Minimizing Transmission: Solutions for Exceeding 25% Local Energy

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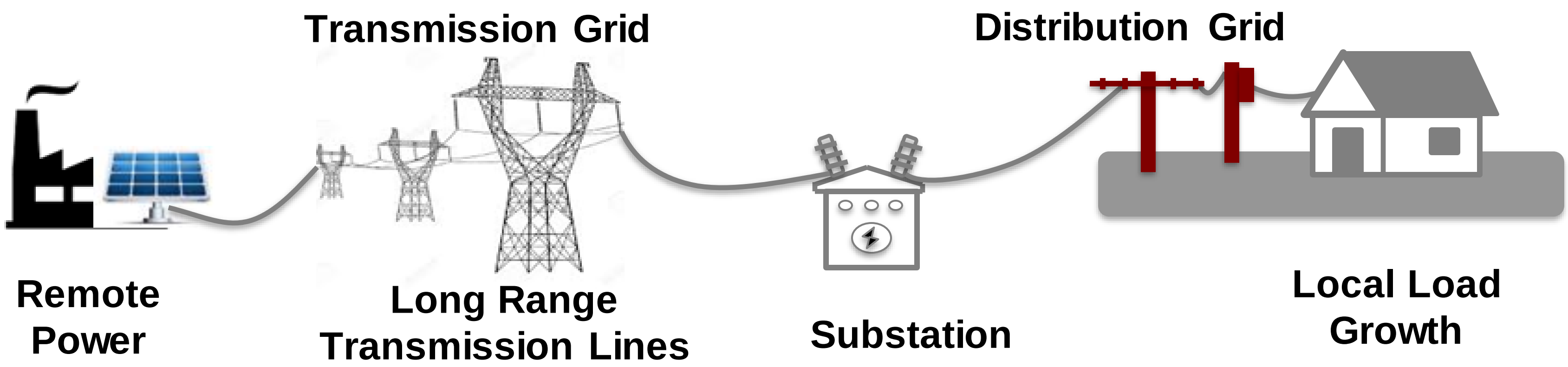
Mission

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.

The existing system is not designed to achieve California's energy and climate goals cost-effectively



The electric grid was designed with 20th century principles based on a one-way flow of energy. Remotely-generated energy is transmitted across long distance transmission lines and delivered to end users located in load centers (on the distribution grid). Problems include:

- Generating energy remotely is inefficient and results in a more complicated grid.
- Building out the grid with new transmission infrastructure is extremely expensive.
- A larger grid is hard to maintain, especially with infrastructure transversing areas at high risk of wildfires.
- *Local residents don't benefit from installations of huge solar farms in the desert.*

The Grid of the Future

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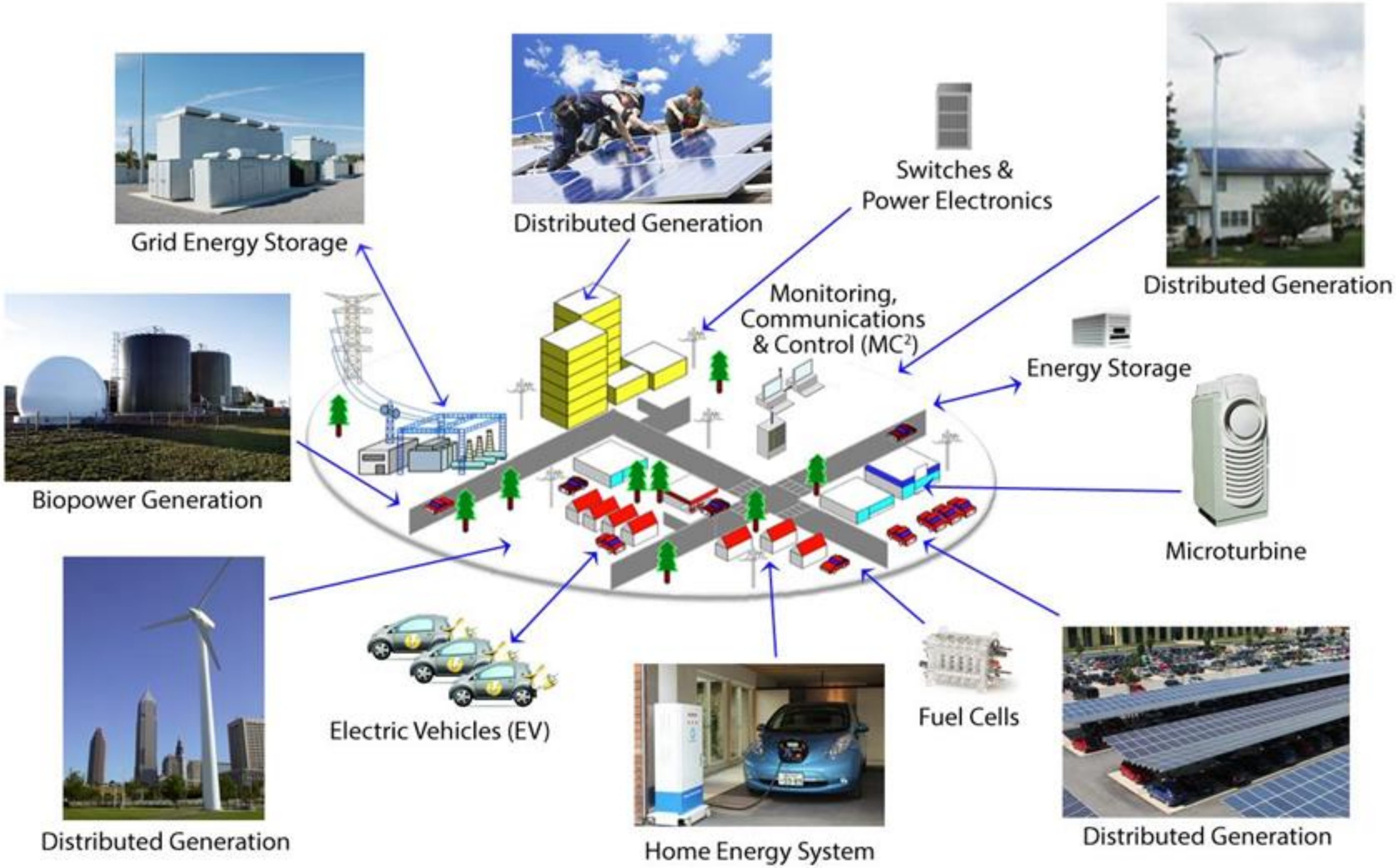
- Community Microgrids: generation, storage, & controls enabling resilience for a section of the grid.
- Solar Microgrids: Community Microgrid building blocks. These are microgrids for individual facilities.



DER Benefits

Ratepayers are footing the bill to achieve California's ambitious energy/climate goals.
We deserve to share in the benefits as well.

- Economic savings from lower-cost energy.
- Investment in the local economy (jobs and wages).
- Creation of carbon-free energy (and less reliance on carbon-intensive energy from the grid).
- Increased grid reliability.
- Grid hardening and wildfire prevention.
- Reduced local air pollution.
- Promoting community-scale resilience.
- Deployments occur far faster than remote projects (CEQA exemption for built environments).
- Increased grid efficiency due to reduction in demand for transmission-interconnected resources.
  - Less energy is wasted, and less grid congestion results in a system that functions more effectively.
- Reduces the need to build the grid out further, limiting skyrocketing rate increases.

20-Year Benefits of Deploying Local Solar and Solar+Storage

10 MW solar

- **$10.9M** total economic stimulation
- **$8.6M** added wages
- **92** construction job-years
- **33.6** operations & maintenance job-years
- **$2M** site leasing income

20 MWh energy storage

- **$6.3M** total economic stimulation
- **$5.5M** added wages
- **64** construction job-years
- **17.6** operations & maintenance job-years

10 MW solar + 20 MWh energy storage

- **$17.3M** total economic stimulation
- **$14M** added wages
- **155** construction job-years
- **51** operations & maintenance job-years
- **$2M** site leasing income

Climate change and affordability are driving energy policy in California

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- Electricity rates in California are the second highest in the nation.
- Total demand for electricity is likely to increase by 67% in order to reach state electrification and decarbonization goals.
- Utilities aim to increase their rate of return:
  - Utilities in California receive an 8% rate or return for investments in distribution infrastructure.
  - For transmission infrastructure, the rate of return is between 9%-12%.

