



# PV + Storage Systems: Global Outlook and Future Trend

Lior Handelsman

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# Meet SolarEdge

# End-to-End Smart Energy Provider

- One-stop-shop for smart energy solutions
- Established 2006 and NASDAQ IPO in 2015
- Global leader in smart solar inverters with installations in over 130 countries
- Award-winning innovative company with strong product portfolio and roadmap
- Ranked as top global inverter company
- Moving beyond solar
  - Gamatronic: Developer of uninterruptible power supply solutions
  - Kokam: A top-tier provider of Li-Ion cells, batteries, and energy storage solutions from South Korea
  - SMRE: Provider of innovative integrated powertrain technology and electronics for electric vehicles



# One-Stop-Shop for Smart Energy Solutions





# SolarEdge in Numbers

**11.8GW**

of our systems  
shipped worldwide



**37.1M**

power optimizers  
shipped



Over **1M** monitored systems around the  
world



**1.5M**

inverters shipped

**\$271.9M**

Q1 2019 revenue



Presence  
in **26**  
countries



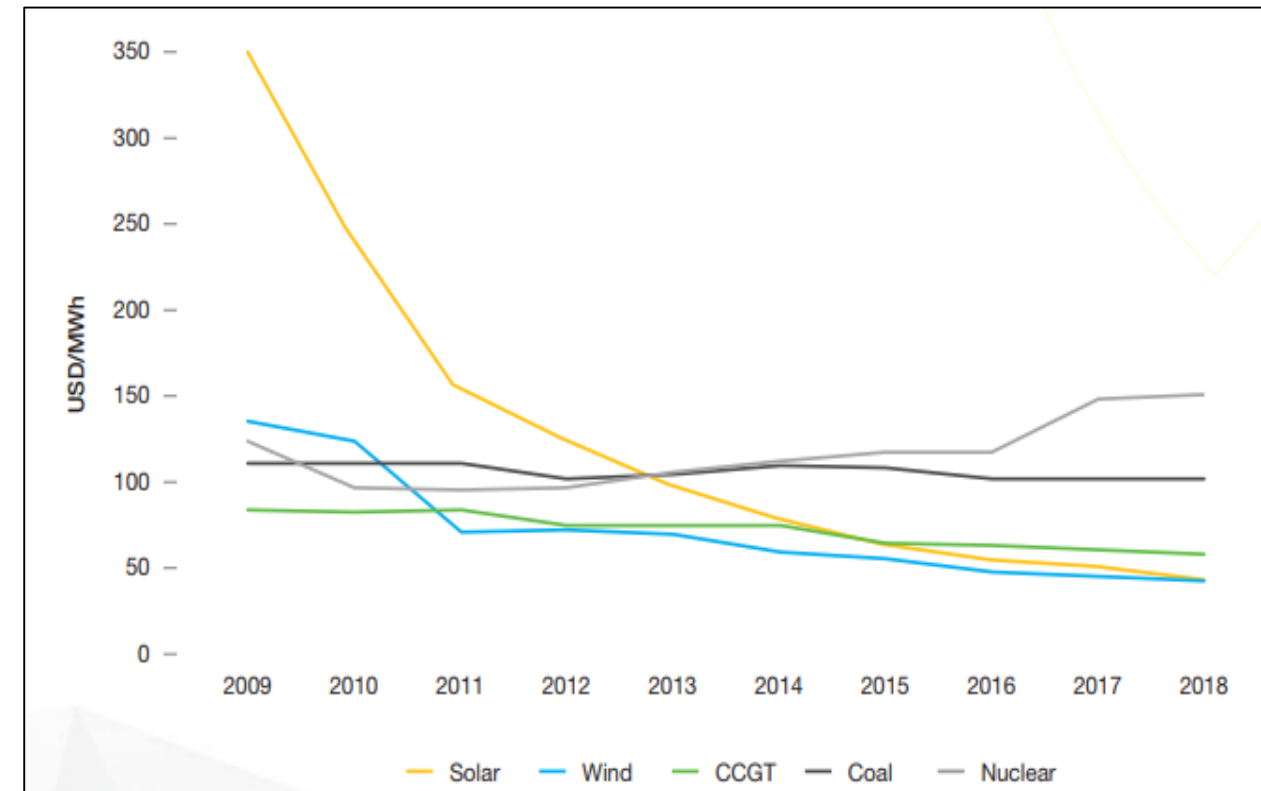
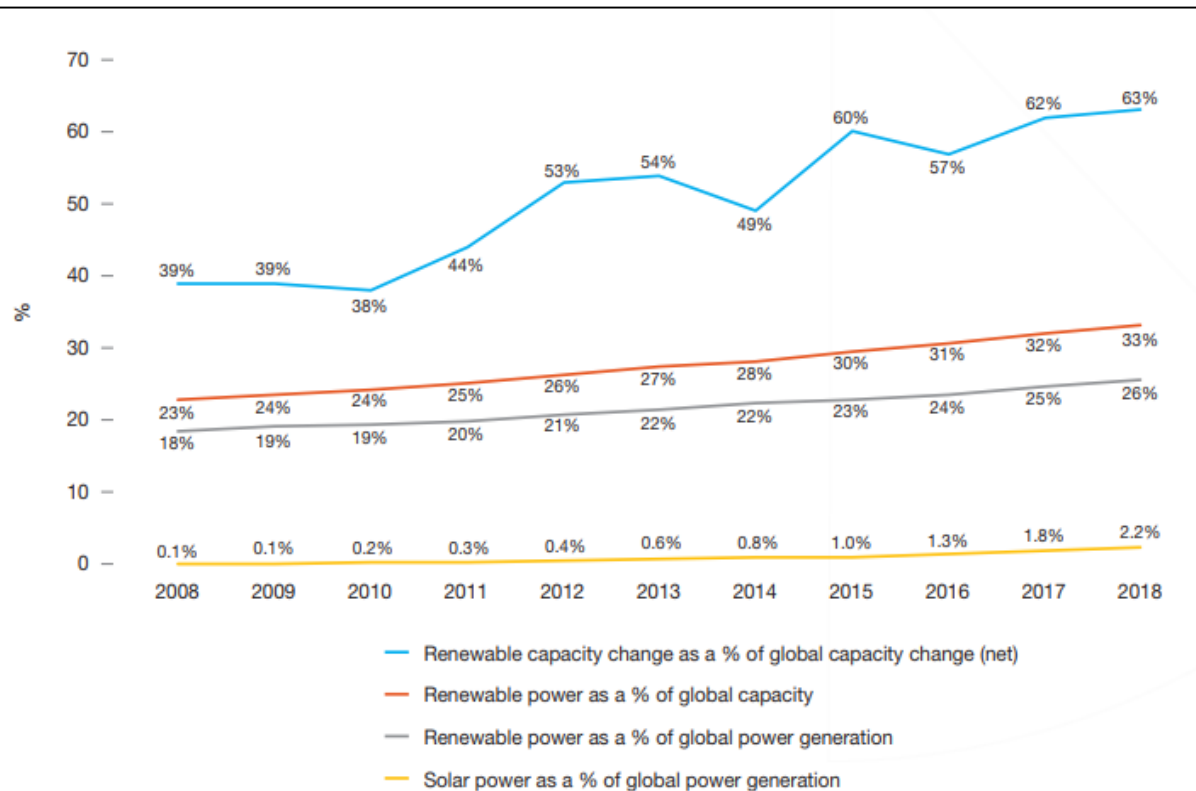
**2,017** employees



