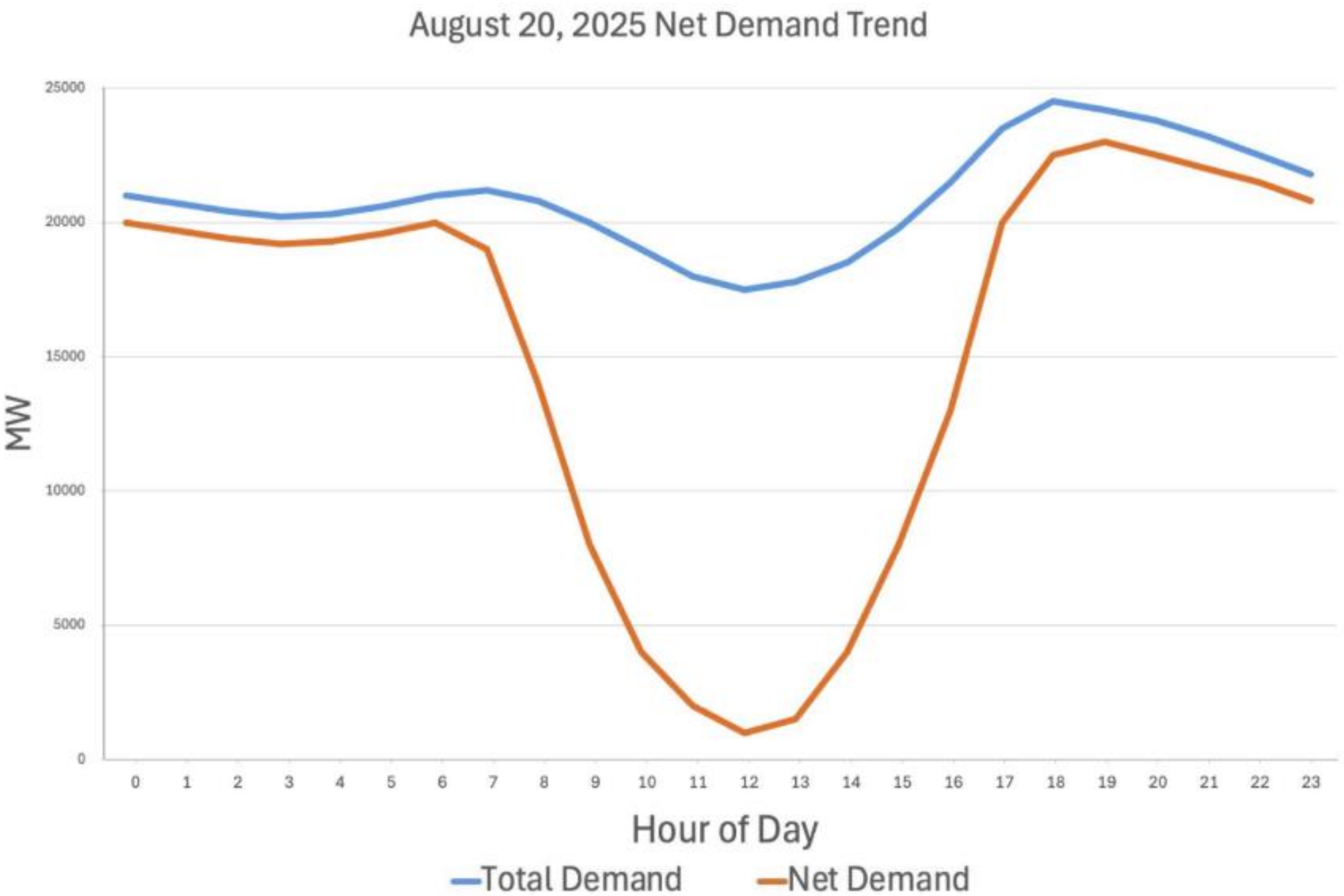
California Statewide Energy Planning Processes – High Level Overview



