



## Energy Services

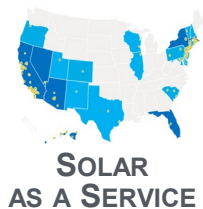
Creating a Planet Run by the Sun

Andlinger Center Annual Mtg | Princeton Univ.  
November 9, 2019

Audrey Lee, Ph.D.  
Vice President, Energy Services



# Brightbox: our home solar and battery service



**Peace of mind.**  
Install, maintain,  
insure, warrant



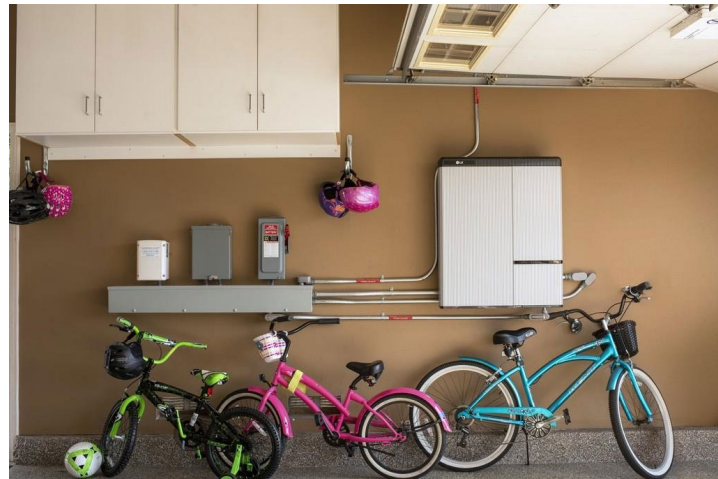
**We offer a strong  
customer  
experience.**  
20+ years



**Financing.**  
\$0 upfront, low  
monthly rate



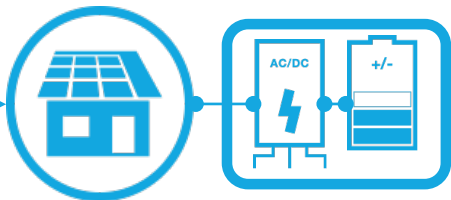
**Clean energy as a  
service.** With  
customers at their  
kitchen table



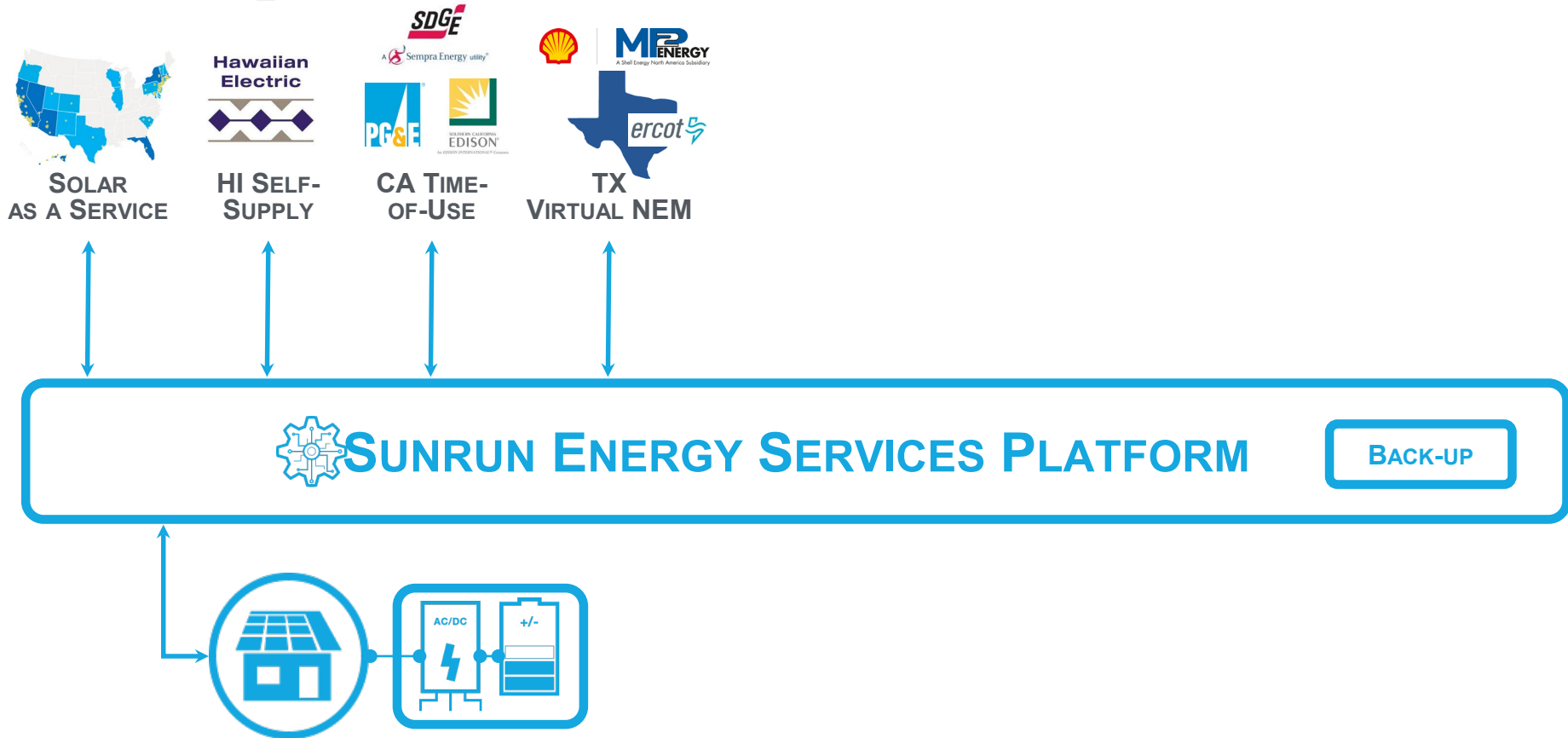
Deployed over **1.7 GW** of residential solar to  
over **255,000** customers.

Installed over **6,000 Brightboxes.**

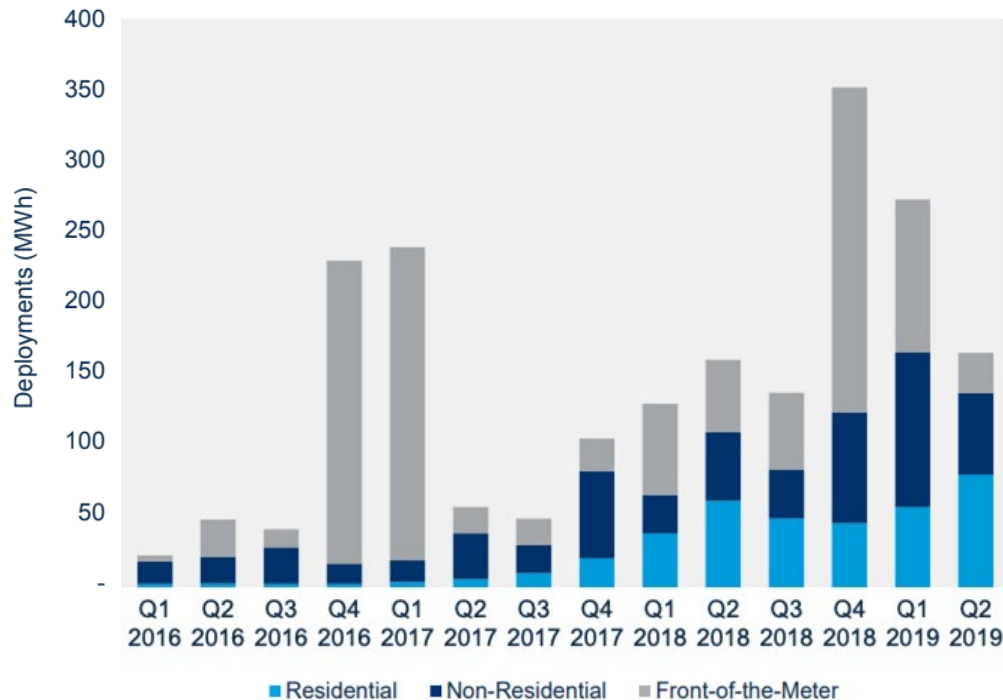
Brightbox represents **>10% of all direct sales**  
(25% in California).