**295** awarded patents and  
additional patent applications **219**

# Global PV Market

# Global Solar Power Growth & Price Decline



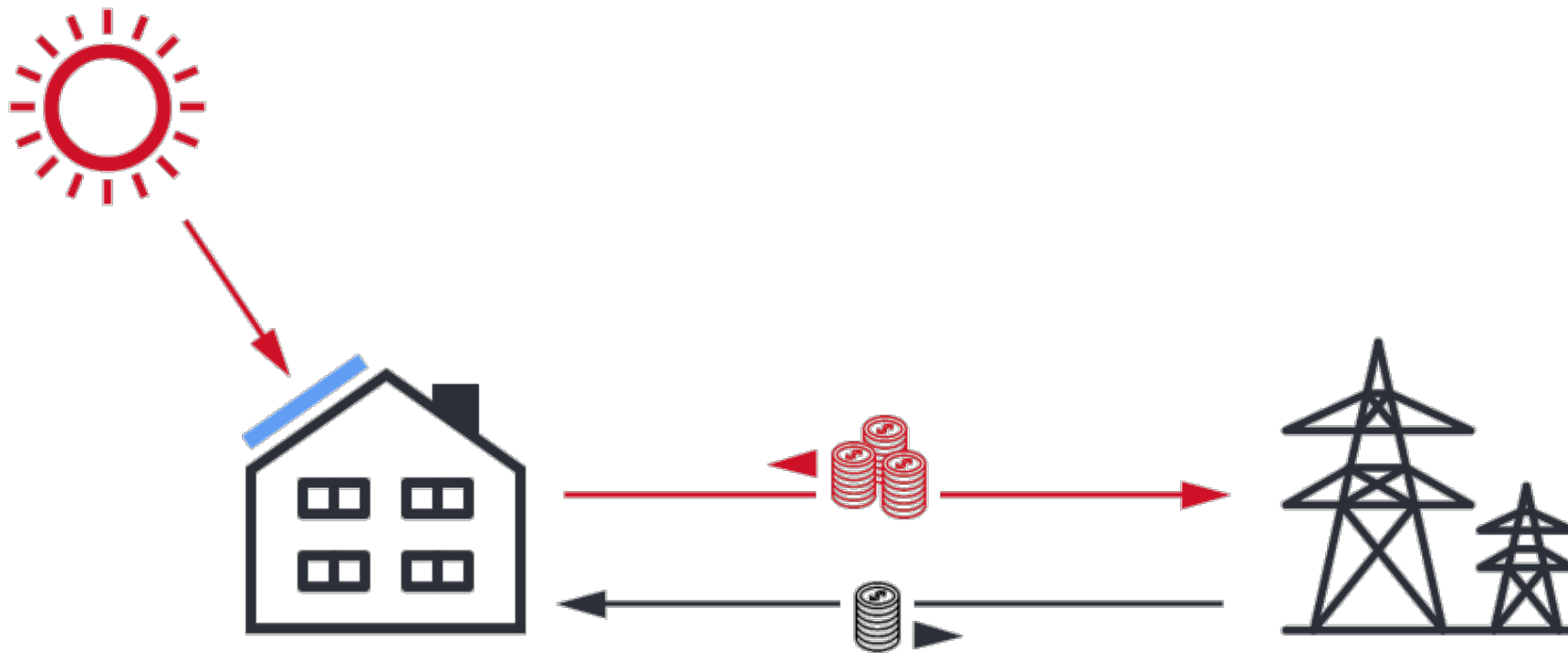
# Evolution of Incentive Structures



# The Evolution of Incentive Structures

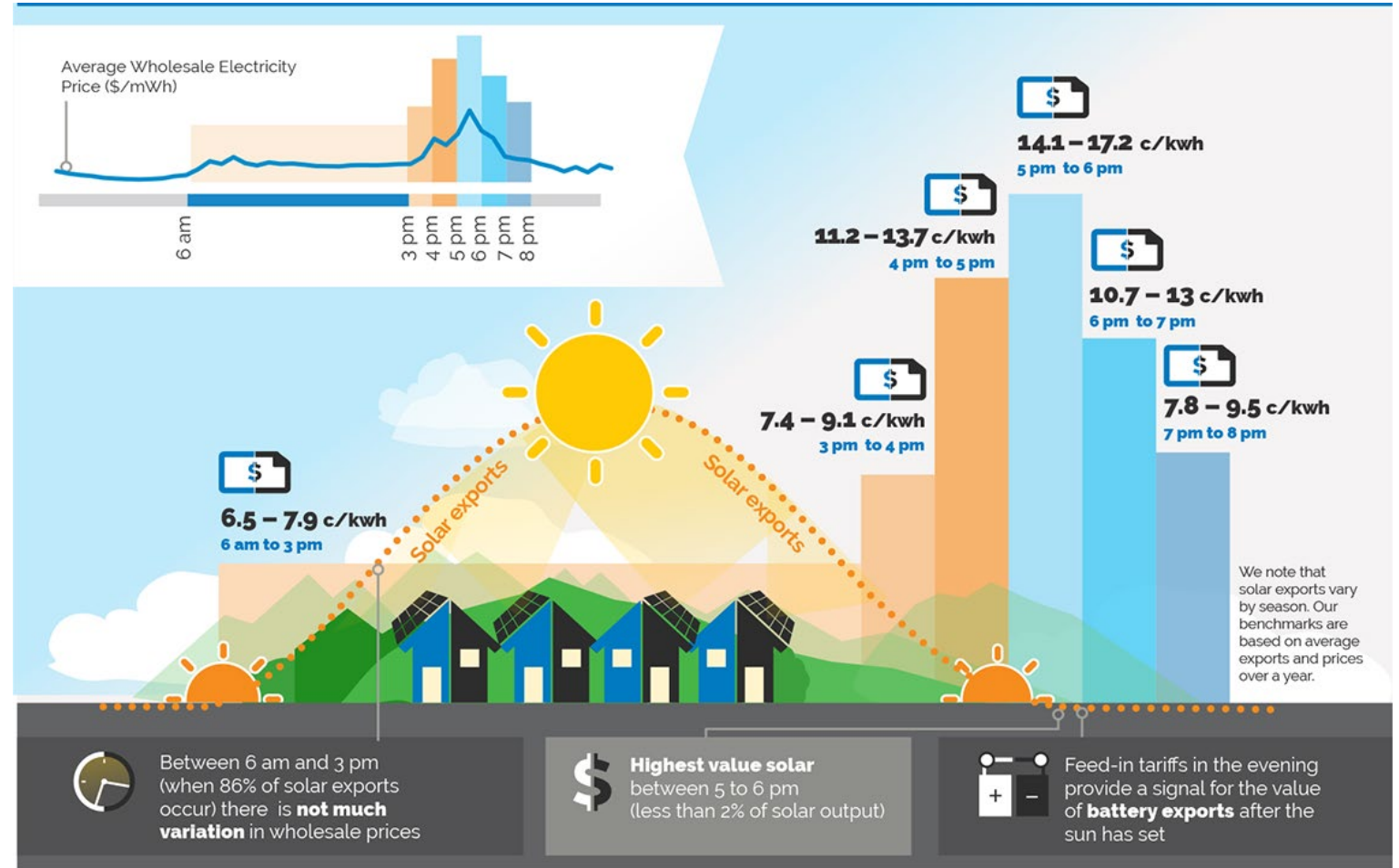
## Feed in Tariff

Utilities pay renewable energy producers a fixed and above-retail rate for electricity supplied to the grid.