Figure 5.2-2. Cross-Utility Miles of Overhead Transmission Lines

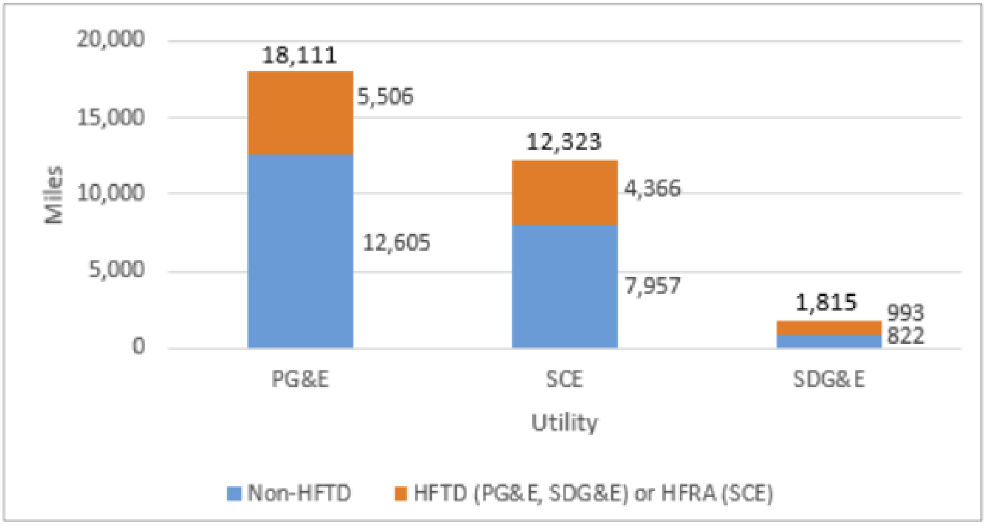
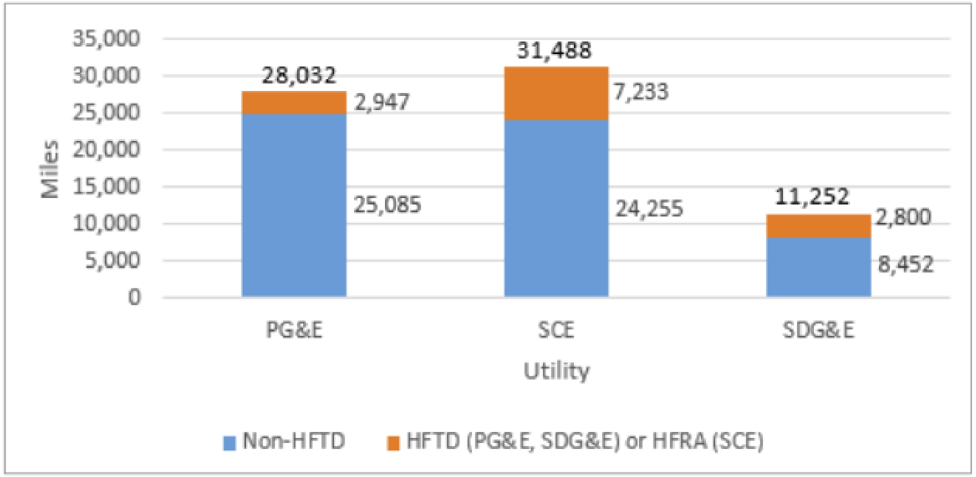


Figure 5.2-3. Cross-Utility Miles of Underground Distribution and Transmission Lines



Cost drivers leading to increases in electricity rates: Transmission Costs

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- **Transmission Access Charges (TAC):** These are volumetric ($/kWh) charges assessed to customers to recover costs of historical and present investments in transmission infrastructure.
  - The chart below shows that the average TAC rate in the IOU service territories has more than tripled over the last 11 years.
  - *Since 2008, the IOU's base transmission revenue requirement has increased from $4.6* billion to $21 billion.
- **Future Transmission:** CAISO estimates that $30 billion will be needed over the next 20-years (for the HV system only, not including LV).
- The up-front capital cost of a transmission project is usually around 1/10 the full cost in nominal dollars shouldered by the ratepayers when considering ROI, O&M, and Capital costs over the lifetime of the assets.

Nominal costs

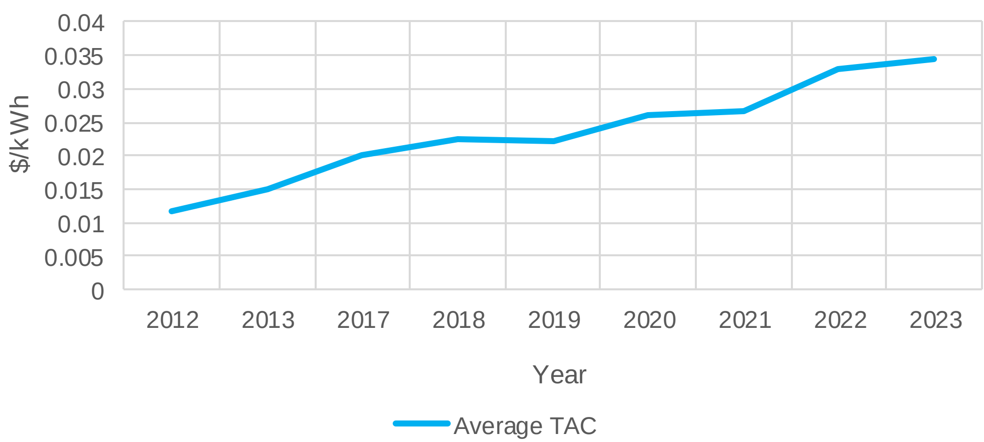
Asset value capital cost ($100 base)	$100
Return	$197
O&M	$631
Total nominal ratepayer cost per $100 investment (50 years)	**$928**

Real costs, discounted for inflation

Discount rate	2.19%
Asset value capital cost ($100 base)	$100
Return, discounted	$140
O&M, discounted	$296
Total discounted (real) ratepayer cost per $100 investment (50 years)	**$536**

In nominal dollars, total lifetime ratepayer cost is nearly 10x the initial capital cost; O&M accounts for 68% of this because it increases much faster than inflation. In real dollars (constant value dollars, accounting for inflation), the total lifetime cost is 5x the initial capital cost, and O&M accounts for 55% of this.

Average Rate of Transmission Access Charges (TAC) over the last 11-years)