# Non-export | Time-of-use Rates | Virtual NEM



# Residential continues to grow, Largest segment in Q2 2019

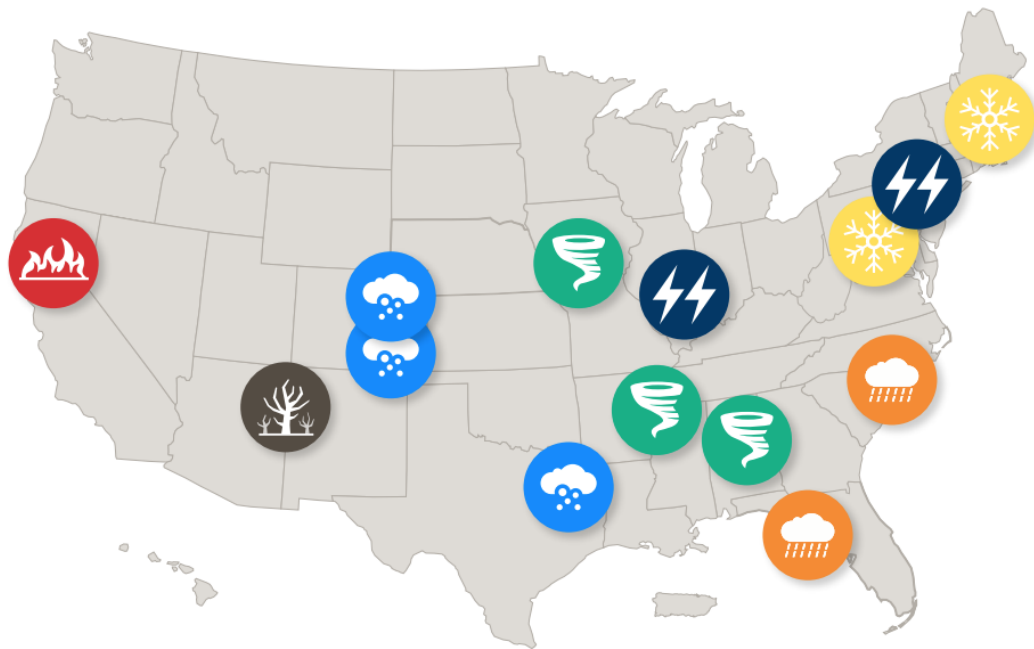


Source: Wood Mackenzie Power & Renewables

- Resi Q2 2019: 34.8 MW | 79.2 MWh
- ~3 million homeowners have already invested in standby generators with higher cost / disadvantages vs. energy storage
- Pairing with solar enhances value and enables distribution through resi solar
- Wood Mackenzie projects **customer-sited storage** will make up **40% of storage market** (in MW) and 47% (in \$) in 2024.

# Customers want reliable and resilient energy

## Billion-Dollar Extreme Weather Disasters In The US, 2018



### Western Wildfires

California Firestorm, Summer-Fall

### Plains Droughts

Southwest/Southern, 2018

### Hail Storms

Rockies & Plains, August 6-7

### Tornadoes & Severe Weather

Central & Eastern, July 19-22

Southern & Eastern, April 13-16

Southeastern, March 18-21

### Severe Weather

Central & Eastern, May 13-15

Central Northeastern, May 1-4

### Hurricane

Hurricane Florence, September 13-16

Hurricane Michael, October 10-11

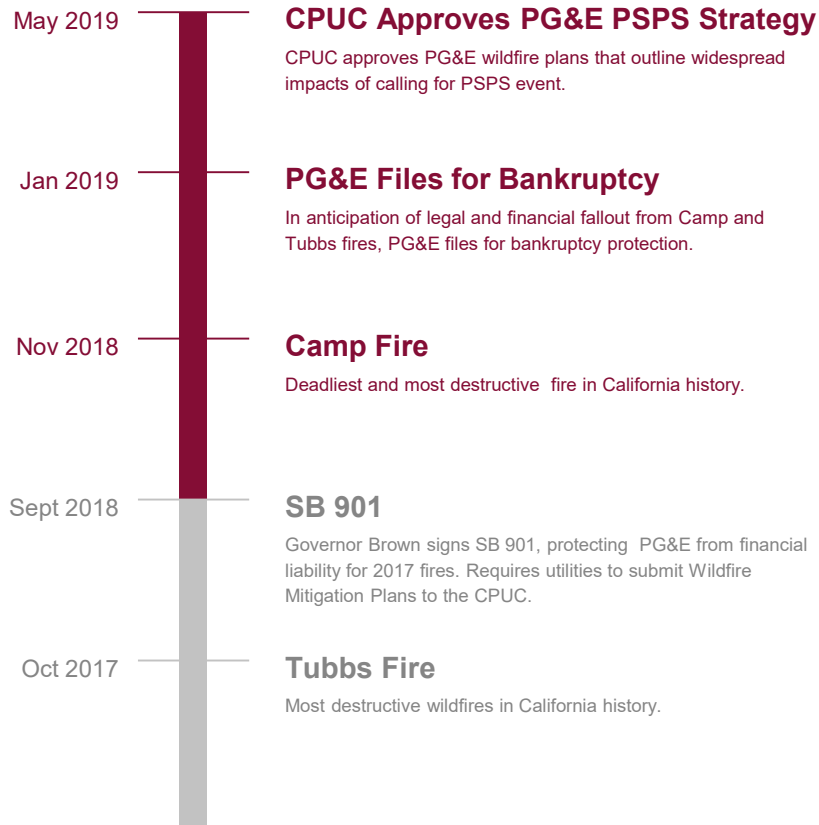
### Winter Storm

Northeast, March 1-3

Northeastern & Eastern, January 3-5

This map denotes the approximate location for each of the **14 separate billion dollar weather and climate disasters** that impacted the United States during 2018.