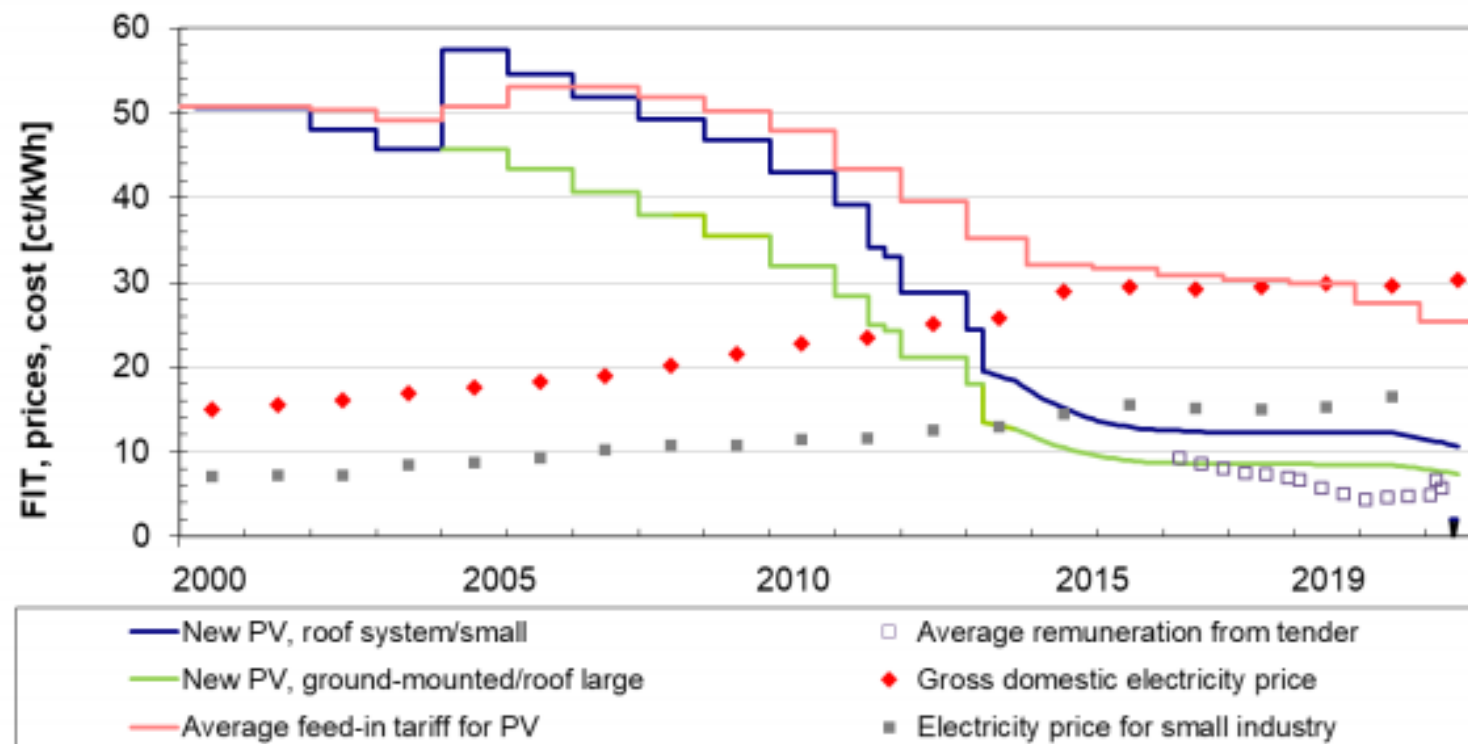
# Australia: A FiT Market

- Australian FiT started at 0.60 AU\$/kWh
- The current all-day benchmark FiT for NSW's is 6.9-8.4 AU¢/kWh
- As a proxy for the average wholesale price, evening FiT signals the value of battery exports after sun sets



# Germany: A strong Feed-In Tariff

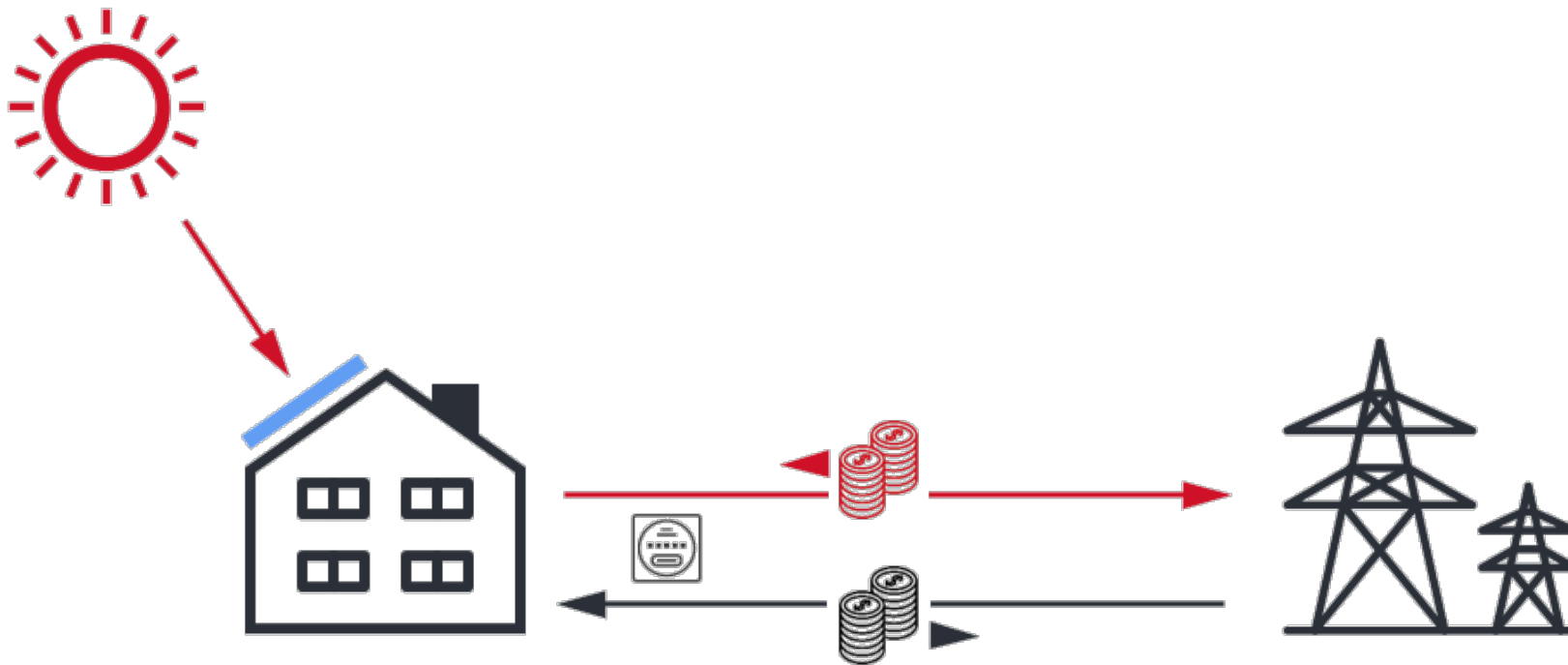
- Until 2014 Germany was traditionally a strong FiT advocate
- FiT declined below domestic retail price circa 2013 creating motivation for maximization of self consumption
- The increasing spread of now ~20€-cent/kWh has become a driver for residential storage



# The Evolution of Incentive Structures

## Net Metering

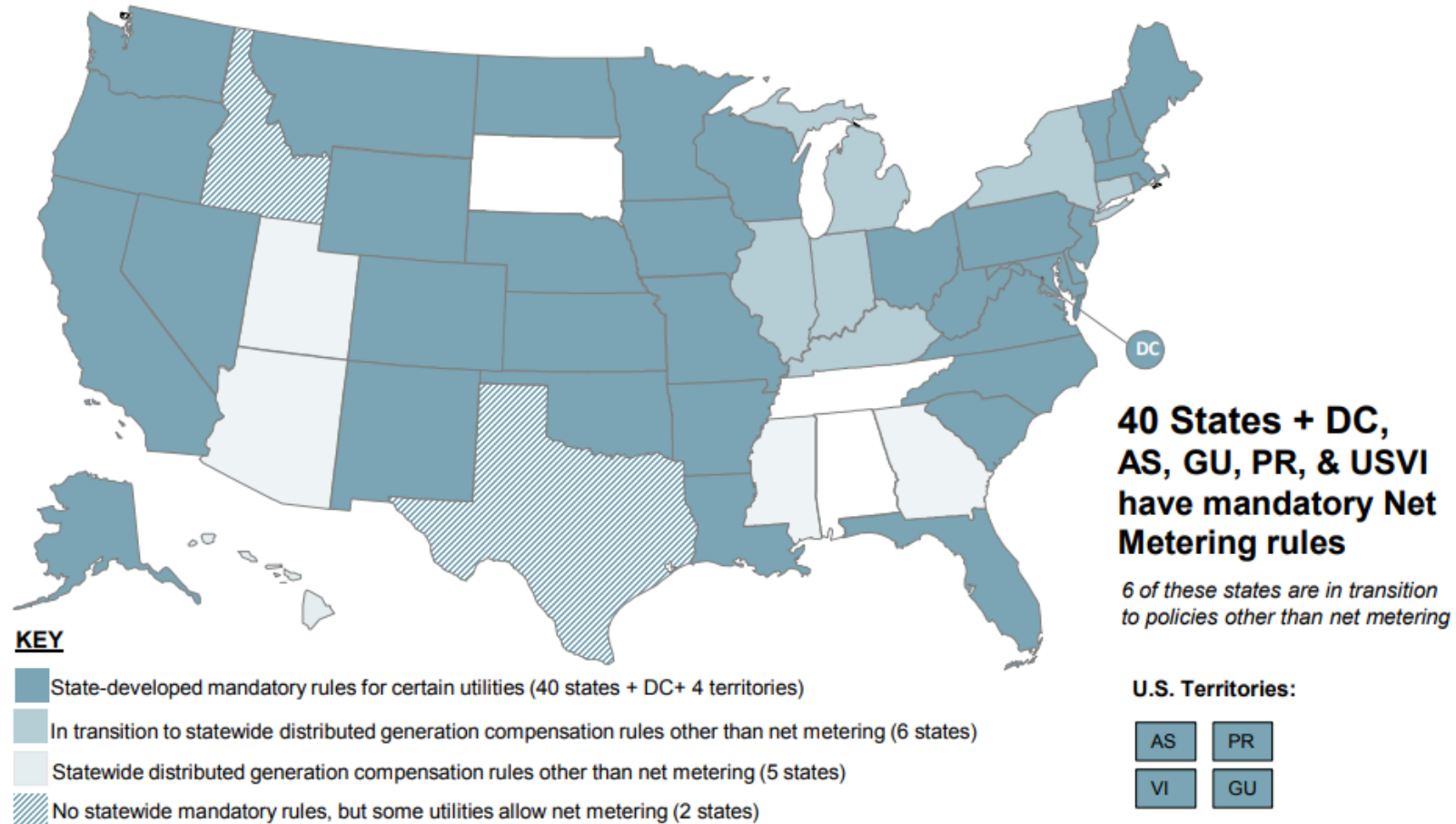
The cost of the electric energy consumed from the grid is offset by the electric energy generated by the renewable source.