Rate increases are outpacing inflation

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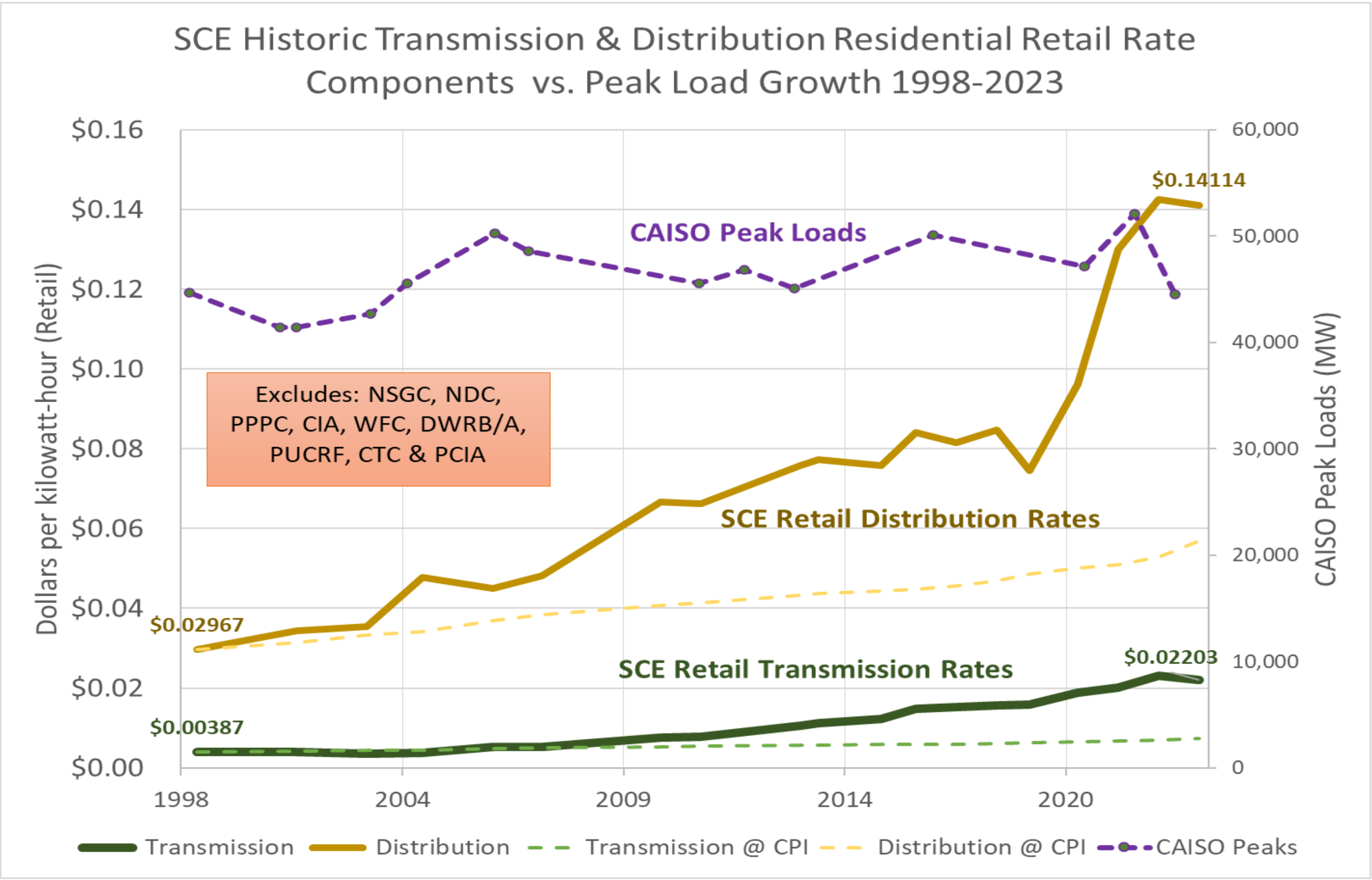
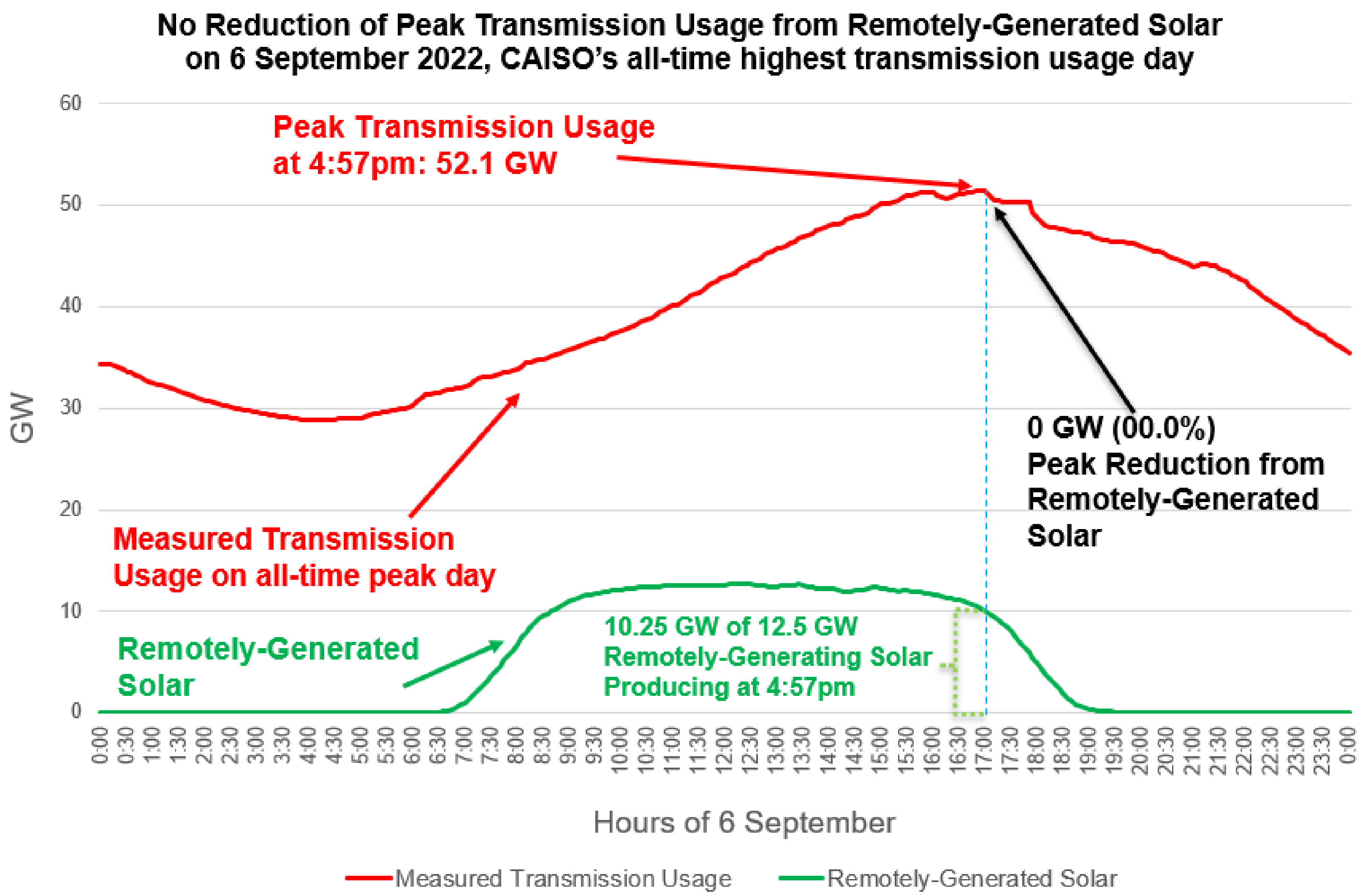


Over the past decade utility rates have increased by:

- PG&E: 127%
- SCE: 91%
- SDG&E: 72%

Meanwhile, the overall cost of living, as measured by the Consumer Price Index, has only increased by 28%.

Remote Solar does not reduce transmission usage



Local Solar is extremely valuable to the grid

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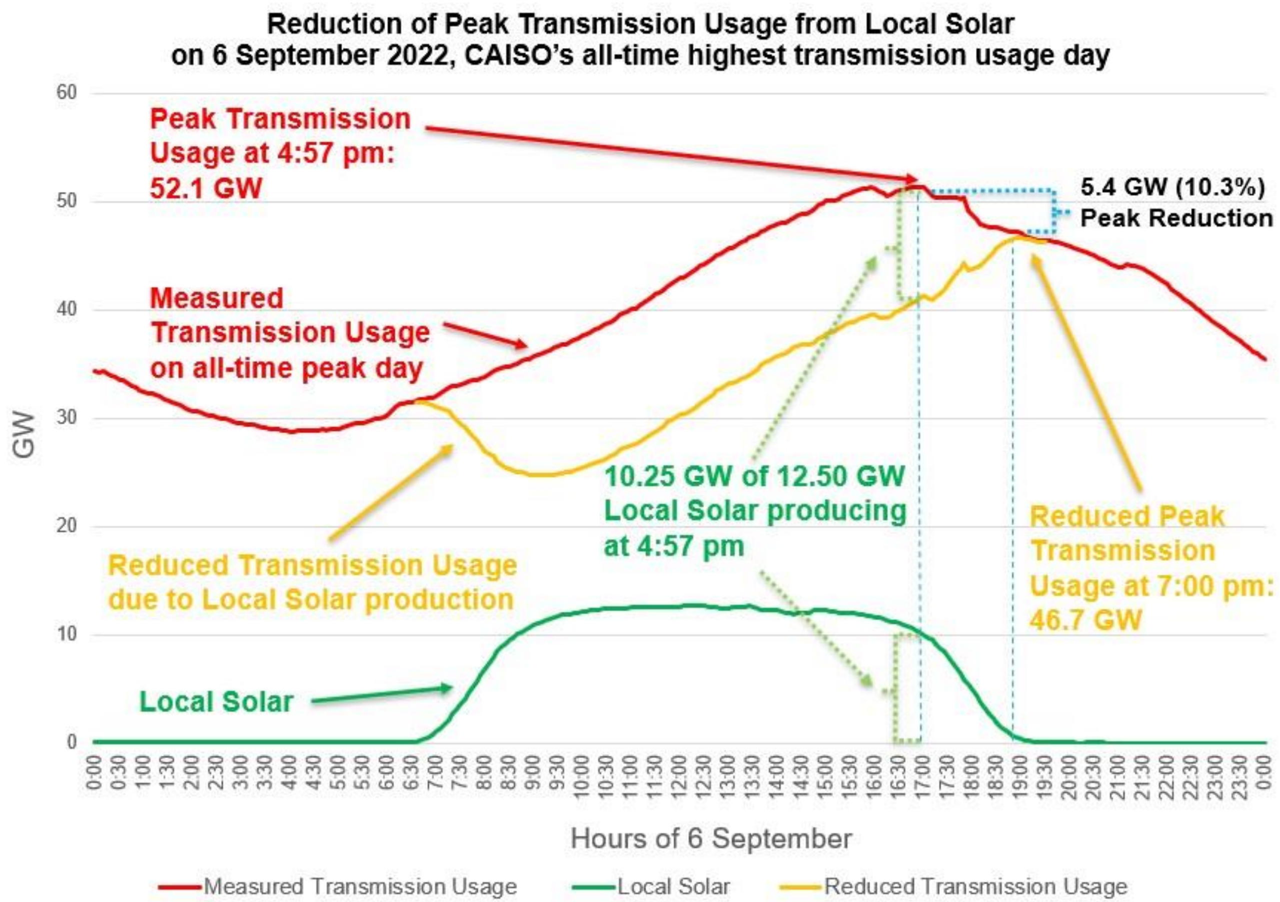

1. Local Solar reduces Peak Transmission Usage by close to 50% of the installed capacity. The effect is amplified by energy storage.
2. Bringing down the peak with distributed generation and demand flexibility will reduce transmission investments, saving ratepayers hundreds of billions of dollars over the next two decades.
3. Reducing the Peak Transmission Usage by around 10% is enough to prevent most major outages.