CAISO Demand Curve



Meeting Total Demand with baseload power

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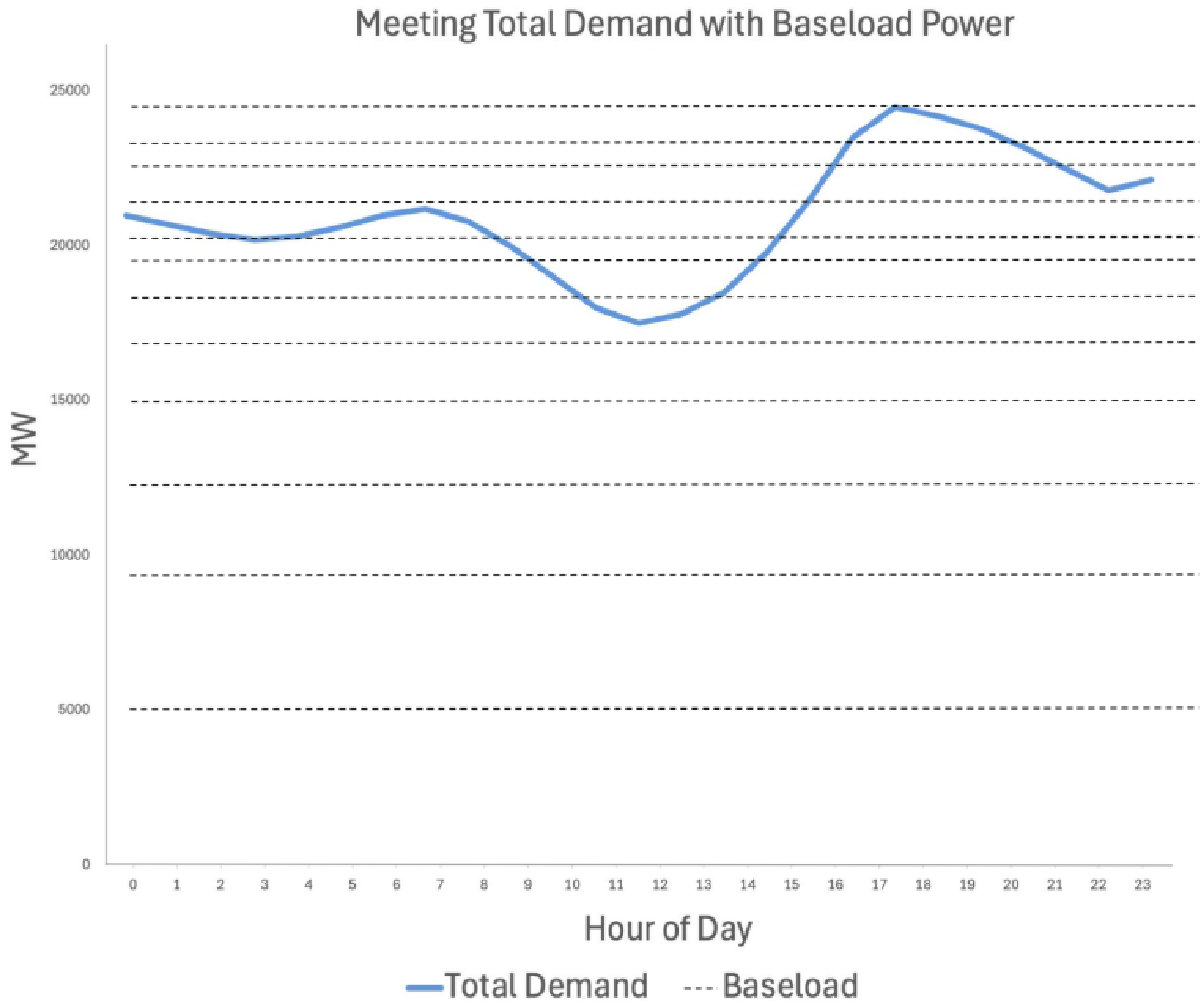