# Public Safety Power Shutoffs (PSPS)



*In May, CPUC approved proactive de-energization of power lines in times of high wind, but only "as a measure of last resort."*

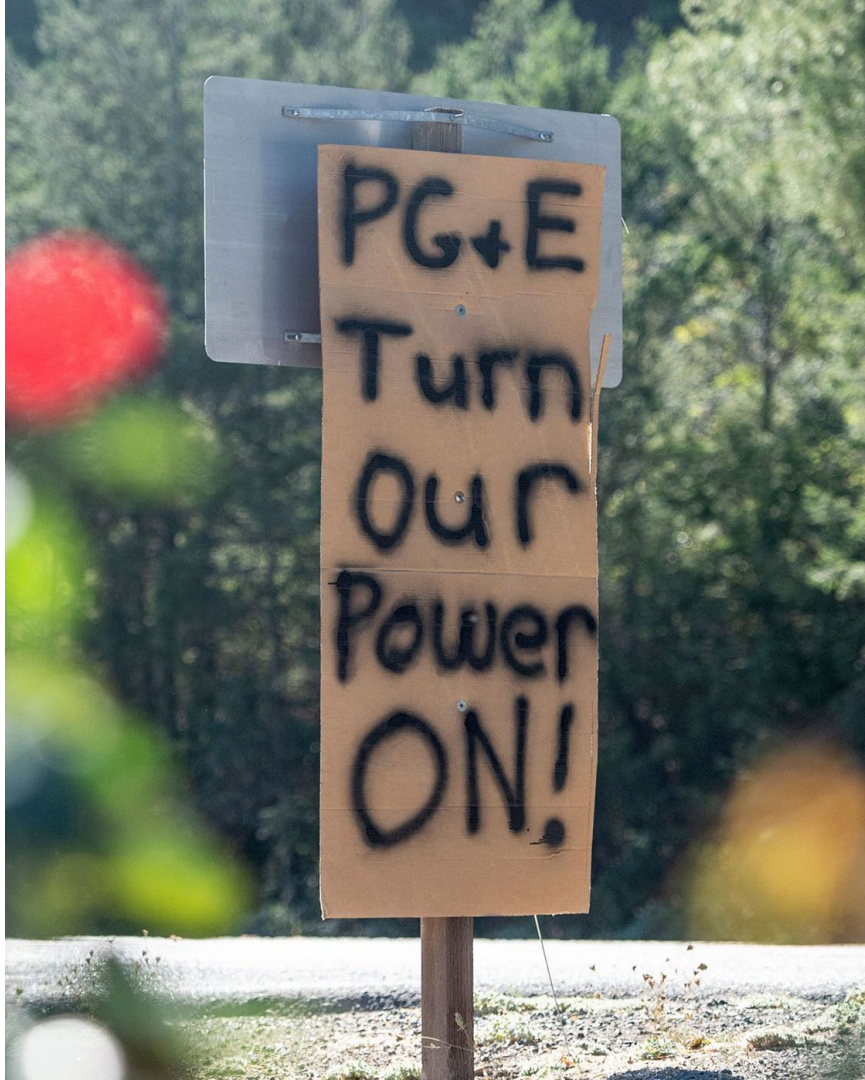


# October 2019

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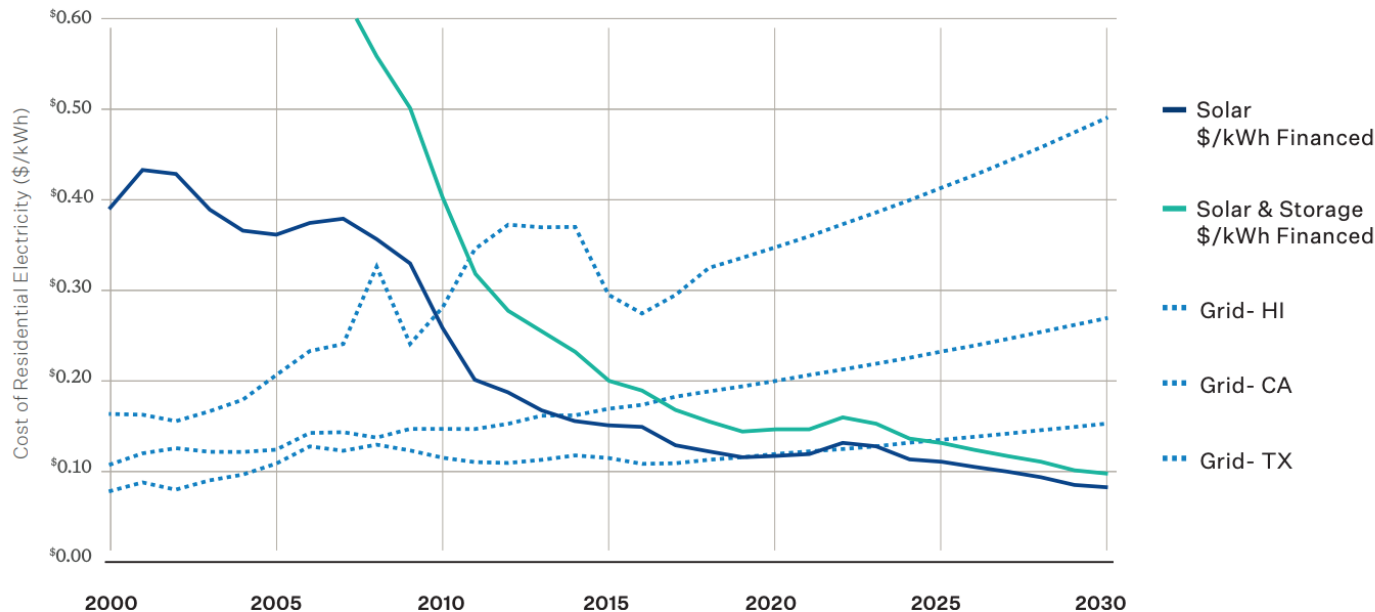
Millions of Californians are impacted by proactive power safety shut offs (PSPS) events as fire seasons intensifies. Unprecedented loss of power:

- Oct. 3rd, PG&E turns off power for **nearly 800,000 customers in 35 counties for 3 days**
- Oct. 27th, historic outage event leaves **1.3 million in Bay Area** and additional customers in SCE without power.
- Fire season continues without rain in the forecast for weeks.



# With scale the cost of technology declines

Actual and Predicted Cost of Solar and Batteries Compared to Utility Rates

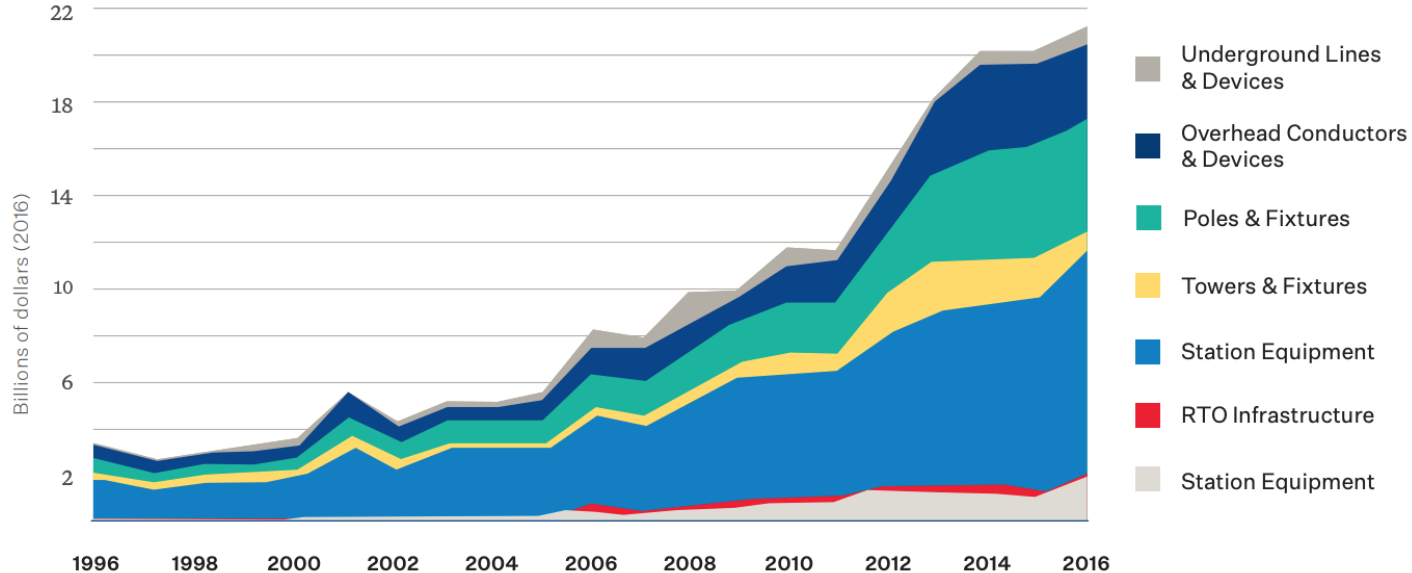


*This graph compares the historical and future cost to deliver a kilowatt-hour of electricity to a residential customer from rooftop solar, rooftop solar paired with energy storage, or from the grid in Hawaii, California and Texas. When all-in delivery costs are considered, the trend towards cost advantage of distributed resources becomes clear.<sup>3</sup>*