Direct Relief Microgrid limited by existing Net Energy Metering size constraints

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Microgrid only serves Direct Relief needs:

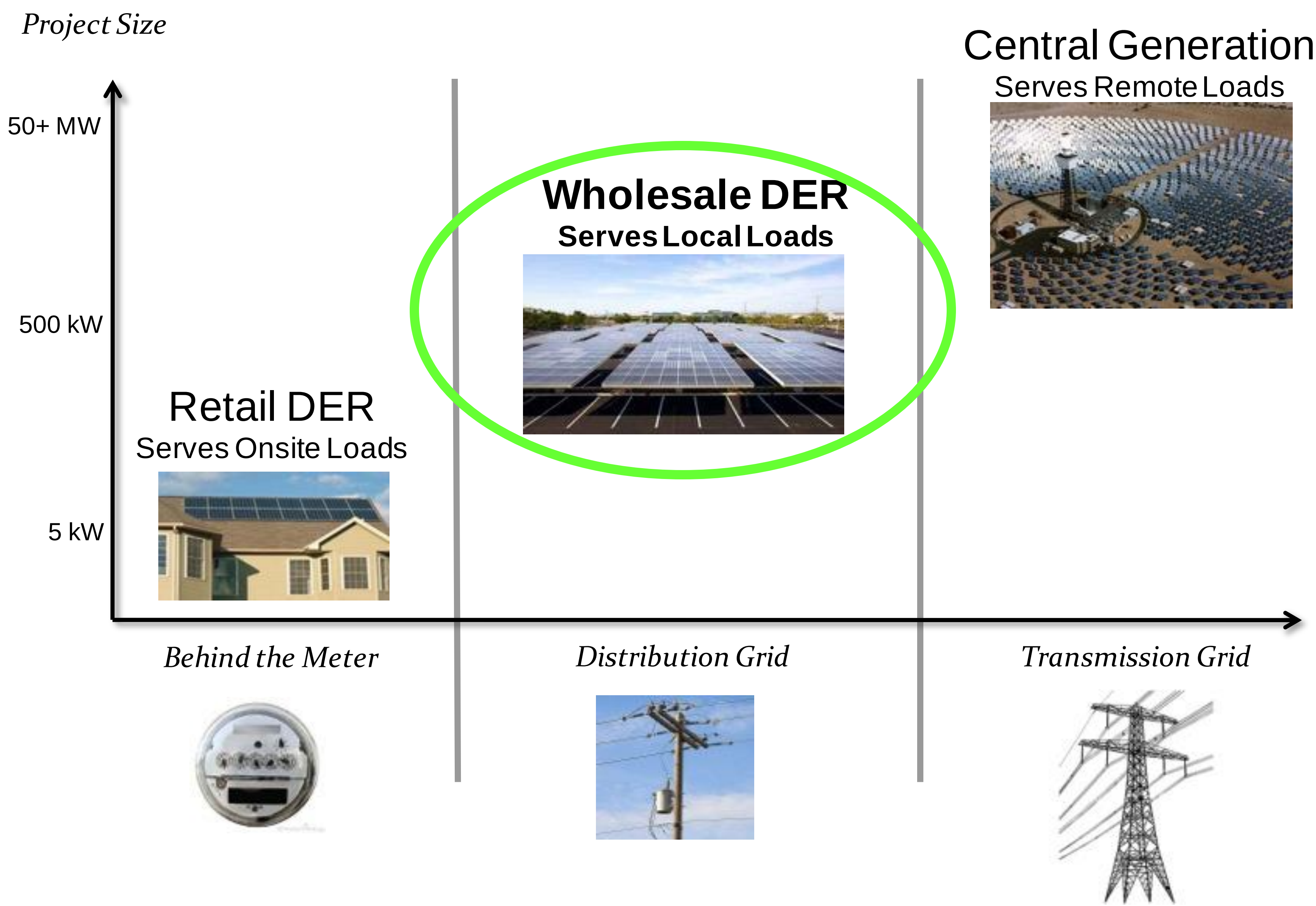
- 70% of roof and 100% of massive parking area solar potential is unused.
- Additional storage not able to be considered due to policy prohibitions around exporting energy from a battery to the grid – even though the energy is 100% stored solar.

Ready to do way more::

- 1,133 kW in total solar siting potential, 427 kW more rooftop and 386 kW in parking lots.
- Existing switch gear is already sized for the expansion and is just awaiting the policy innovation!

Solar Microgrid located at Direct Relief headquarters in Goleta, CA

Wholesale Distributed Energy Resources defined



Community Solar

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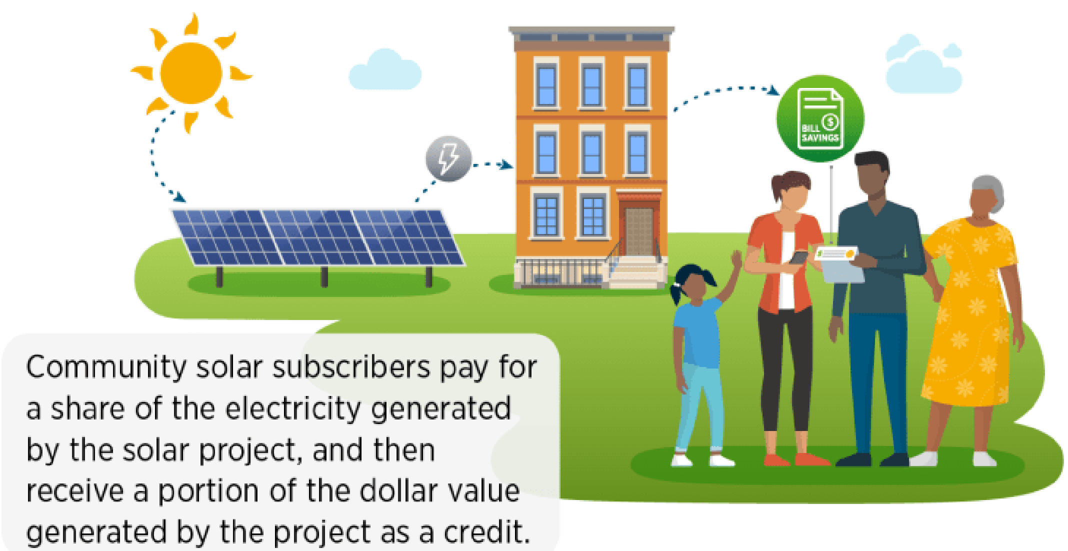
- *Defined as, “a*ny solar project or purchasing program, within a geographic area, in which the benefits flow to multiple customers such as individuals, businesses, nonprofits, and other *groups.”*
  - Customers benefit from energy generated by solar panels at an off-site array.
- 43 states currently have at least one program. California has 3, none of which are flourishing.
- A recent Proposed Decision will take the state in the wrong direction, hampering the potential for a flourishing market.

How does it work?

Community solar projects generate electricity from sunlight and the electricity flows to the electricity grid. Project owners can sell this power to their local utility.