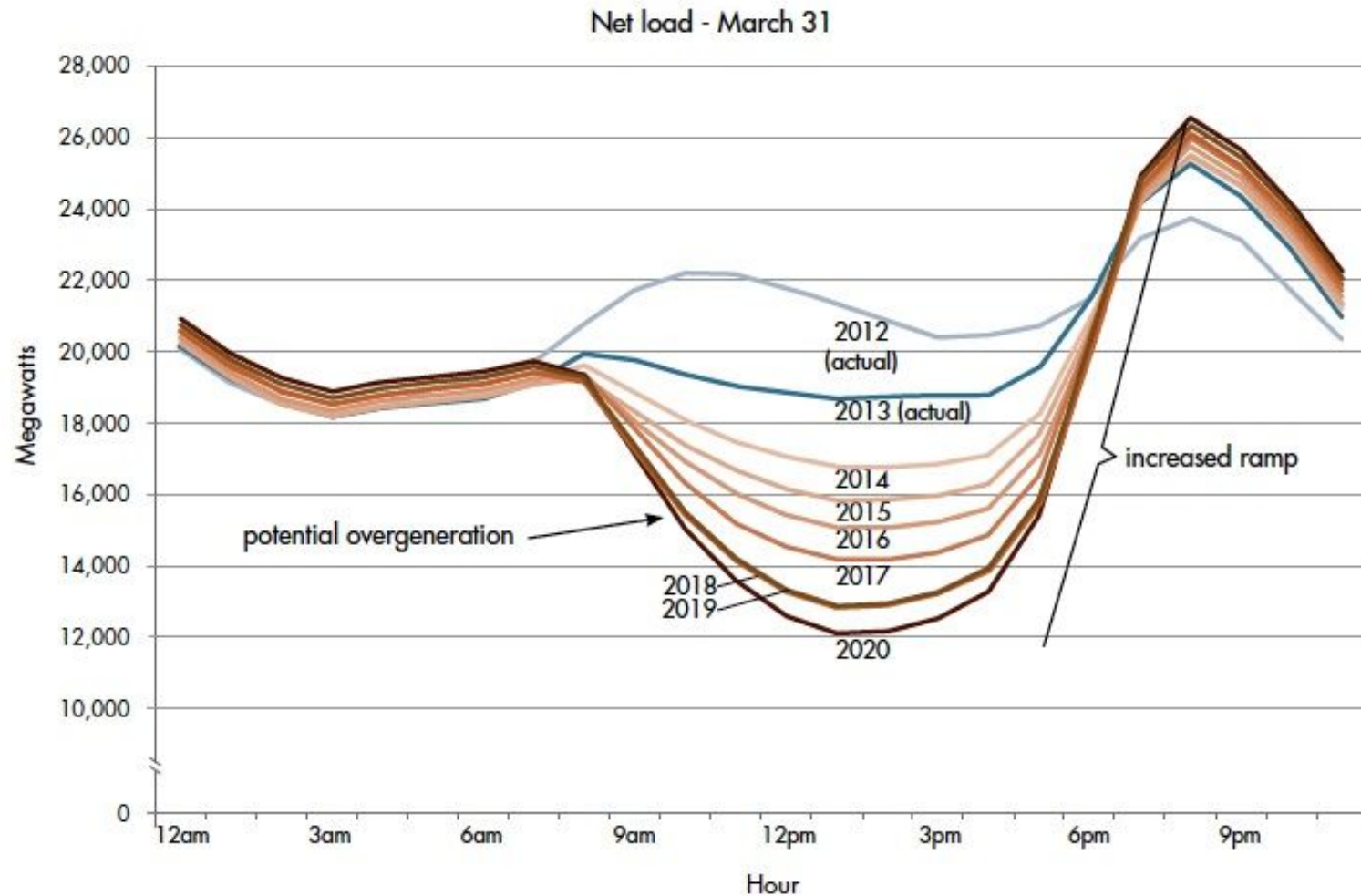


# USA: A Net Metering Country

The US PV market has traditionally been a Net Metering Market



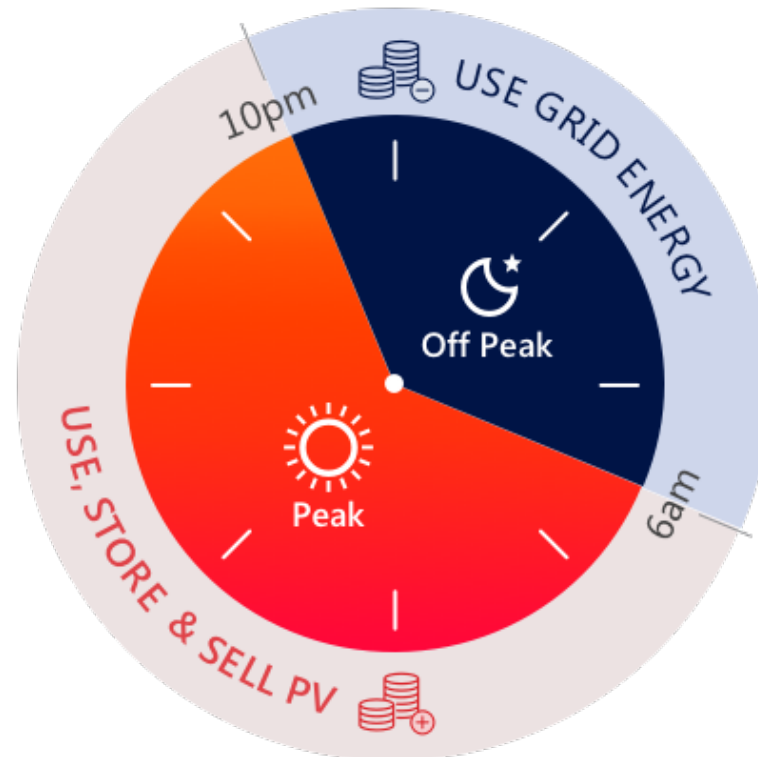
# High PV Penetration Requires Creative Solutions