# ....but the cost to deliver is increasing

Investment in Transmission Infrastructure by Major Utilities (1996-2016)



By 2030, the electric utility industry will need to make a total infrastructure investment of **\$1.5 to \$2.0 trillion**

# We must decarbonize and we can (without stranded assets)

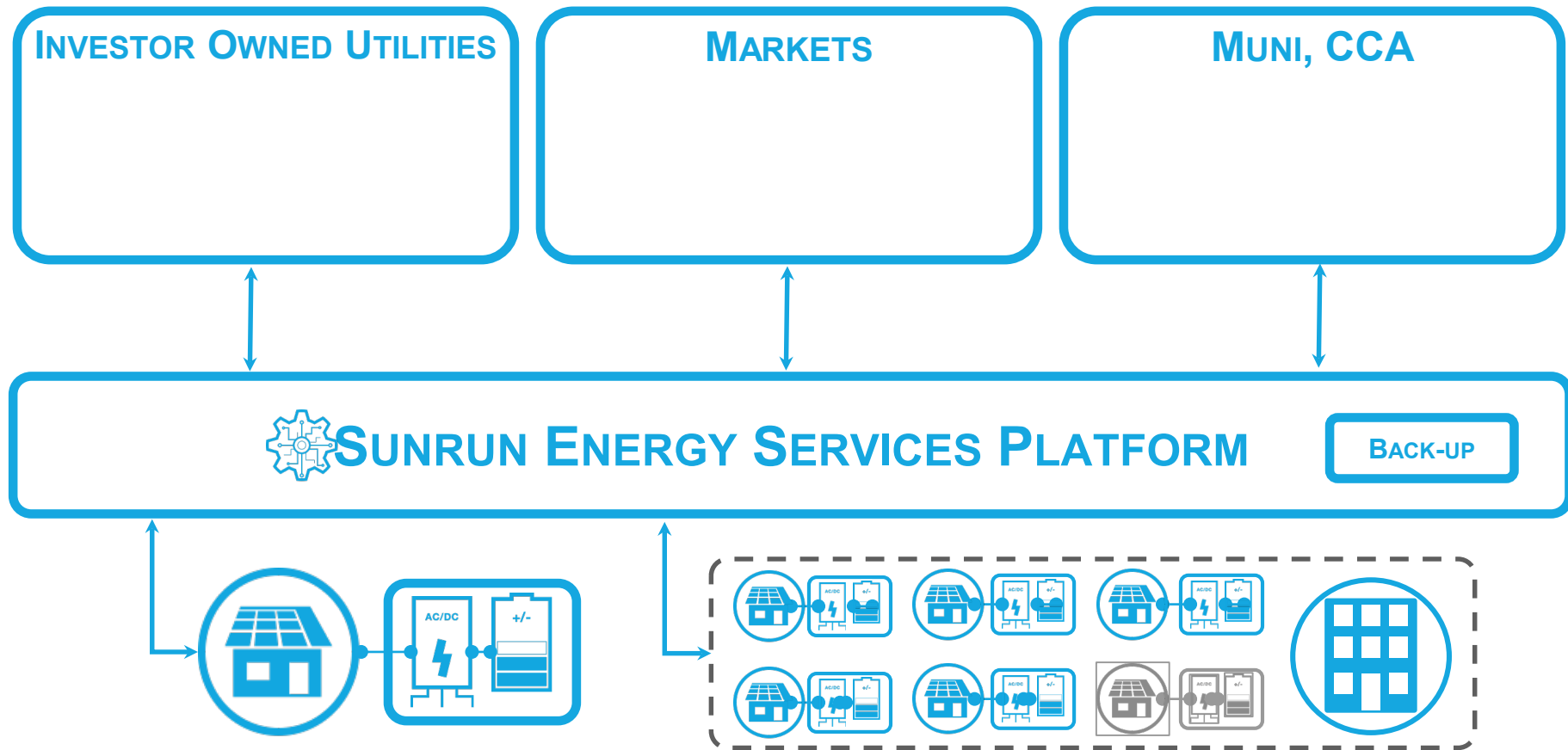


Edison Electric Institute Study:

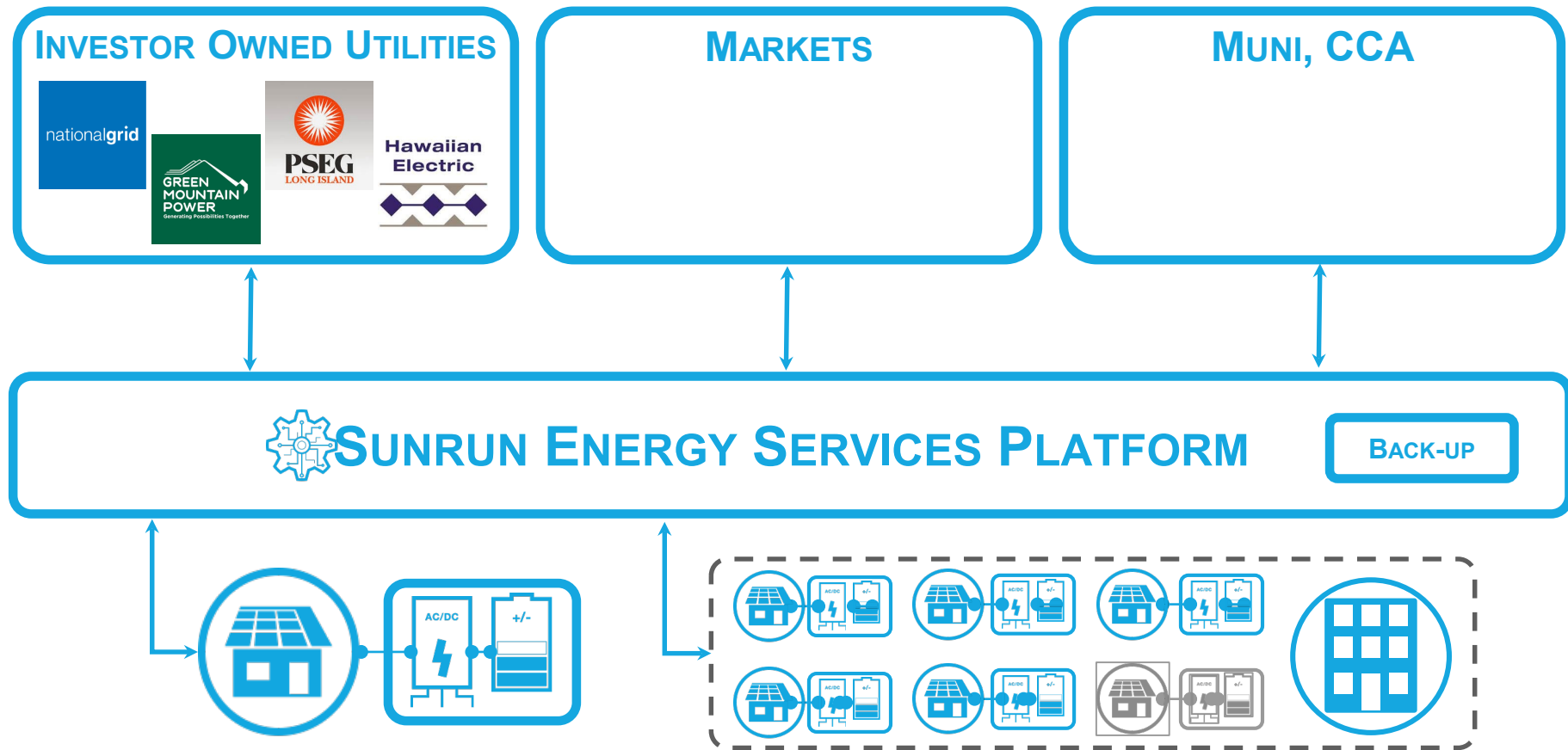
70% believe 100% of our electricity should come from renewables