Conclusions on siting opportunities for Local Solar

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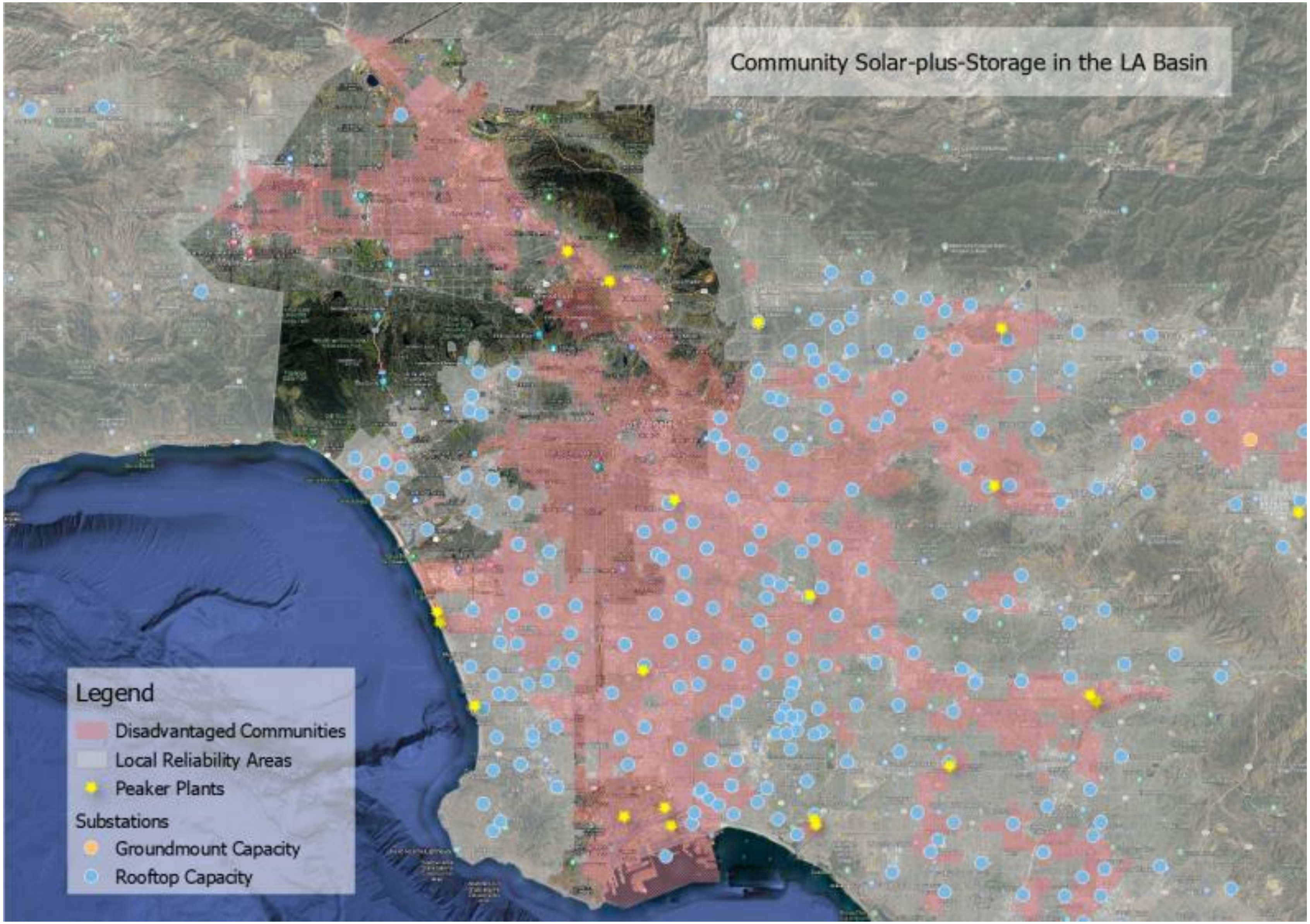
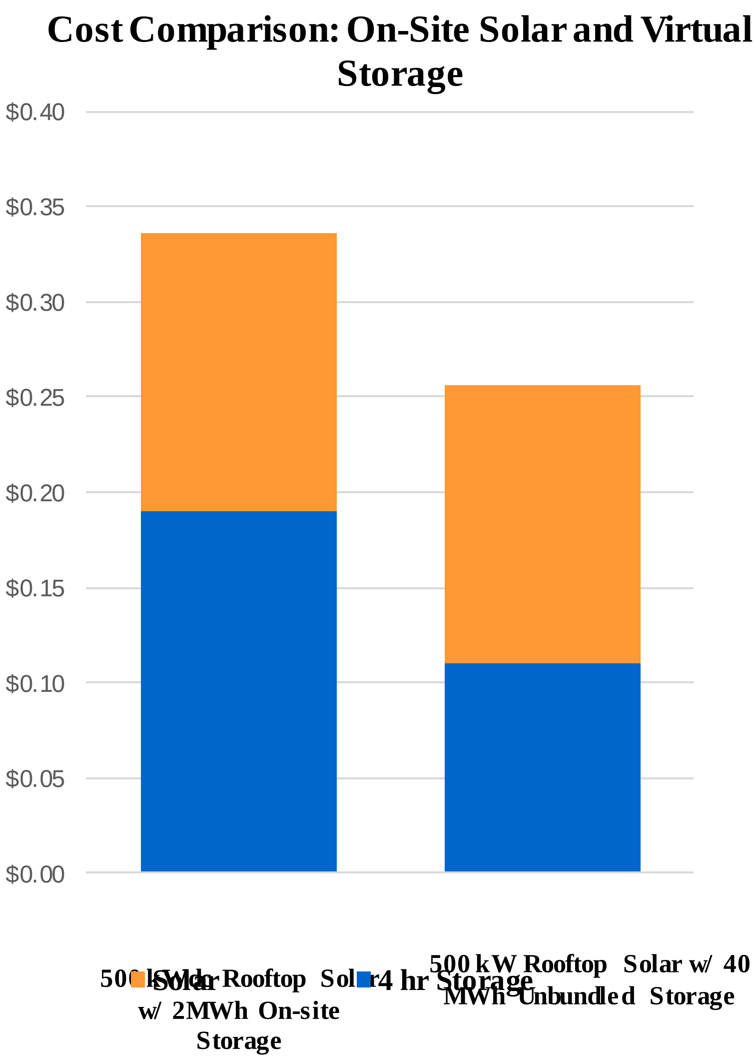
- **The vast majority** of Community Solar siting potential is on sites in built environments.
- 44% of Californians are tenants who cannot access their roofs.
- **Even tenants with VNEM systems are not really able to take advantage of the extra value from paired storage.**
- The state is estimating around 12,000 MW of new customer-sited solar will need to be sited by 2030.
- "California has more warehouse roof potential than any other state, boasting over 66,000 eligible commercial roofs that could power 4.9 million households with solar." – Solar Landscapes
- *Maximizing the opportunity for infill solar is in the best interest of the state.*
- Having a requirement for on-site energy storage makes it difficult to maximize the size of the solar deployment. This could restrict a number of sites otherwise capable of hosting a sizeable solar array from participating.

Ground mount will not be sited near DACs: the real siting potential is in infill solar



Virtual (unbundled) storage enables economies of scale



- With a paired storage requirement, storage will be the main cost driver.
- Unbundling and increasing the size of the storage will lead to cost reductions from economies of scale.
- <u>**Example:** *500 kW Rooftop Solar with 2 MWh on-site storage versus 500 kW with 40 MWh unbundled storage.*</u>
- With on-site storage, the price is nearly $0.34/kWh. The same sized solar system with unbundled storage results in a PPA price of $0.25/kWh, **a cost reduction of 25%.**
- The larger-sized energy storage will provide much greater value than a 4-hour battery co-located with on-site solar.
- Cost reductions and increased sizing potential make unbundled storage essential.

California is paying energy storage systems to import energy from the grid!

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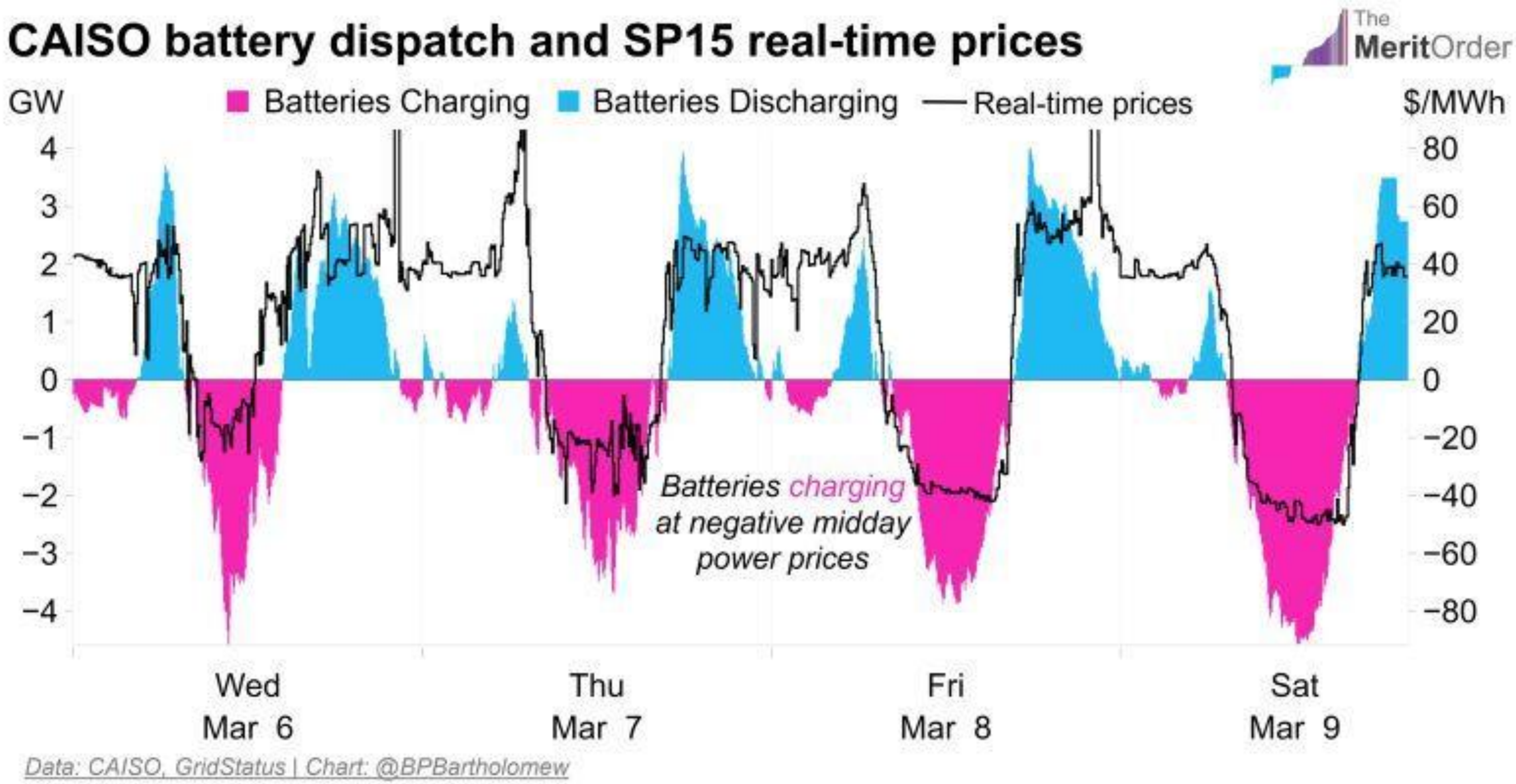