CAISO Demand Curve with Transmission-Interconnected Renewables

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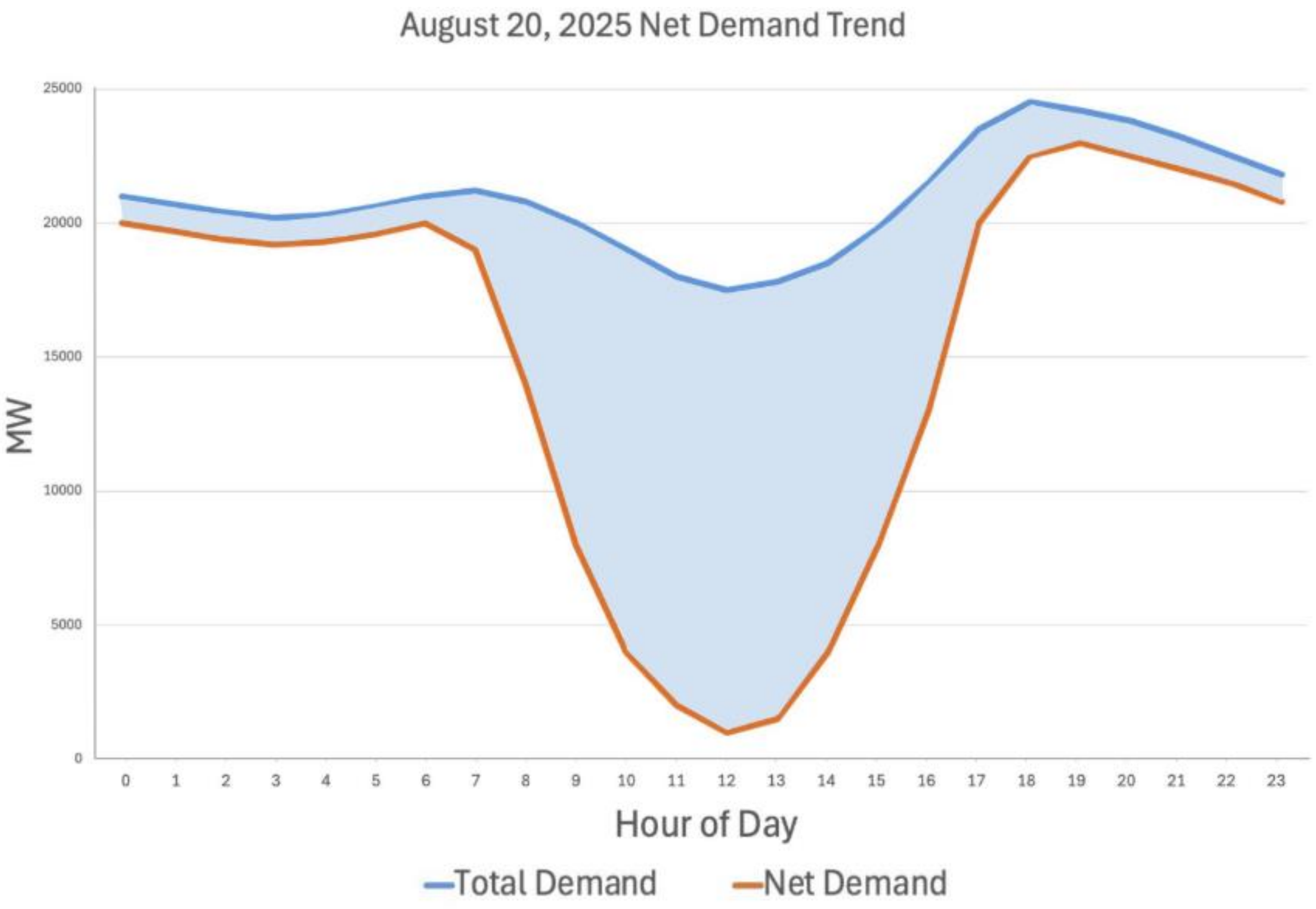

California's Loading Order (& other policy goals)

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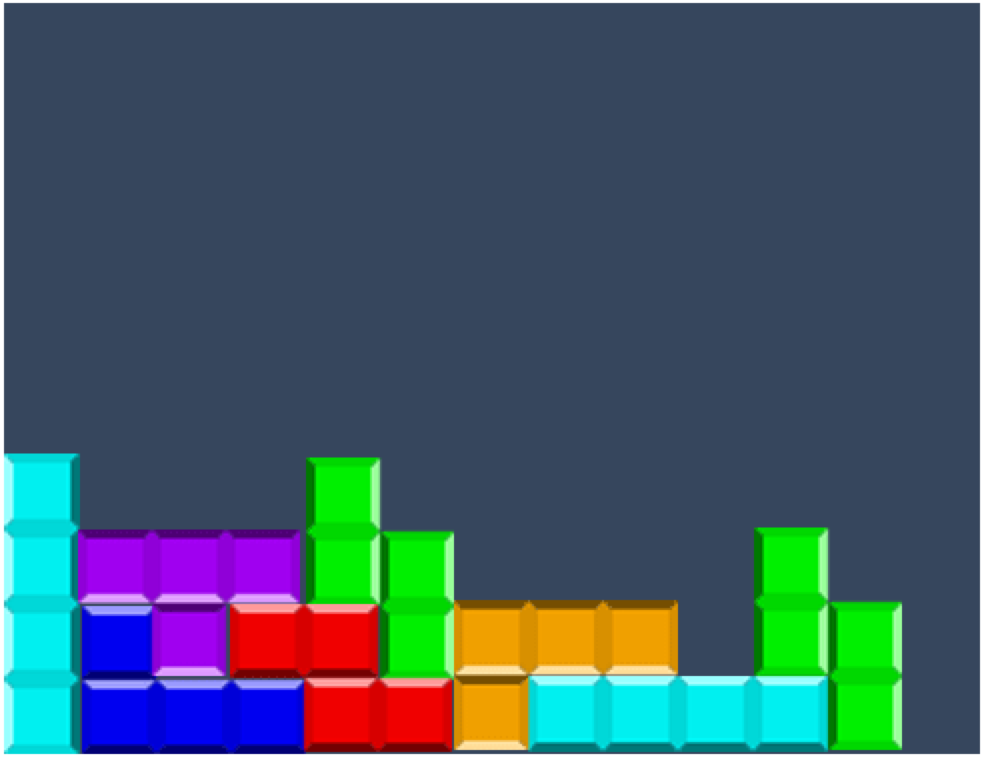
1. Energy Efficiency & Conservation (always first)	• Building efficiency • Appliance standards • Industrial process efficiency • Conservation and behavior-based programs • Demand avoidance (e.g., weatherization)
2. Demand Response, Load Flexibility & Distributed Energy Resources	• Traditional DR programs • Automated load shifting and flexible demand • Behind-the-meter solar, storage, EV charging control • Virtual Power Plants & Aggregated DERs • Community Microgrids & Energy management systems
3. Renewable Energy	• Solar PV (utility-scale) • Wind (onshore & offshore) • Geothermal • Biomass/biogas • Small hydro • Eligible RPS resources
4. Grid Enhancements & Upgrades	• Distribution system upgrades • Transmission upgrades • Interconnection improvements • Hosting capacity increases • Advanced inverters & voltage support • Non-wires alternatives • Dynamic operating envelopes
5. Clean & Efficient Fossil Generation (always last)	• High-efficiency gas turbines • Combined-cycle natural gas • Reliability-must-run (RMR) units • CHP that meets FERC/CEC efficiency thresholds