51% believe 100% renewables is a good idea even if it raises their bills by 30 percent

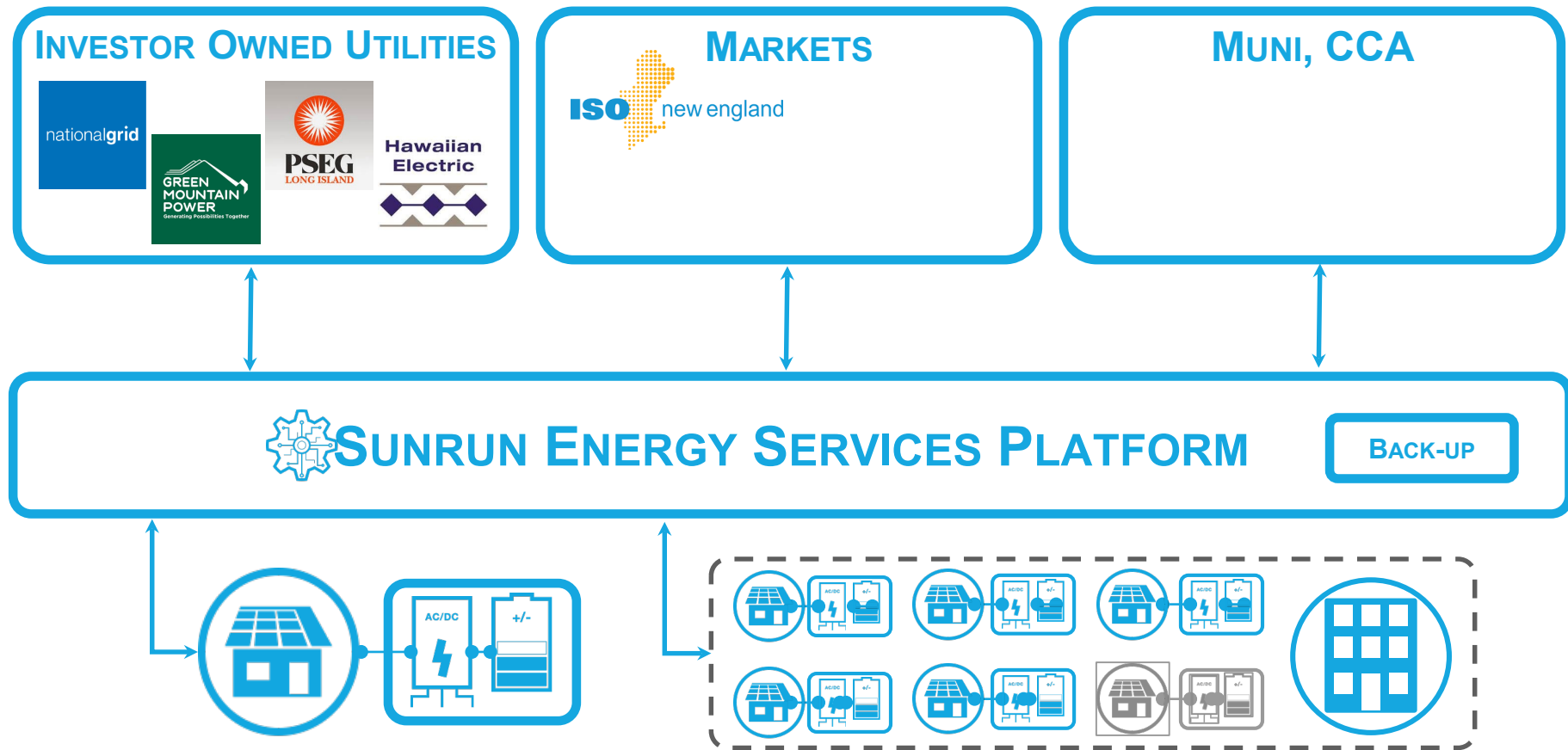
# Partnerships with Utilities/Grid Operators



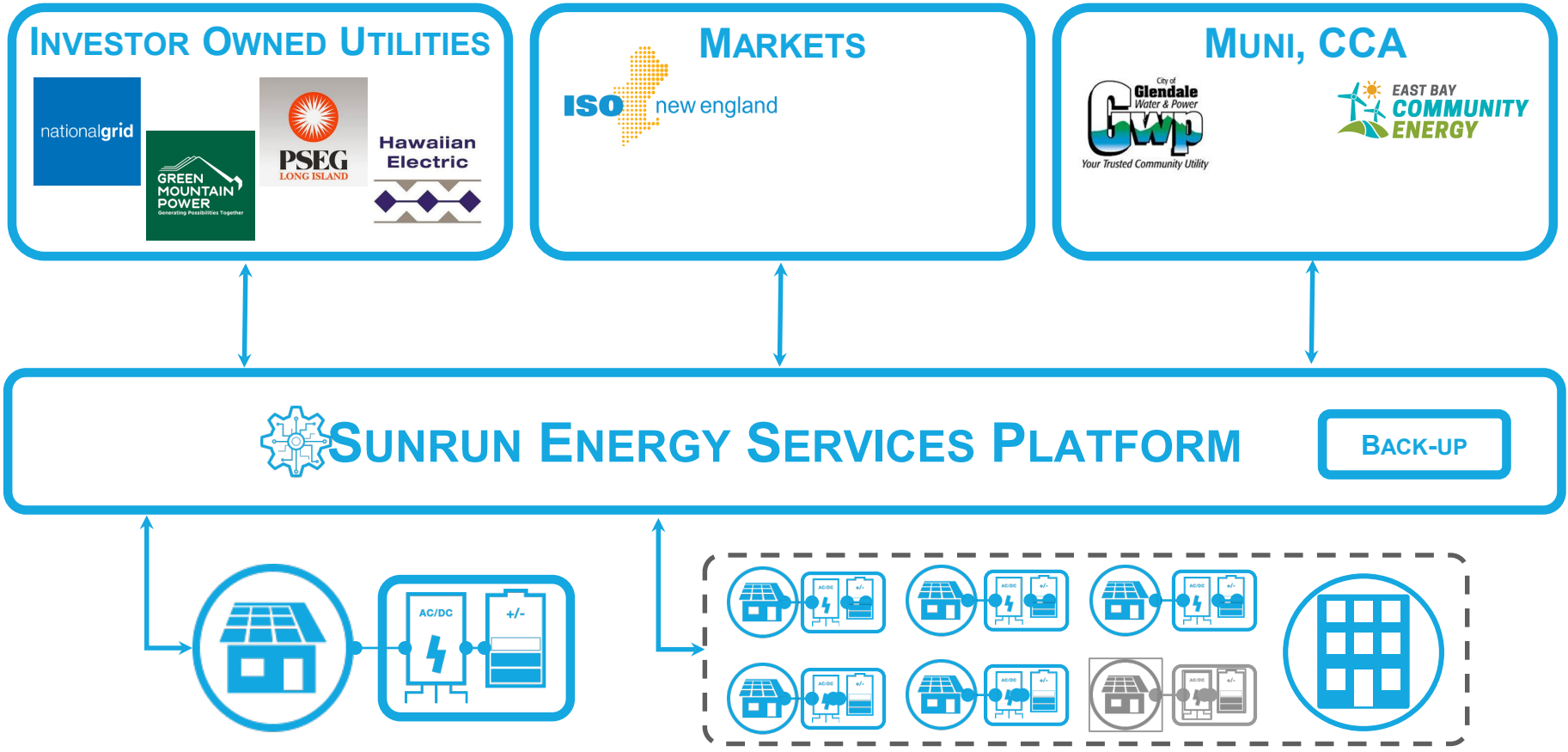
# Bring Your Own Device and Coordinated Export