# The Evolution of Incentive Structures

## Time of Use

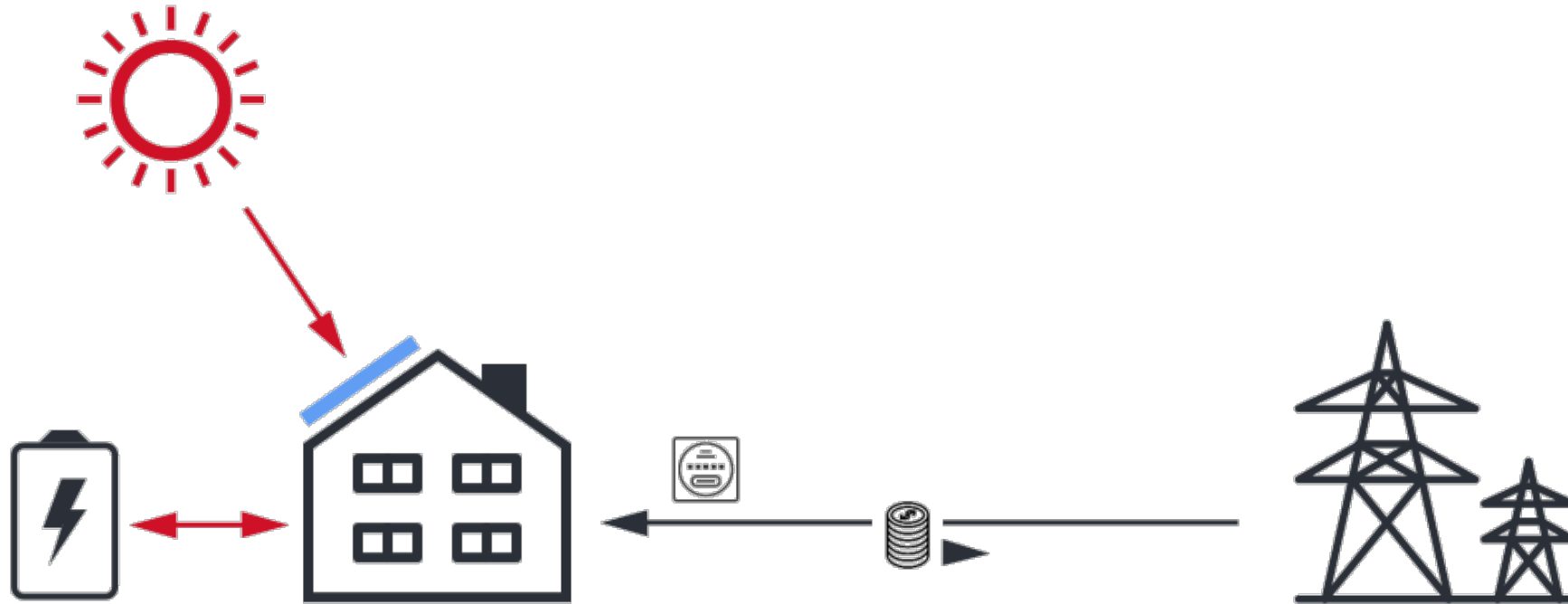
The cost of electricity varies based on the time of day and week it is used.  
Example: California



# The Evolution of Incentive Structures

## Maximized Self Consumption

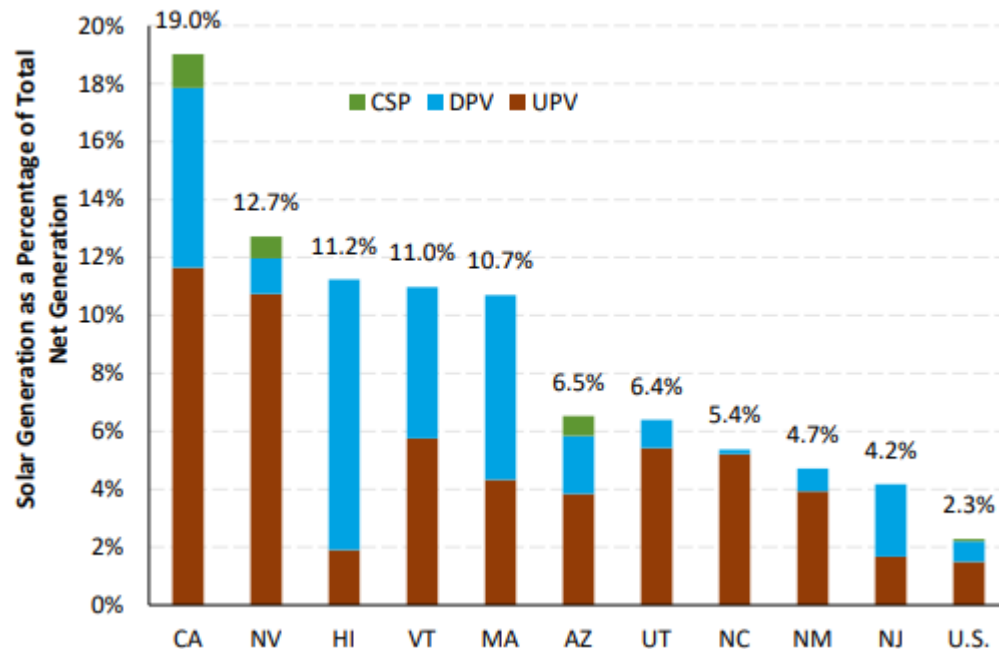
PV system owners consume self-generated solar electricity.  
Example: Germany and Australia





# Hawaii: NEM to Zero Export to Batteries

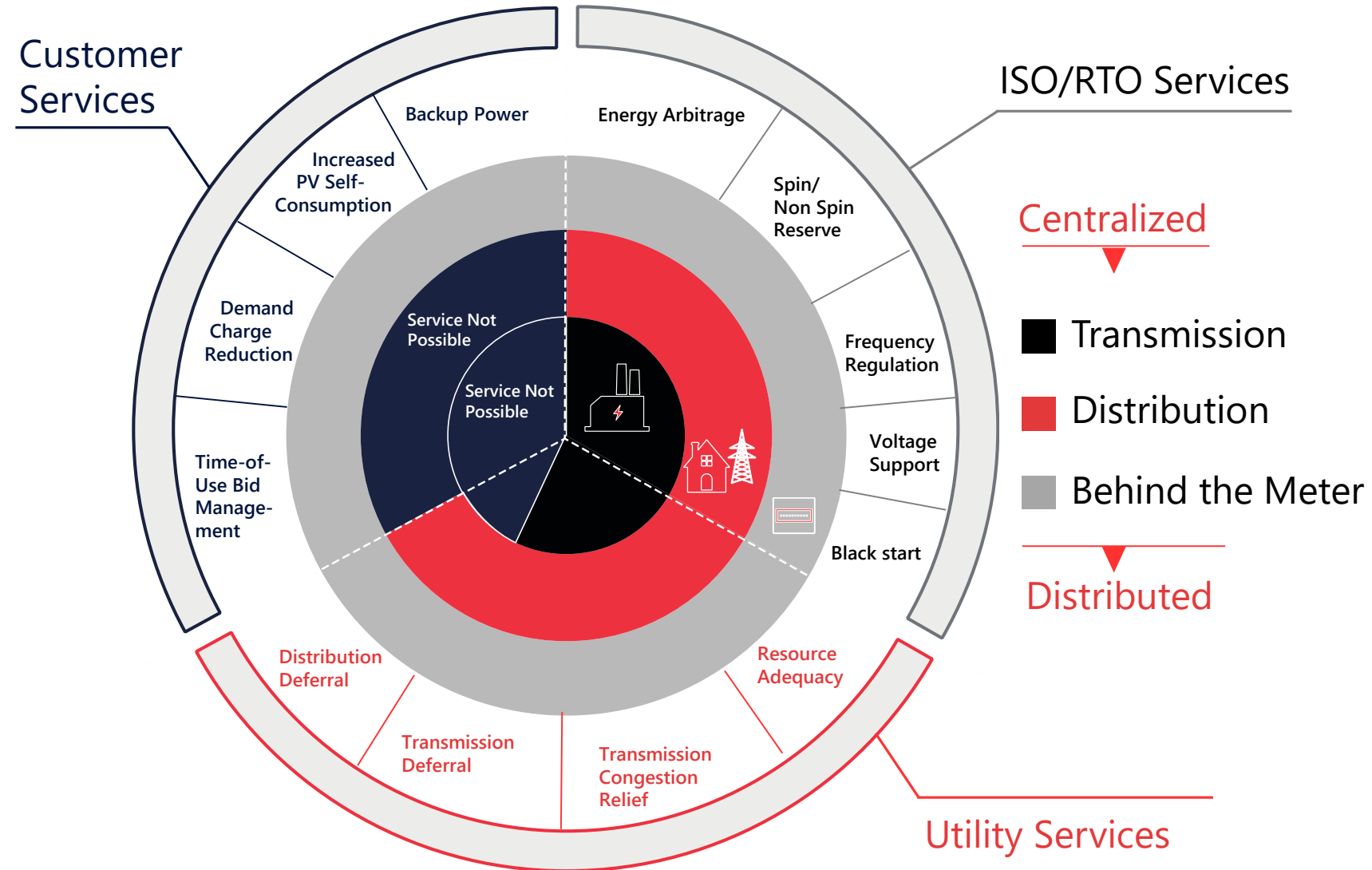
- Hawaii is the state with the highest penetration of distributed PV (~10%)
- It ran NEM between 2001 and 2015 when the program was shut down by Hawaii regulators
- As of today, PV systems without storage are NOT allowed to export to the grid at any time
- HECO allows energy export for PV + storage (under quota), with partial compensation