2030 Energy Goals:

- **7 GW of load flexibility,** double what is currently deployed *(SB 846)*
- **Double energy efficiency savings** *(SB 350)*
- **Deploy 2-5 GW of offshore wind** (AB 525)
- **Install 6 million heat pumps** *(California Building Energy Action Plan)*
- Expected need for **1 million public/shared EV chargers**.

So why Tetris?

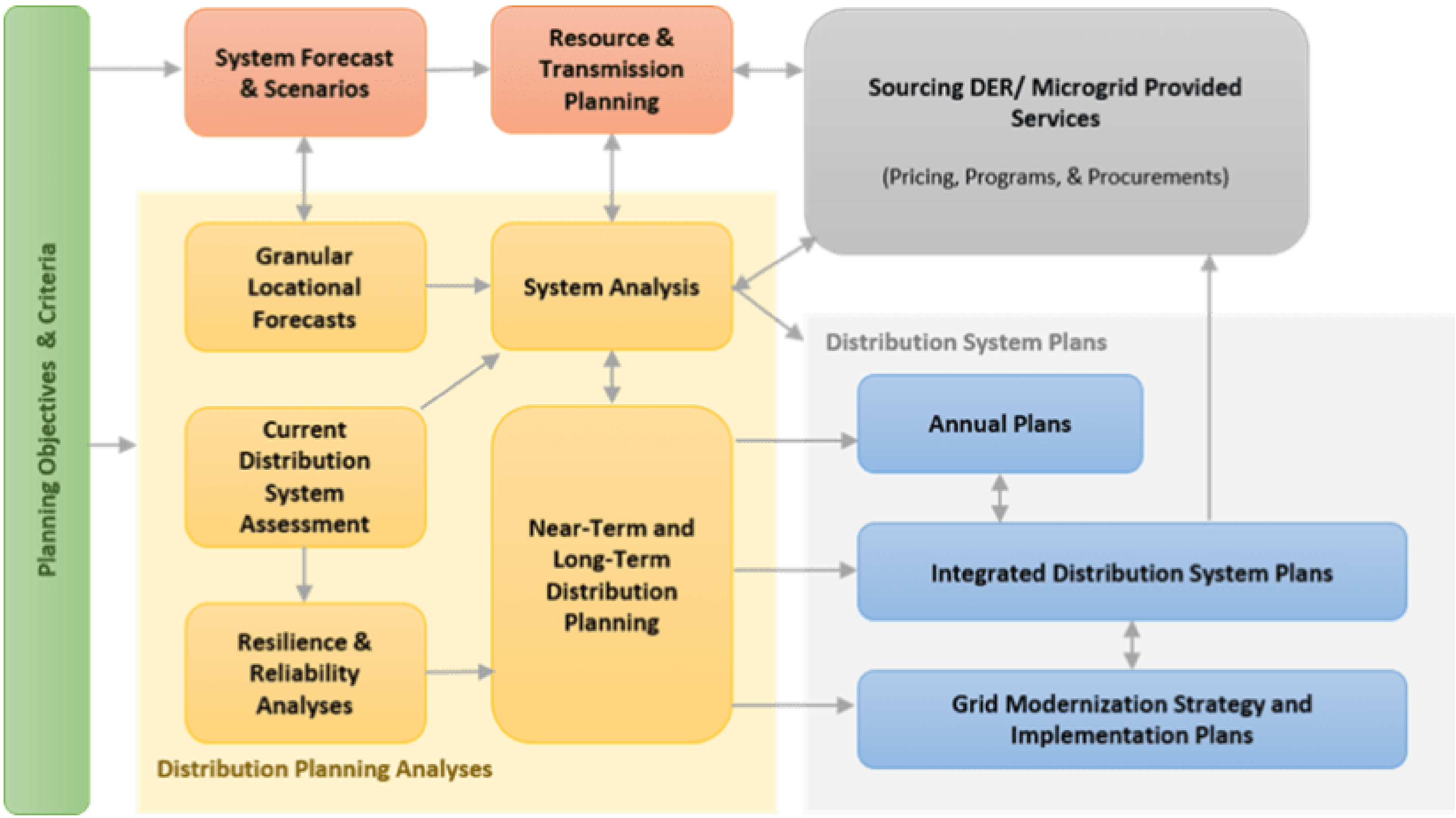


California is attempting to meet it energy goals and balance the grid by playing Tetris without using half of the available pieces. The affordability crisis is a clear sign that things need to change