# Evolve rules for fossil-fueled power plants, Replace them

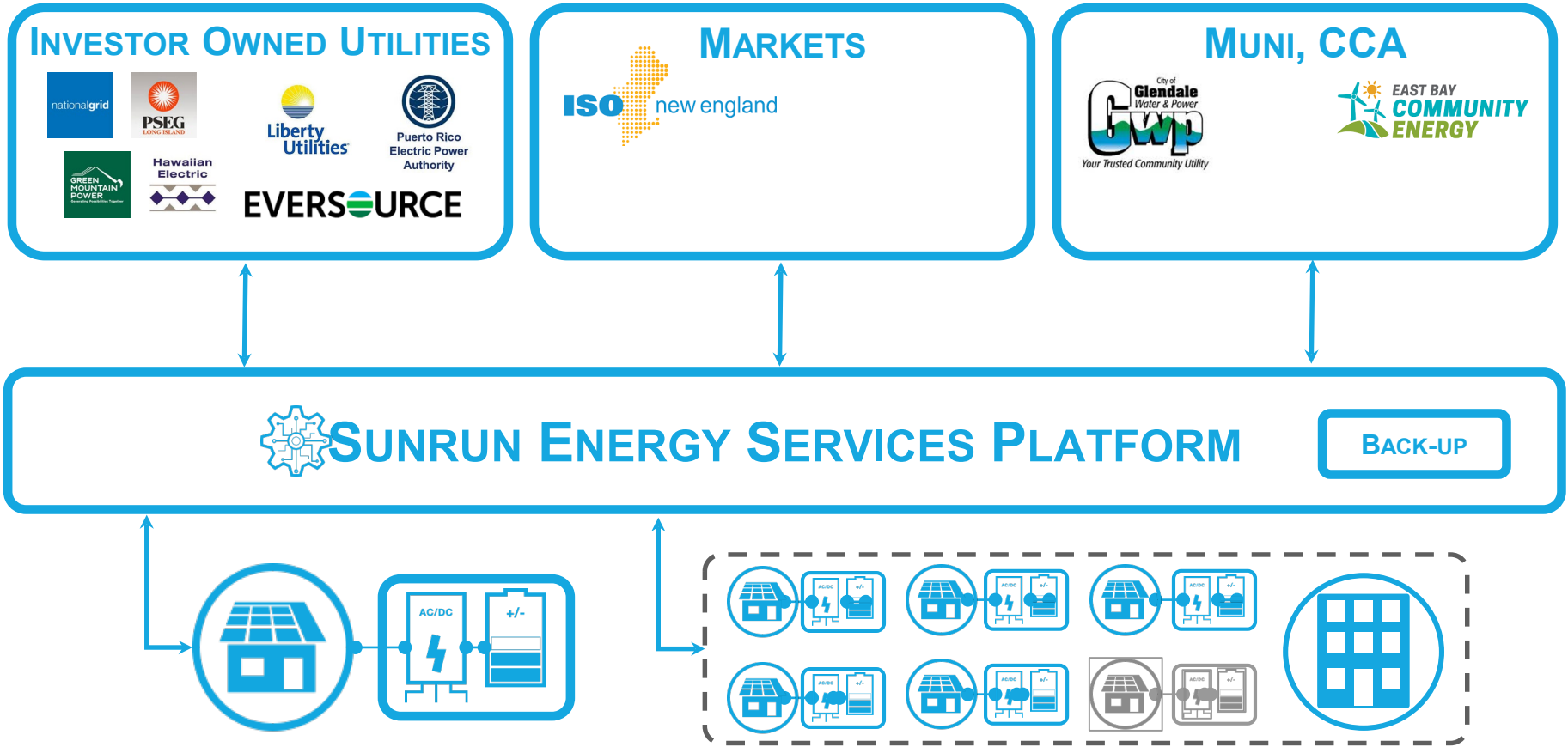


# Give voters an alternative to backyard power plants

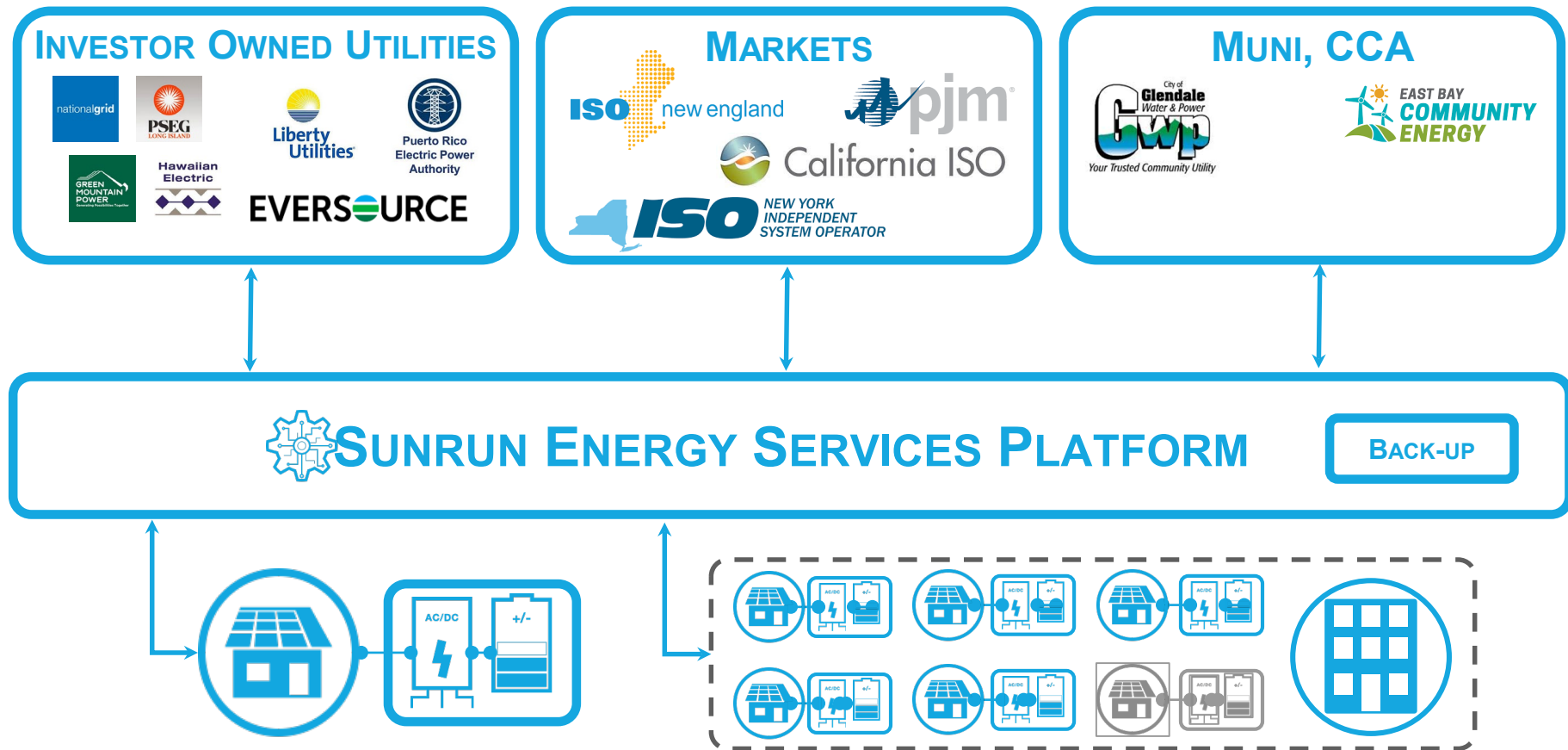




# Scaling Across the Country: BYOD and Islands



# Scaling: Competitive Market Rules



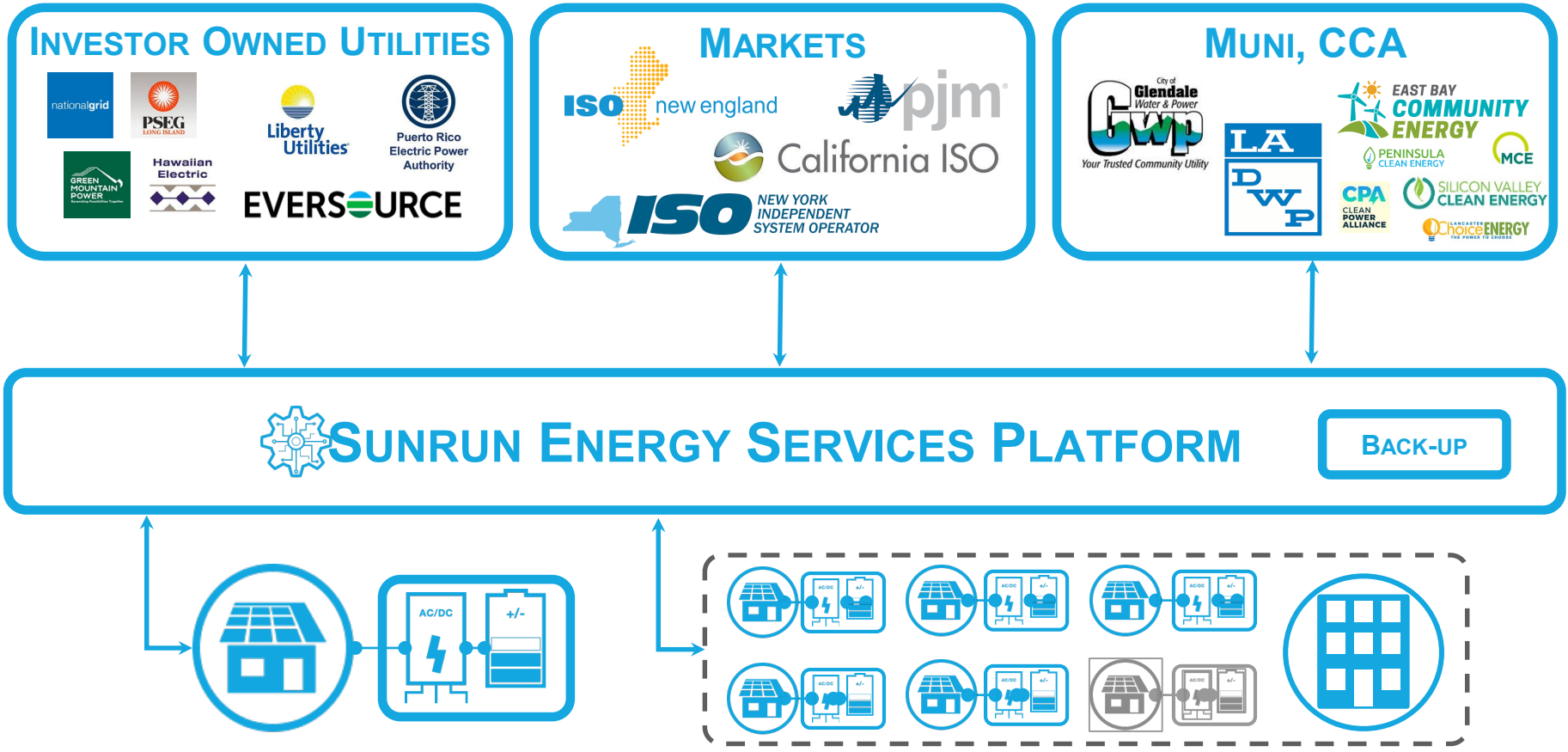