Island	12 a.m. to 9 a.m.	9 a.m. to 4 p.m.	4 p.m. to 12 a.m.
Oahu	14.97 cents/kWh*	No Credit	14.97 cents/kWh*
Maui	14.41 cents/kWh*	No Credit	14.41 cents/kWh*
Lanai	20.79 cents/kWh*	No Credit	20.79 cents/kWh*
Molokai	16.64 cents/kWh*	No Credit	16.64 cents/kWh*
Hawaii Island	11.00 cents/kWh*	No Credit	11.00 cents/kWh*

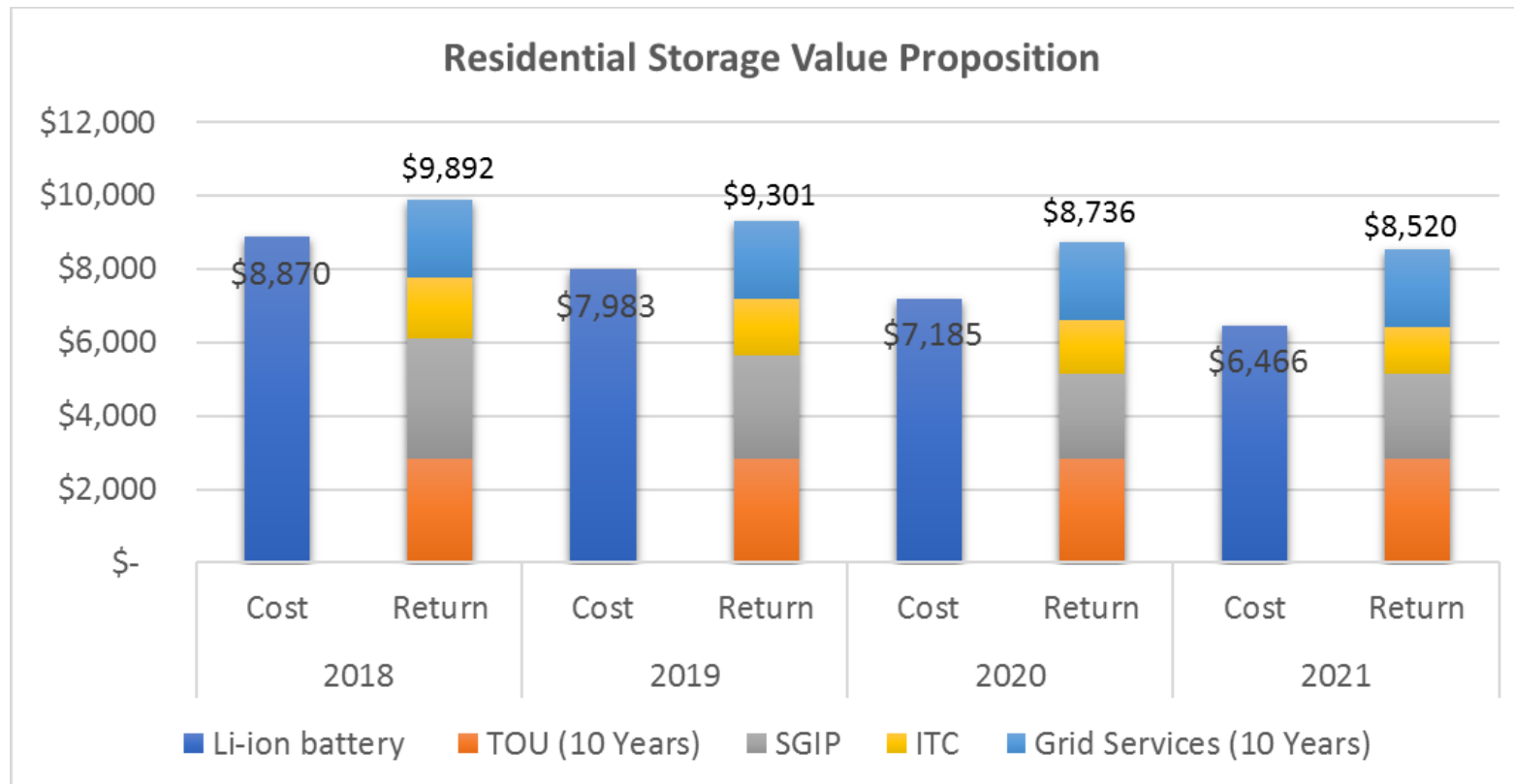
# Value Stacking

- Batteries can provide up to 13 services for 3 different stakeholders
- Examples of value stacking:
  - Demand Charges
  - Primary Control Reserve / Frequency Control Regulation
  - Virtual Power Plants



# Value Stacking with Residential Storage in CA

- Installing all new residential PV + storage systems with storage makes more economic sense
- The value of backup and minimizing exposure to rate increase turns it to the sensible action already today



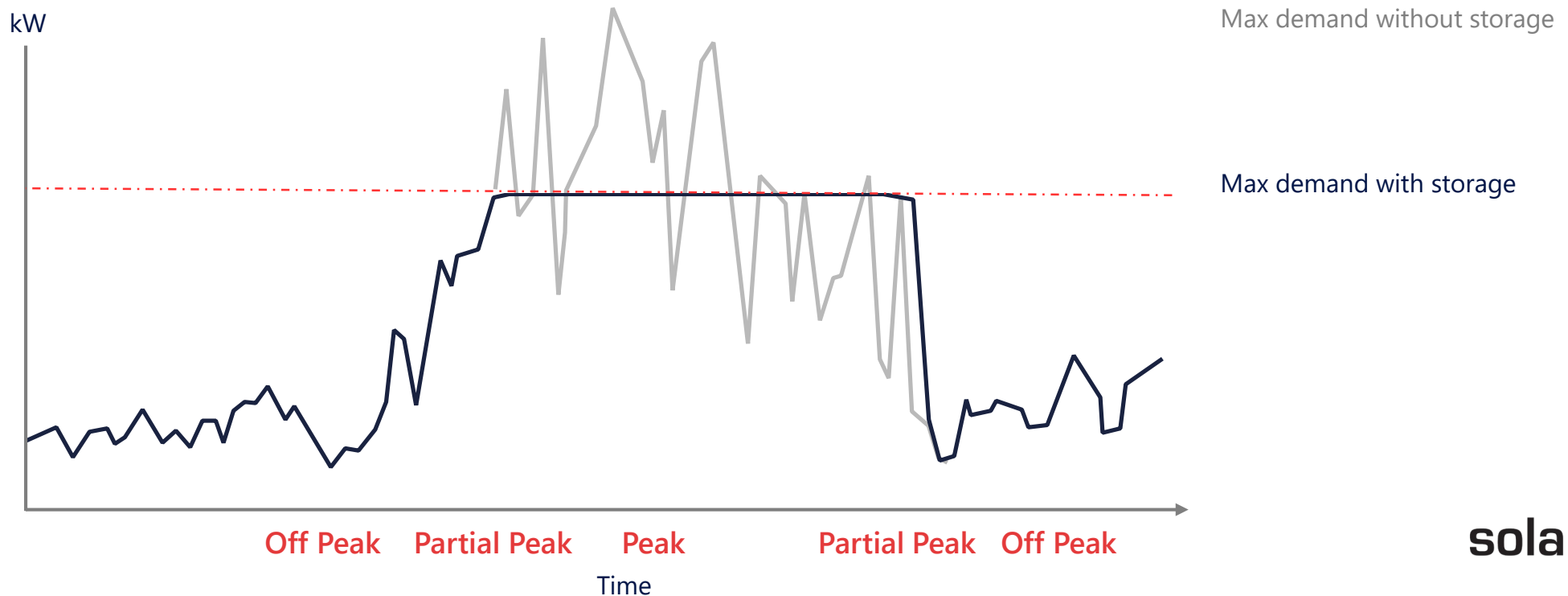
Grid Services contribution estimated at \$127/kW/year.

Total is 10 year revenue divided by 3 for conservatism

# Value Stacking

## Demand charges

Additional fees that utilities charge non-residential or commercial customers for maintaining constant supply of electricity.