- Opportunities for distributed supply & demand side management are consistently missed.
- DER are excluded from core energy portfolio planning, suggesting that the state has not yet fully accepted the reality of a rapidly modernizing grid.
- On average, it takes 8-10 years to complete a new transmission project in California.
- Local solar alone lowers peak transmission usage by roughly 50% of its installed capacity, translating into billions of dollars in avoided transmission investments.

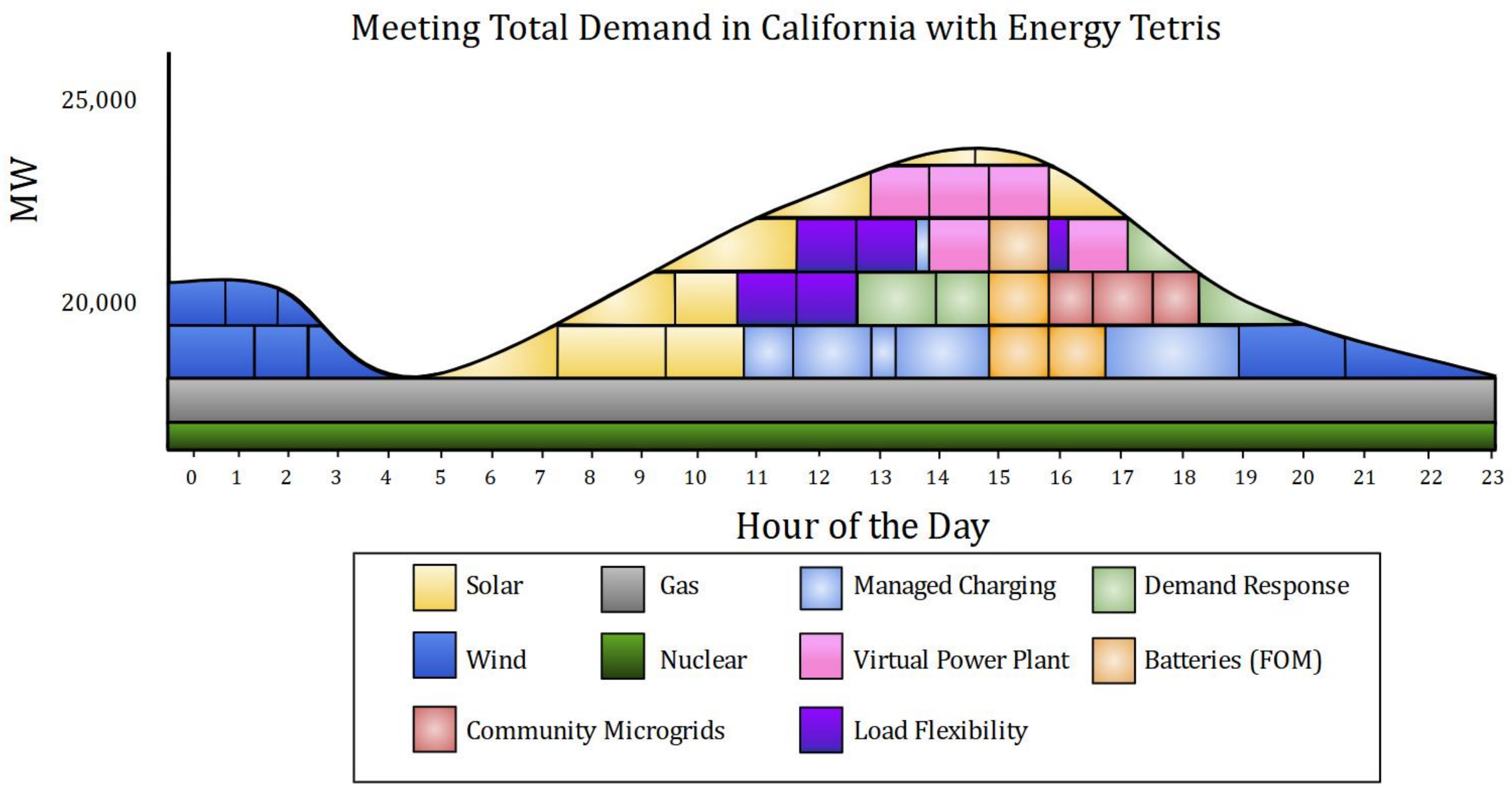
Integrated Grid Planning that incorporates DER