# Los Angeles Dept. of Water & Power

## Virtual power plant with rooftop solar and batteries

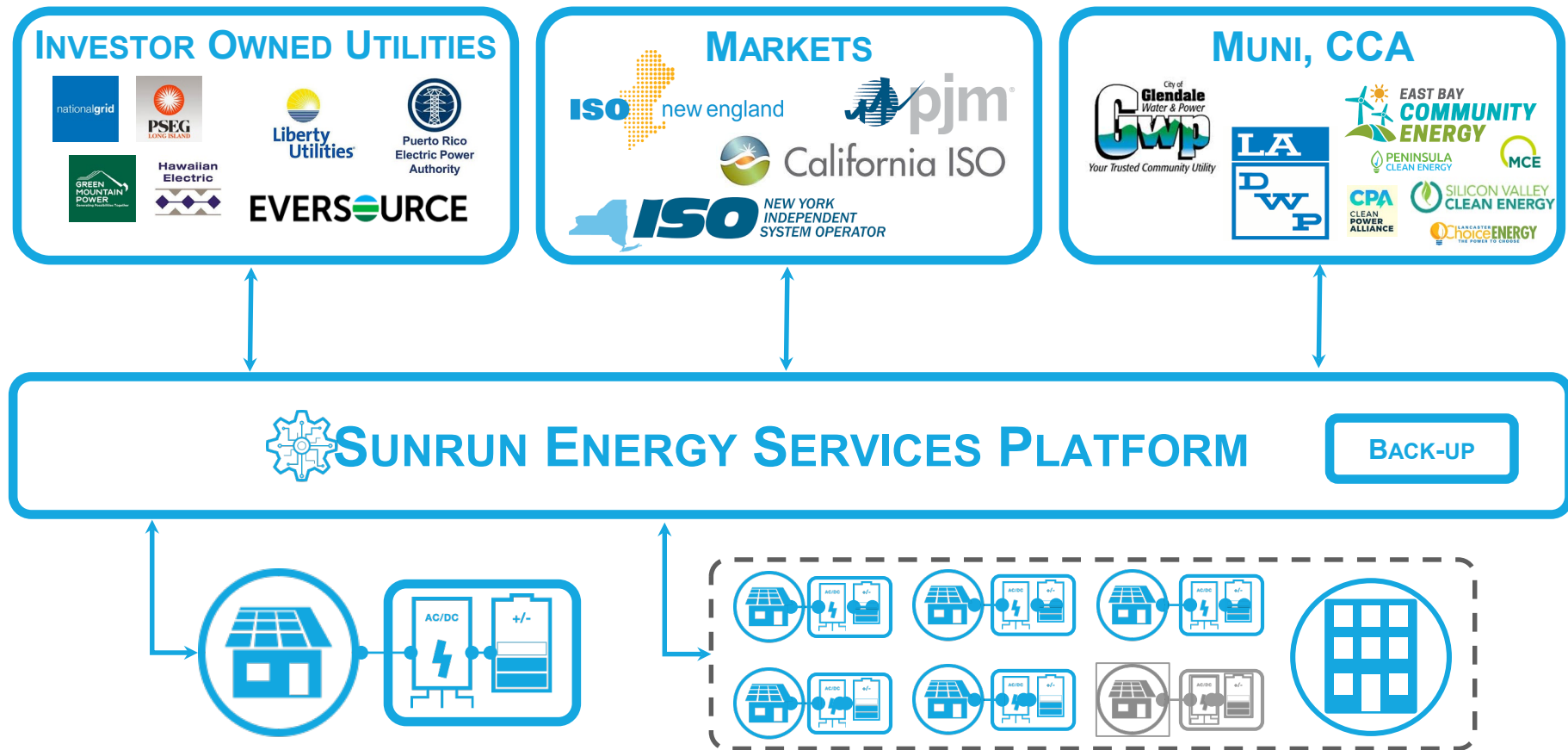
- By 2030, fleet of 150,000 homes and 5,000 apartments with rooftop solar, from 36,000 homes today
- 75,000 homes equipped with solar + batteries can generate ~300 MW peaking capacity, equivalent to a gas power plant
- [www.sunrun.com/cleanenergyla](http://www.sunrun.com/cleanenergyla)