Local solar+storage optimize the grid for ratepayer savings

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- Intelligently siting 4 GW of local solar would preempt over **$2.2 billion** in new transmission infrastructure investments — about **$20 billion** in ratepayer savings when considering O&M. (Southern California Edison study)
- Transmission costs are always borne by ratepayers, while distribution & interconnection costs are borne by solar project developers.

Goleta Load Pocket (GLP)

The GLP is the perfect opportunity for a comprehensive Community Microgrid

- GLP spans 70 miles of California coastline, from Point Conception to Lake Casitas, encompassing the cities of Goleta, Santa Barbara (including Montecito), and Carpinteria.
- GLP is highly transmission-vulnerable and disaster-prone (fire, landslide, earthquake).
- **200 megawatts (MW) of solar and 400 megawatt-hours (MWh) of energy storage** will provide *100% protection to GLP against a complete transmission outage ("N-2 event").*
  - 200 MW of solar is equivalent to about 5 times the amount of solar currently deployed in the GLP and represents about 25% of the energy mix.
  - Multi-GWs of solar siting opportunity exists on commercial-scale built-environments like parking lots, parking structures, and rooftops; and 200 MW represents about 7% of the technical siting potential.
  - Other resources like energy efficiency, demand response, and offshore wind can significantly reduce solar+storage requirements.

What is Needed to Commercialize Microgrids?

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When it comes to commercializing microgrids, the state needs to create pathways to enable swift deployments at sites that can be considered low hanging fruits. Distributed Energy Resources and microgrids are tools that can help us achieve multiple goals simultaneously.

- Schools
- Emergency Shelter Sites
- Multi-family homes
- Government buildings
- Disadvantaged communities
- Load Pockets (areas that are geographically isolated and/or difficult to deliver electricity to)
- Rural areas, particularly those that are in High Fire Threat Districts.
- Areas that are reaching limits in hosting capacity.
  - Locations where transmission upgrades will take multiple years to complete (such as Humboldt County).

Typical office charging profile

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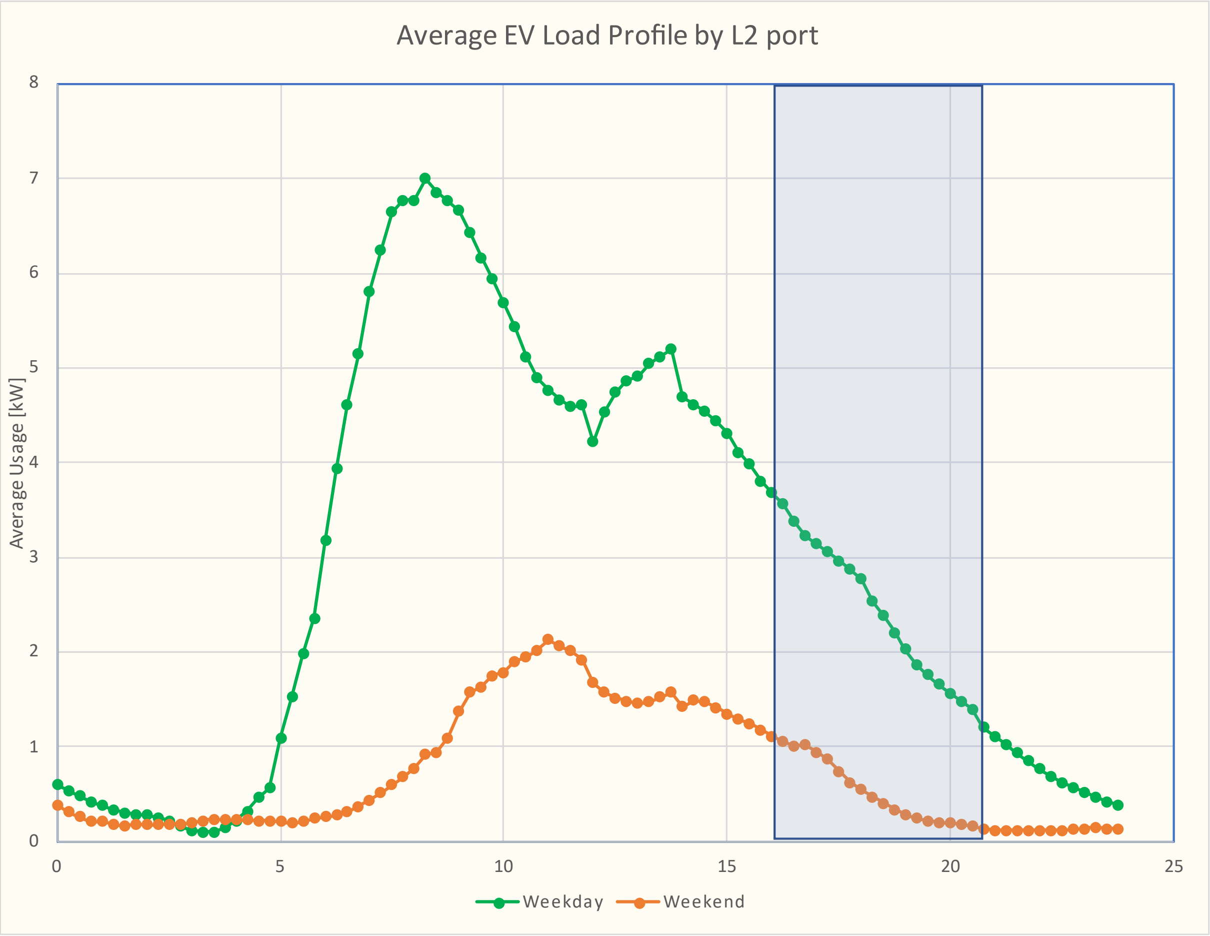
- Weekday and weekend profiles for an office environment.
- Values show actual data gathered & averaged from a large bank of Level-2 (L2) charging ports capped at 7 kW.
- Note the weekday lunchtime curve as EVs are moved.
- The weekend (orange) curve does not reach the same peak as weekday because the lower utilization reduces the average value.