Transitioning to an integrated grid planning process that embraces Energy Tetris at the distribution level will promote an energy future that is affordable, cleaner, and more resilient.



Levelized cost of energy (LCOE) should be replaced by a metric that considers the **total system benefit (TSB)** for the ratepayers based multiple criteria, not just the cost of generation.

Meeting total demand through Energy Tetris



Relying on a more diverse mix of resources will help California meet demand in the most efficient manner possible, preventing a costly overbuild of grid infrastructure. Utilizing IBDER to reduce demand and support the distribution grid will allow utilities to balance all dimensions of the grid – energy, frequency, & voltage – at a granular level.

Example: Standalone front-of-meter (FOM) storage

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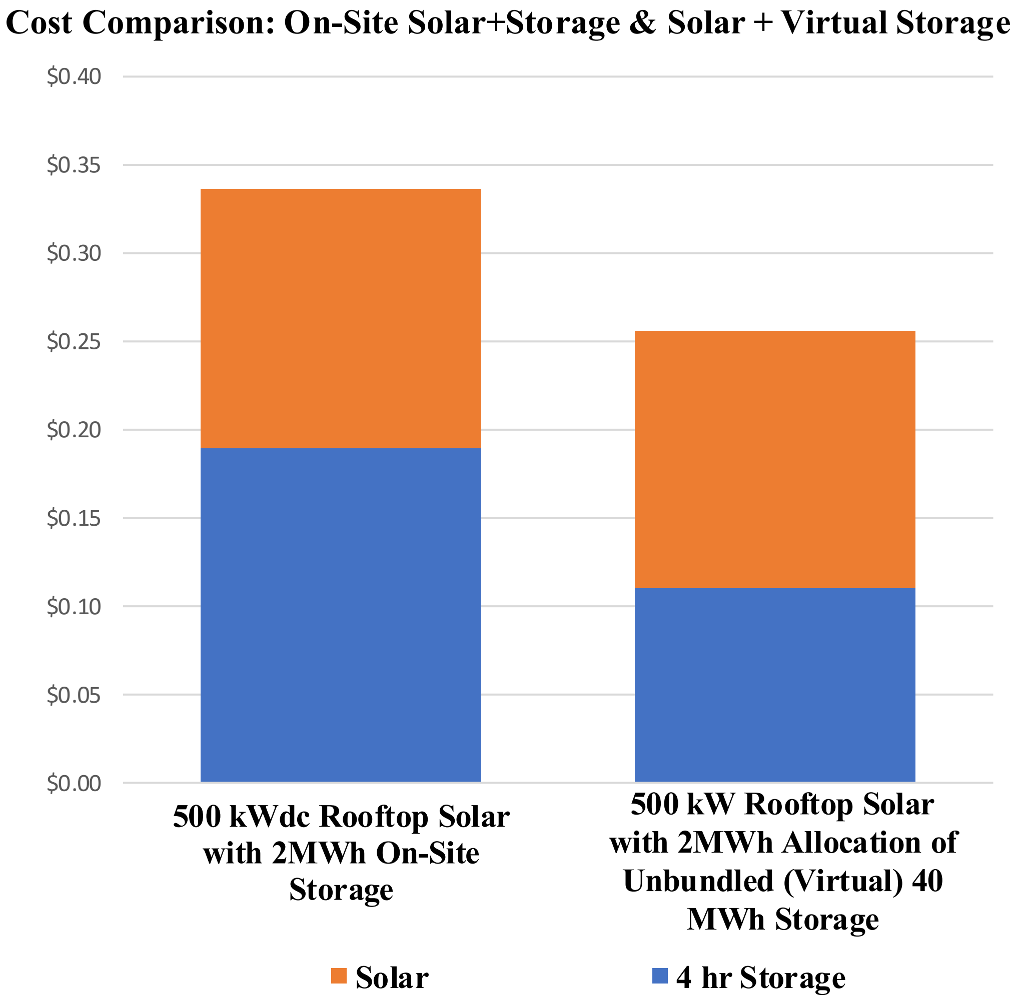

- Standalone storage can achieve lower per-unit costs than distributed paired systems due to economies of scale and optimized interconnection.
- The Community Solar cost comparison shows a 25% lower storage cost with a virtual allocation of standalone storage.
- Strategically sited storage near substations can defer or avoid T&D upgrades.
- FOM storage provides energy shifting, capacity value, voltage support, and frequency response.
- Properly sized FOM storage reduces peak demand and improves overall grid reliability.