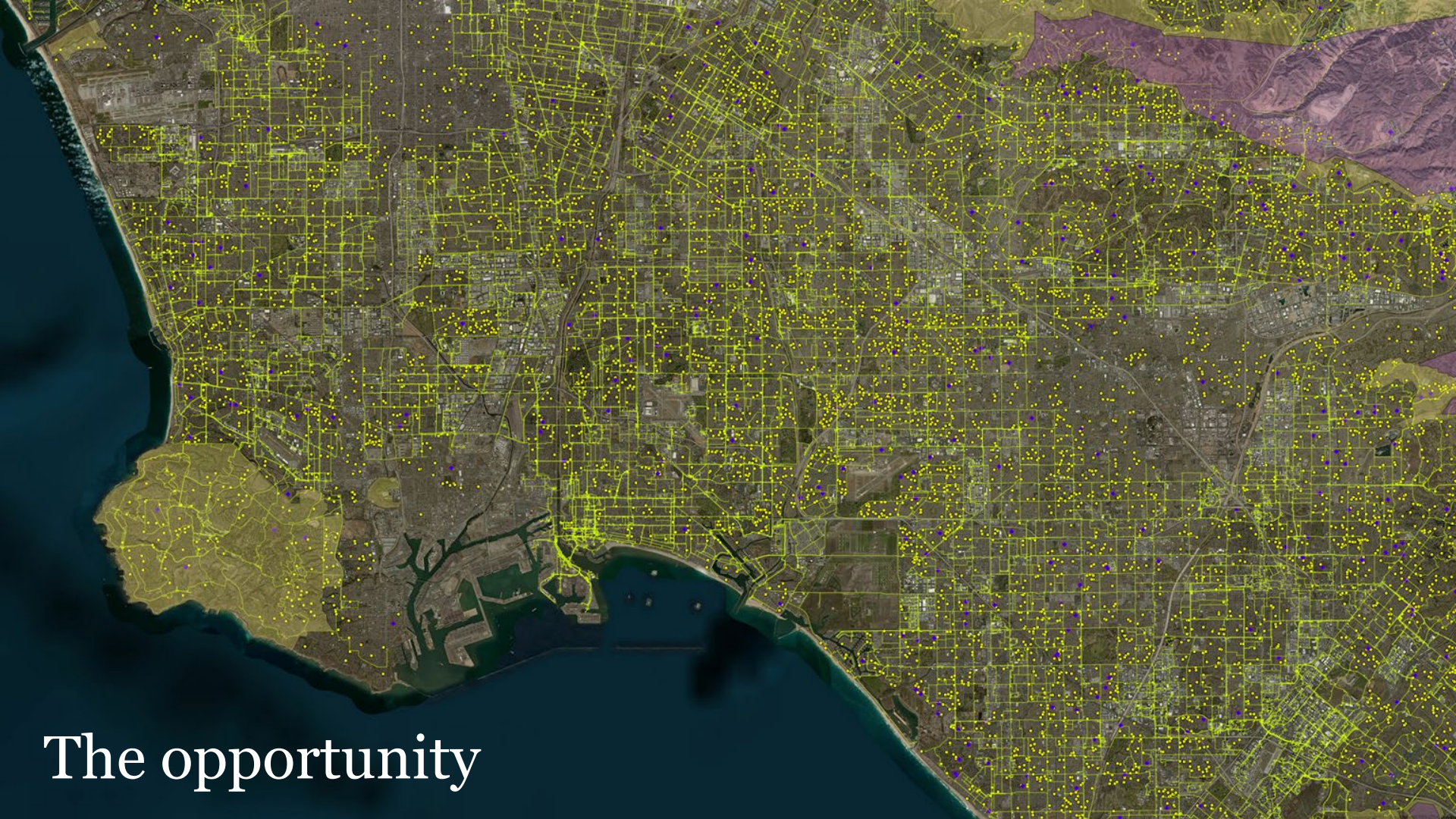
# Scaling: Eliminating Power Plants



# Battery Sharing Economy for Customer & Grid





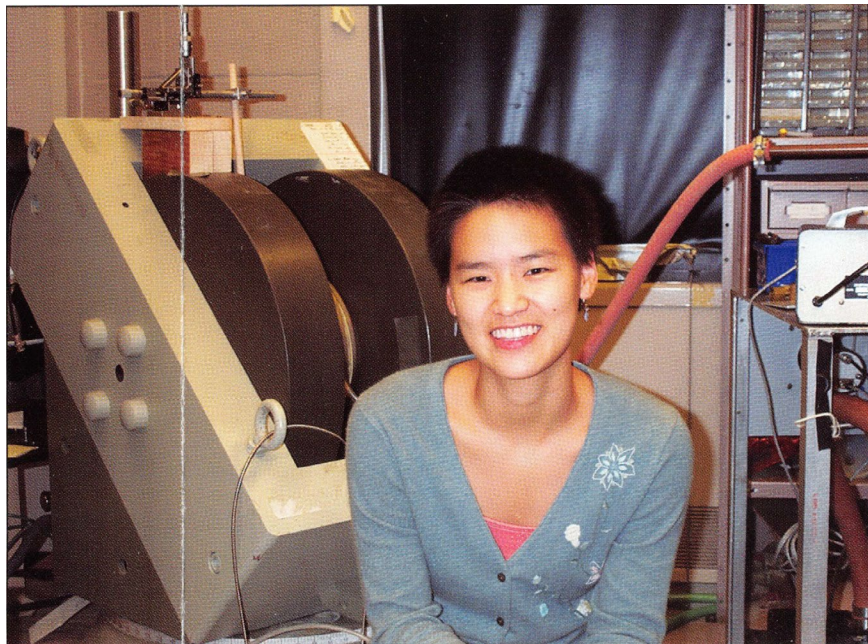


The opportunity



# Thank you!

[www.sunrun.com/grid-services](http://www.sunrun.com/grid-services)



## *Memory Lane*

- Steve Lyon Lab
- Circa 2002
- Attempt to measure electron spin lifetime in quantum dots