Economics could warrant EV charging constraints

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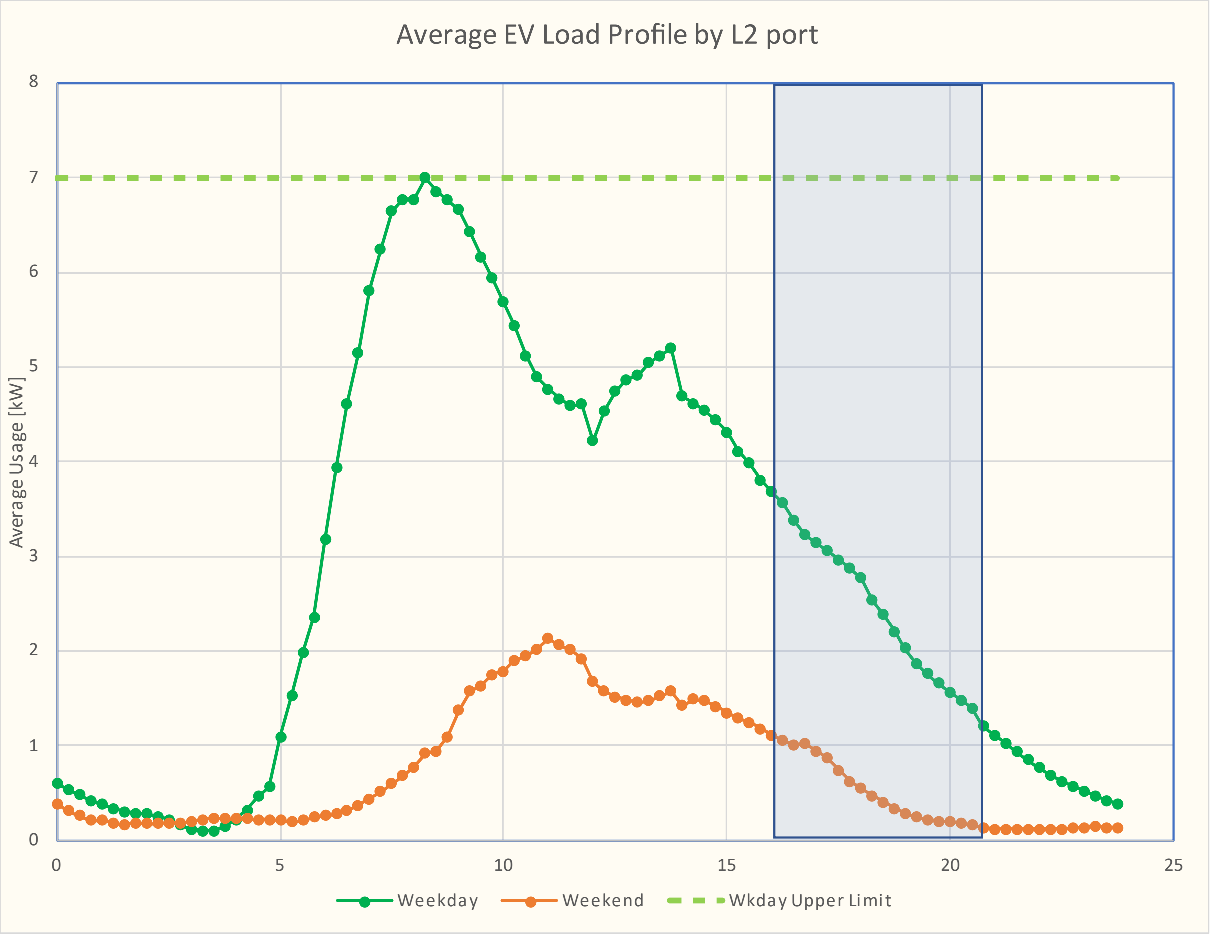
- The only natural charging constraint is the power capacity of the L2 EV chargers, which is 7 kW for each port in this example.
- Economic considerations could warrant charging constraints that avoid excessive demand charges and/or minimize energy usage at peak energy rates.
- Additional economic considerations could result from monetizing demand response (DR) and other grid services.



Example profile for optimizing EV charging economics

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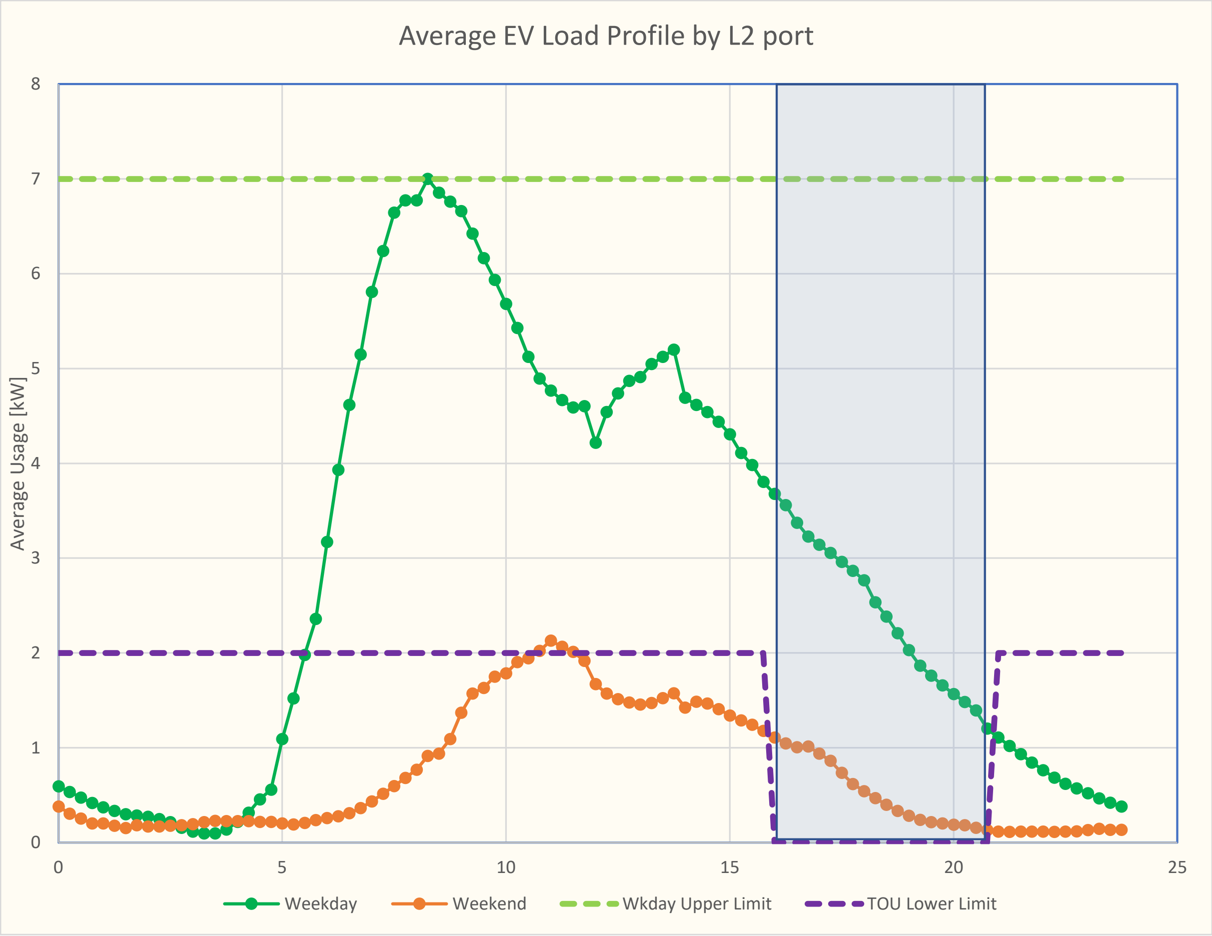
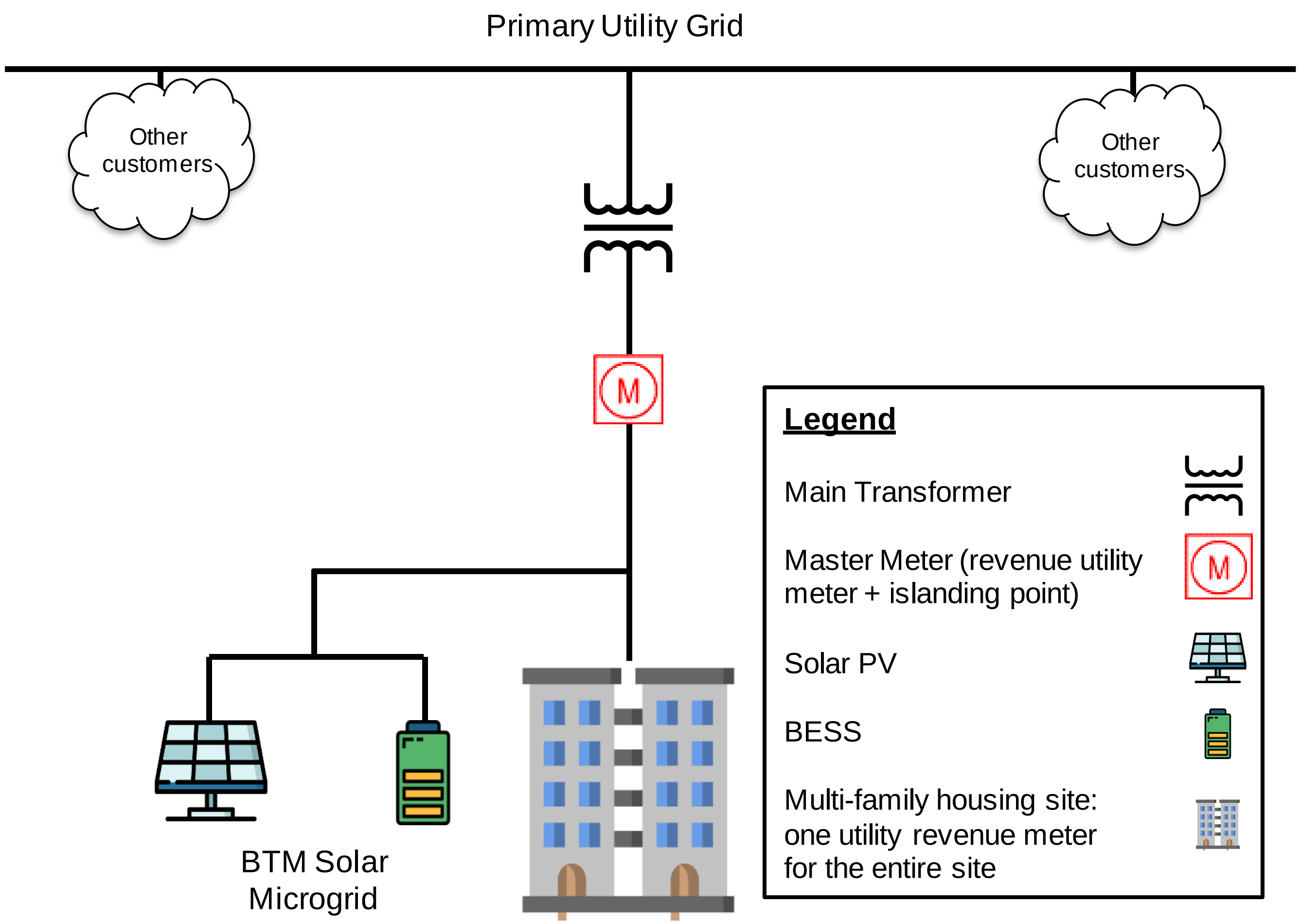
- The purple line shows a maximum EV charging profile that could be set to avoid excessive demand charges and prohibit EV charging via peak energy rates.
- Such limits will be increasingly important as more EV charging proliferates.
- The constrained profile limits charging to 2 kW per port and completely prohibits charging during 4-9pm peak energy rates.