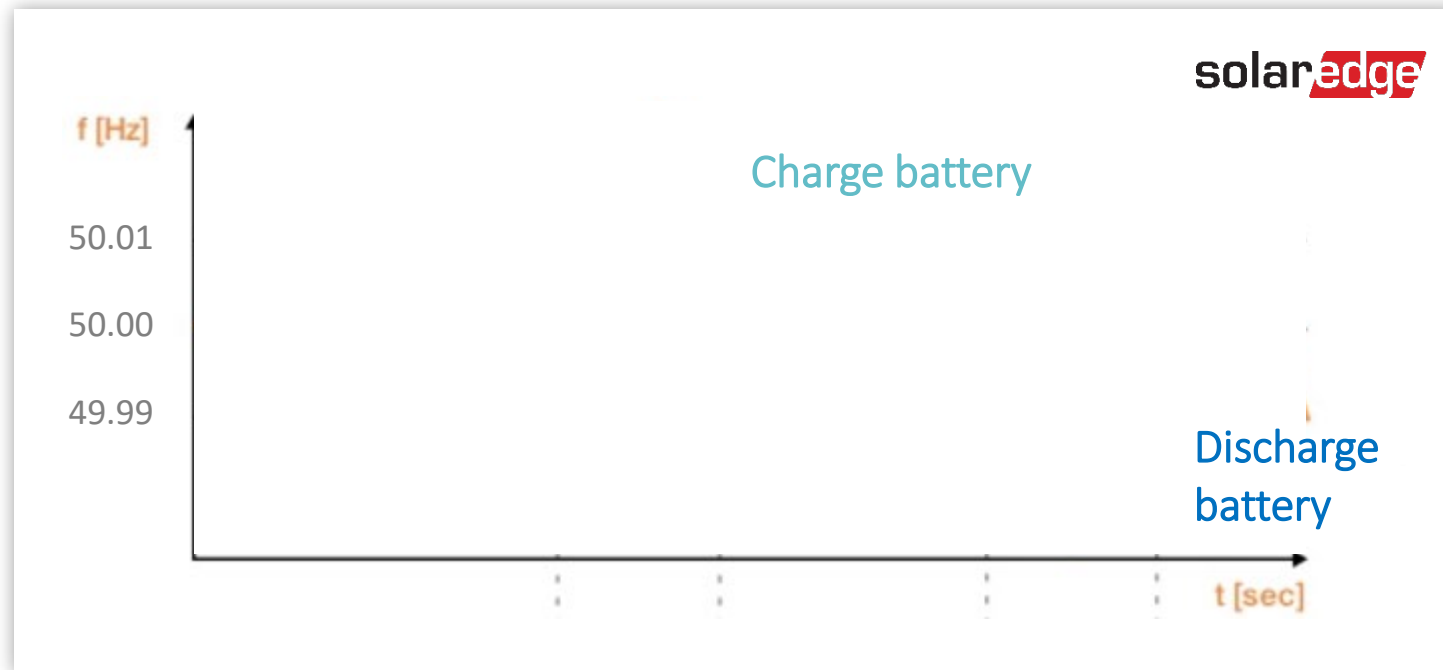




# Value Stacking

## Primary Control Reserve or Frequency Control Regulation

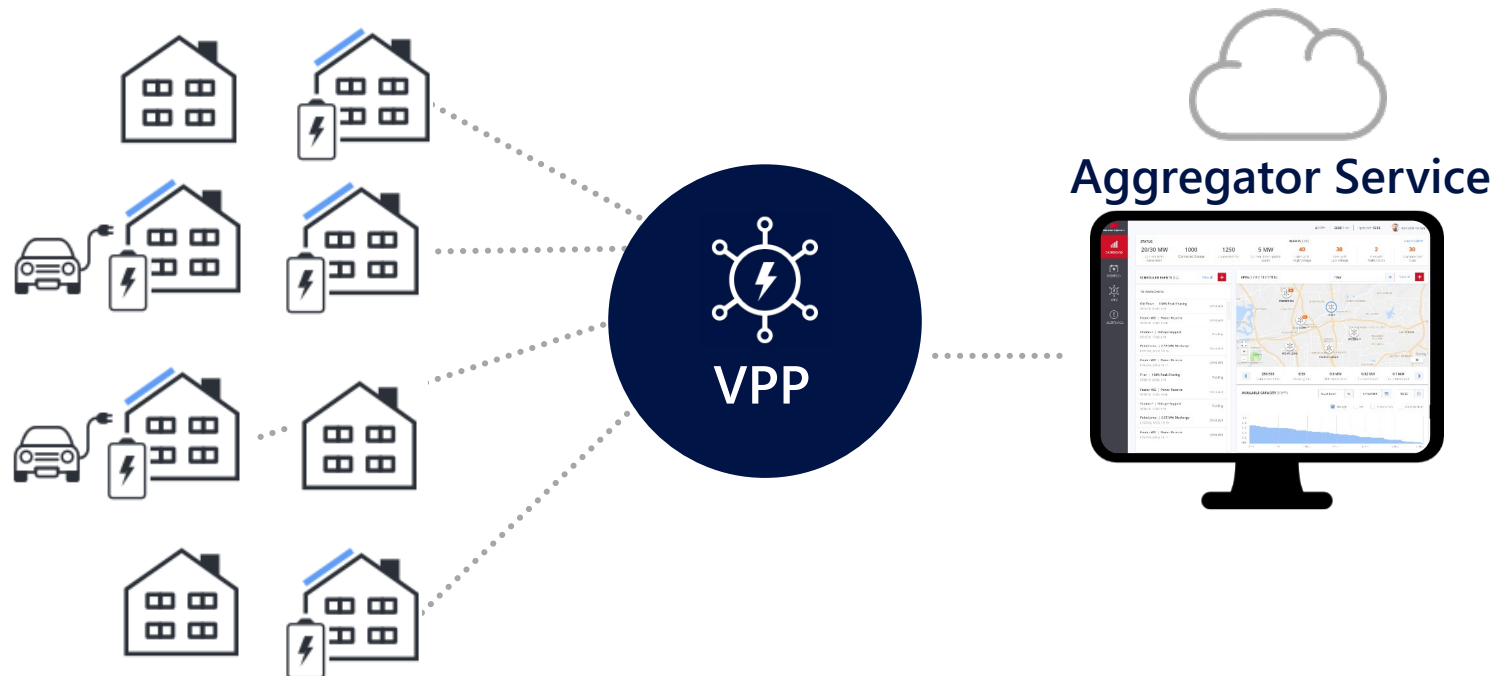
Energy source that can be quickly activated to balance grid supply and demand