Example: Distribution-sited storage

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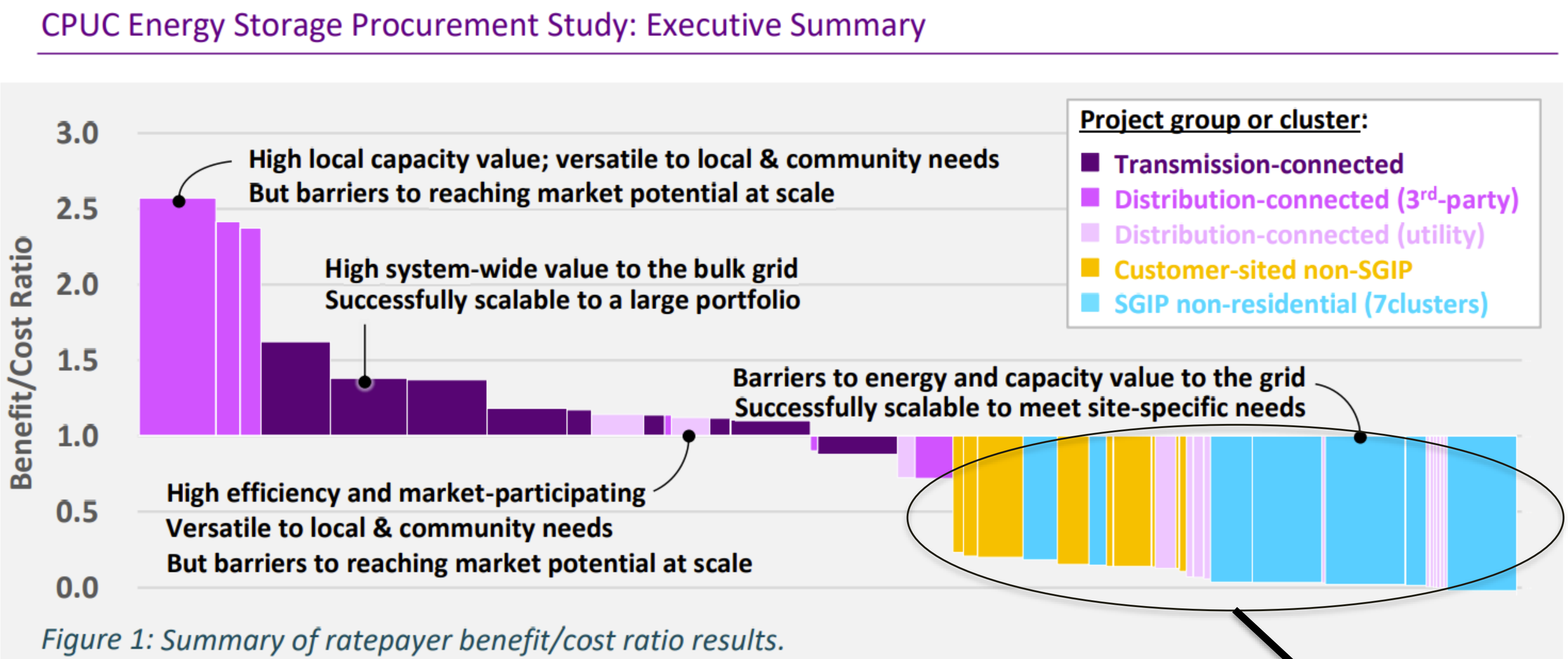

Figure 1: Summary of ratepayer benefit/cost ratio results.

Barry's presentation will demonstrate how data centers can increase the benefits from behind the meter energy storage.

Distributed Capacity Procurement in Minnesota:

- Xcel proposed deploying 200 MW of utility-owned front-of-meter distributed storage.
- "Xcel presents the program as a pragmatic, low-risk way to deploy distributed storage, gain operational experience and deliver system benefits to customers. "
- *The underlying premise is that these assets are cost-effective.*