Resilience for Apartments Using a Master Meter



Resilience is possible at apartments in a streamlined/standard fashion using a master meter.

Questions?

Questions?

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Backup Slides

Enabling utility alignment with ratepayer interests via transmission divestment

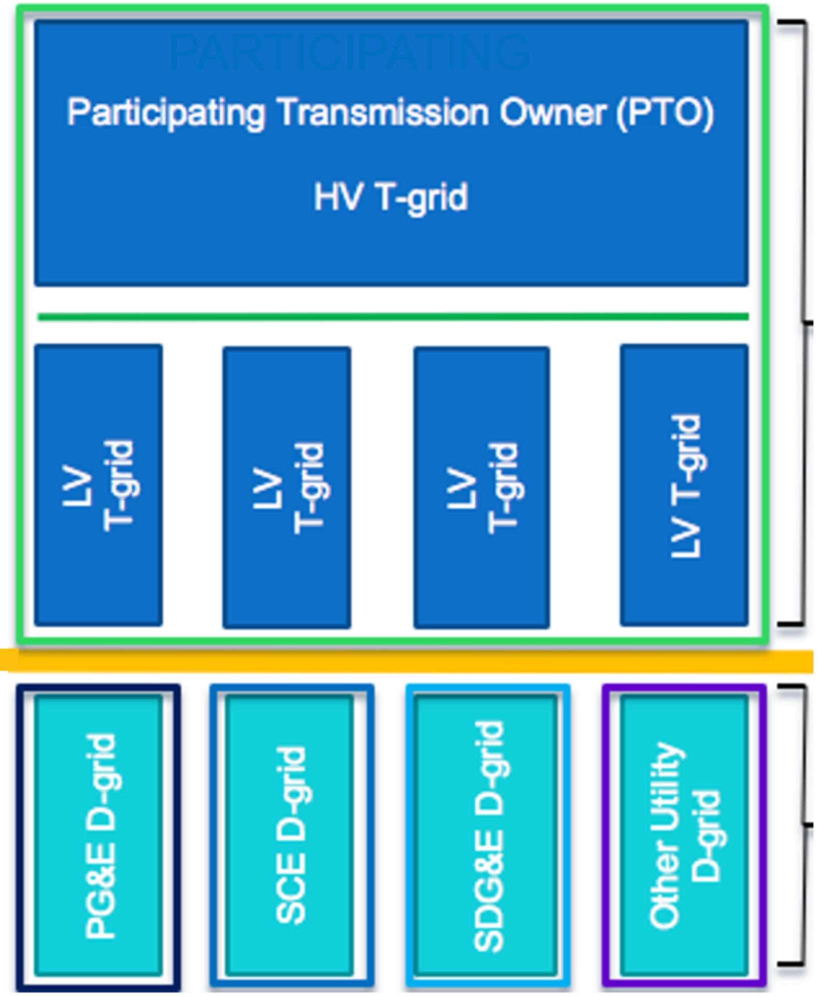
Transmission and distribution facilities

PARTICIPATING TRANSMISSION OWNERS own transmission assets

High-voltage (HV) transmission Grid Above 200 kV

Low-voltage (LV) transmission grid Above 69 kV

BRIGHT LINE



- OPERATED BY CAISO
- REGULATED BY FERC

UTILITIES own & operate distribution assets

Distribution grid

- OPERATED BY UTILITIES
- REGULATED BY CPUC

A DSO will increase the value from DER

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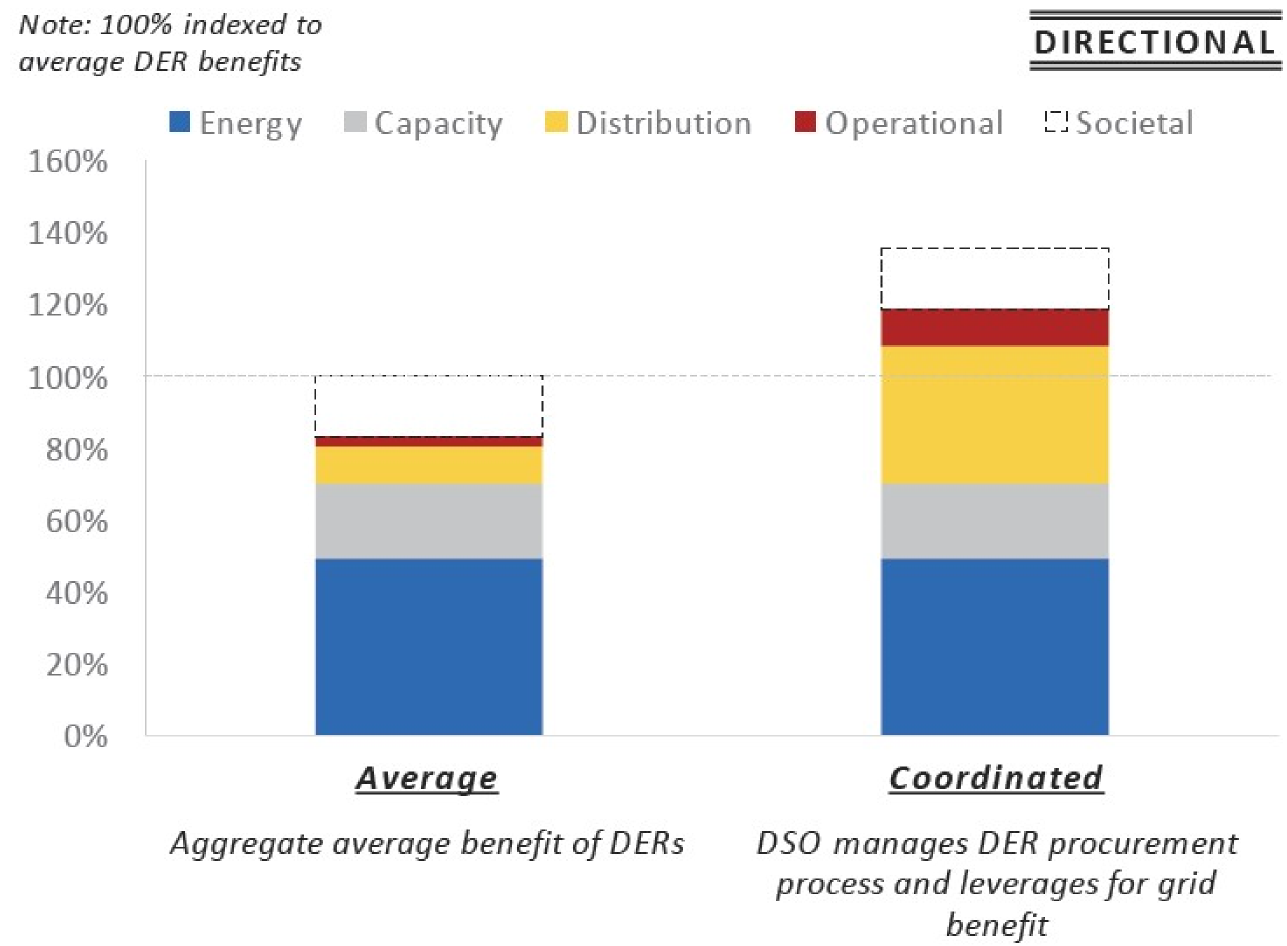
Figure 5: Impact of DSO coordination of DERs on benefits to grid



Southern California Edison, September 2016

7