Example: Managed Charging

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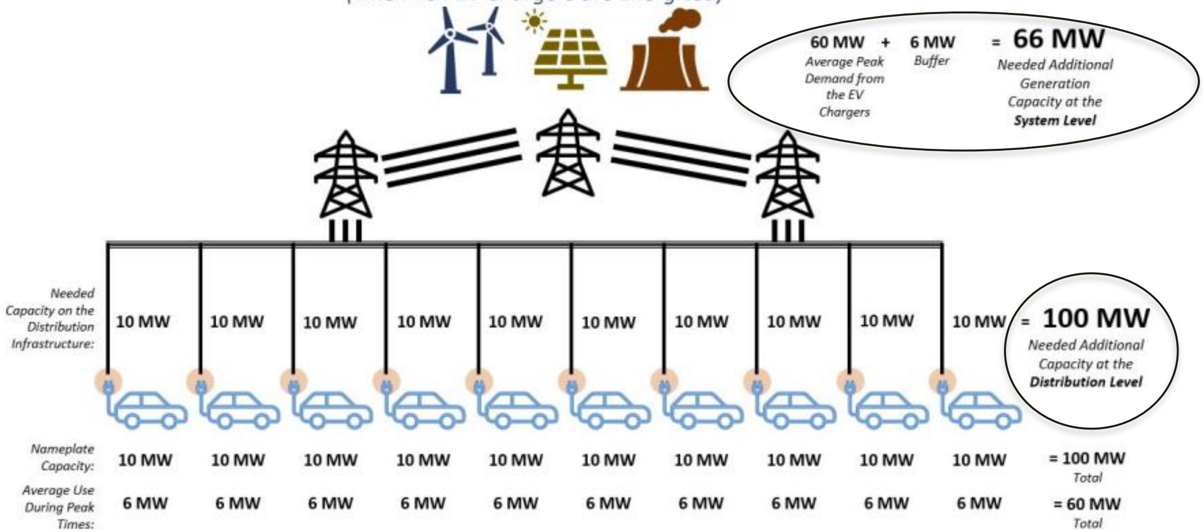
Figure 3-5: Example of the Difference Between System Level and Distribution Level Need (when Ten EV Chargers are Energized)



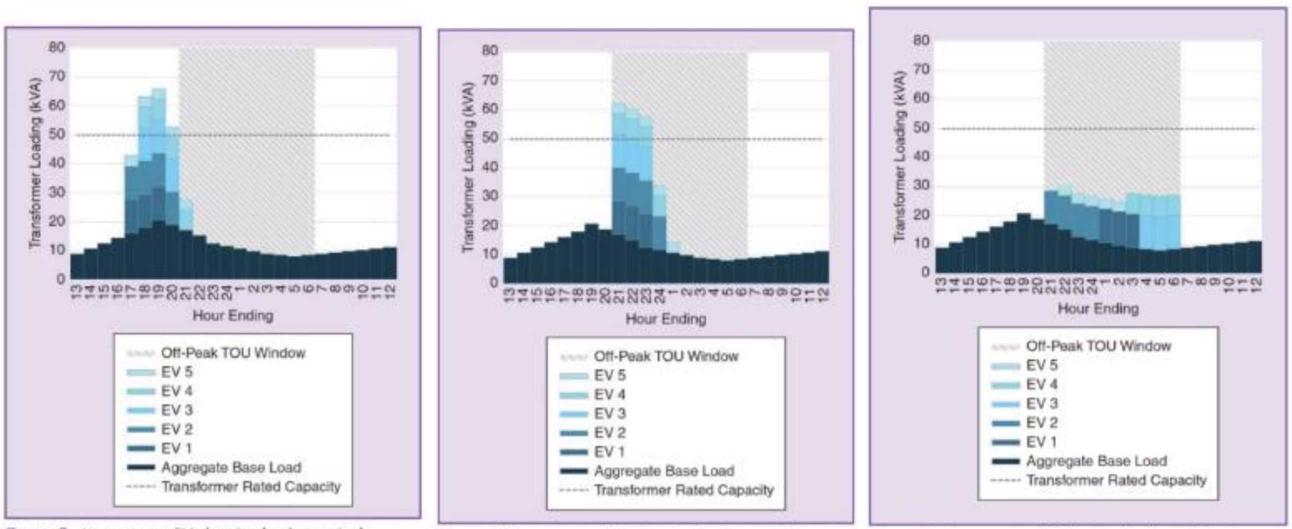


figure 2. An aggregate EV charging load on a single transformer with no management. kVA: kilovolt-amperes. (Source: WeaveGrid.)

figure 3. An aggregate EV charging load on a single transformer when optimized solely for bulk system benefits. (Source: WeaveGrid.)

figure 6. An aggregate EV charging load optimization on a single transformer when considering distribution constraints. (Source: WeaveGrid.)

- Grid upgrades are conducted based on the assumption that grid energy will be needed to serve 100% of loads during peak periods.
- Managed charging responds to signals from the grid to charge during periods when the grid is less congested, minimizing the hosting capacity impact and avoiding T&D grid upgrades.
- A dynamic rates pilot delivered 98% of EV charging loads during off-peak periods (MCE & SVCE).

Results of Effective Policy Design