# Value Stacking

## Virtual Power Plant

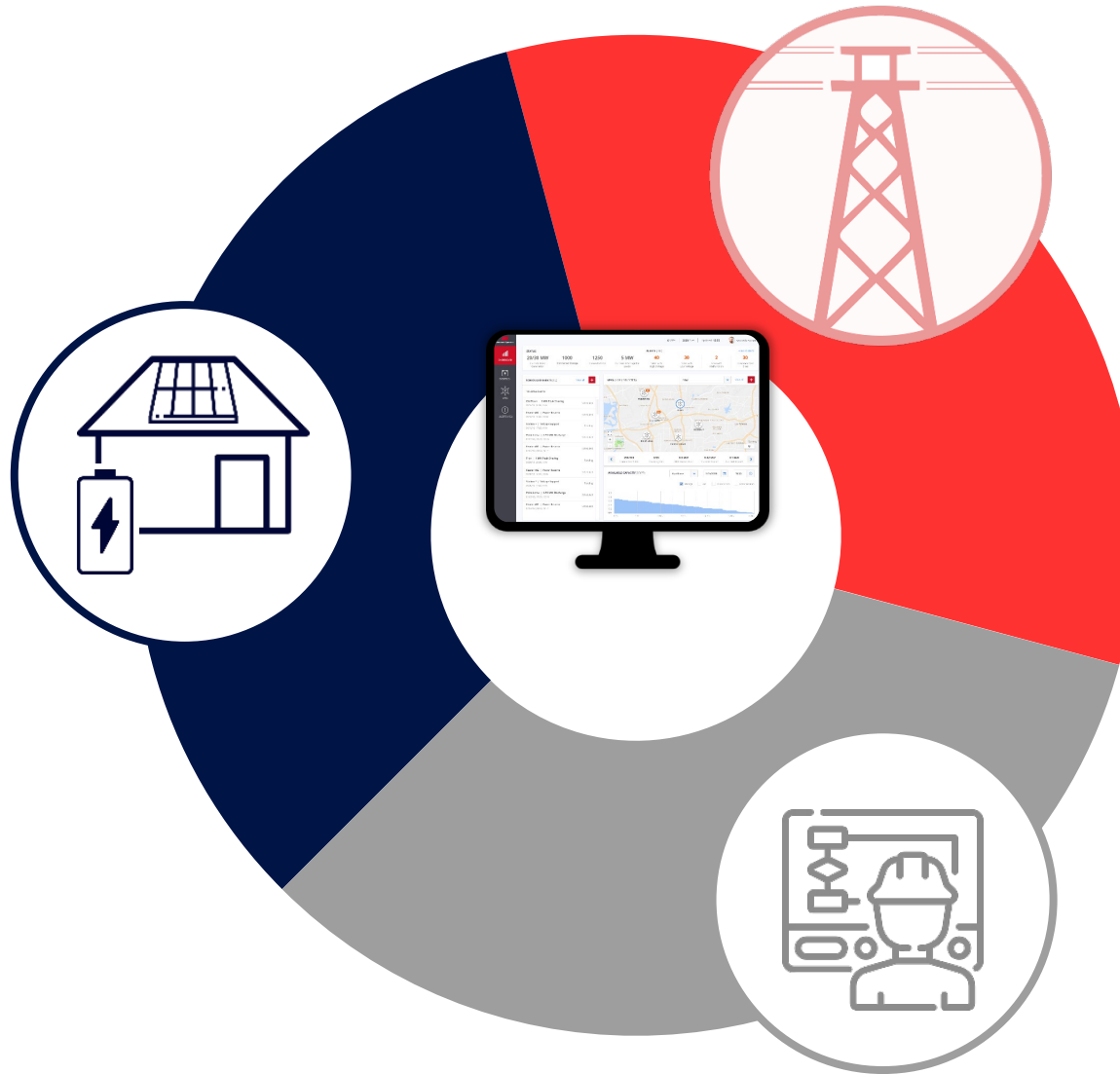
- Pooling DERs in the cloud enables to overcome local supply shortages
- Hedge against price volatility by providing access to stored energy at a capped price
- Modify generation or consumption to stabilize grid frequency and voltage



# Value for All Stakeholders

## Households

Upfront subsidy for hardware or monthly rebate for access to batteries and EV chargers



## DNOs

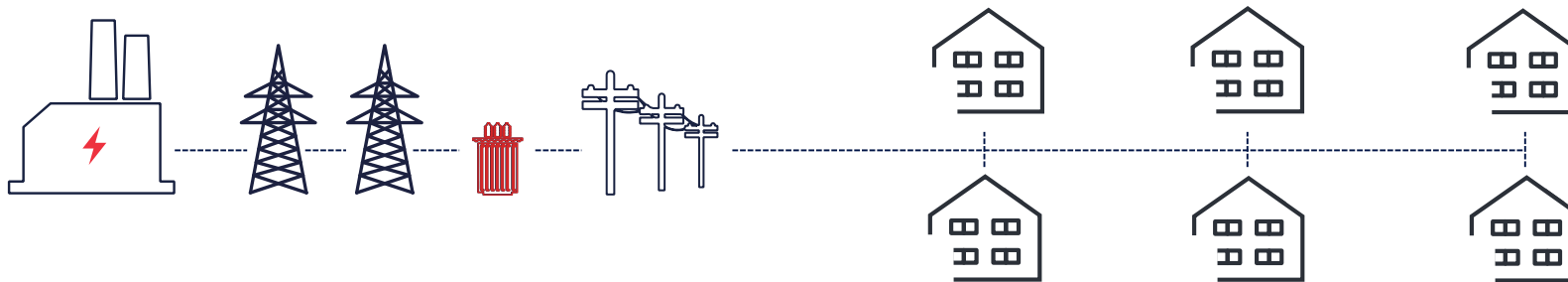
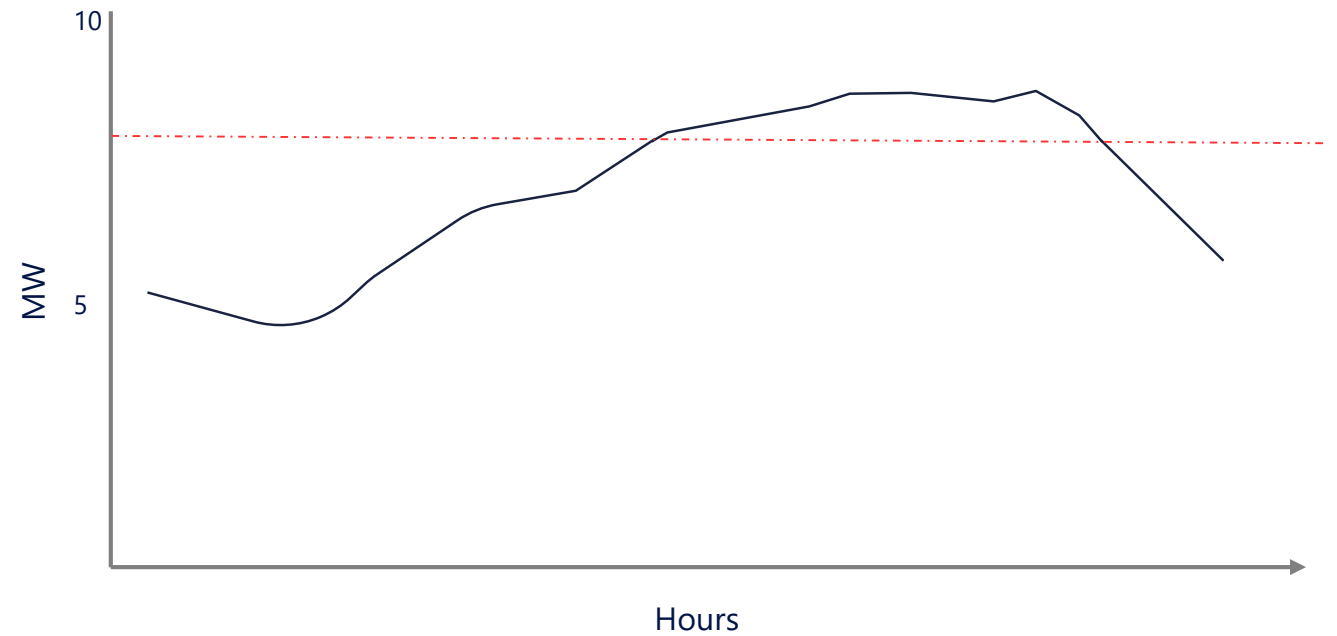
Defer costly (~€10-20M) and underutilized upgrades or additions to substations/feeders

Eliminating some costly voltage regulator equipment, saving €K/feeder

## Energy Suppliers

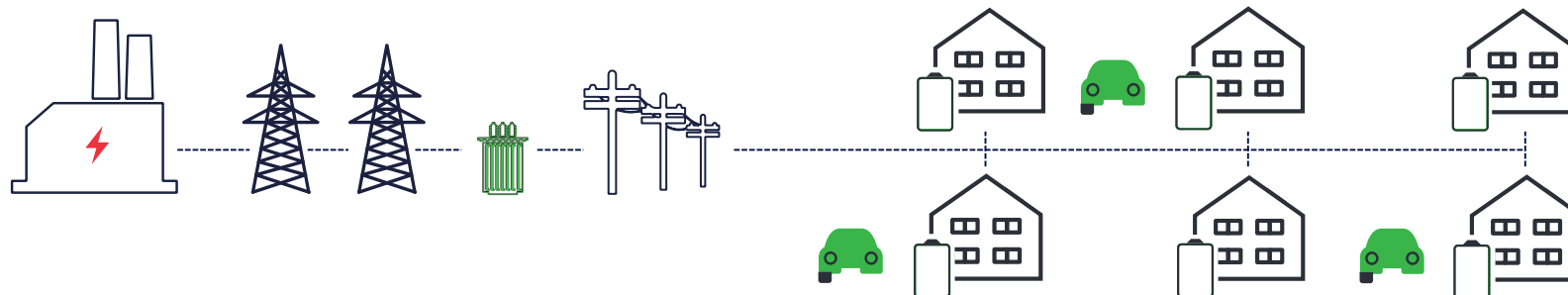
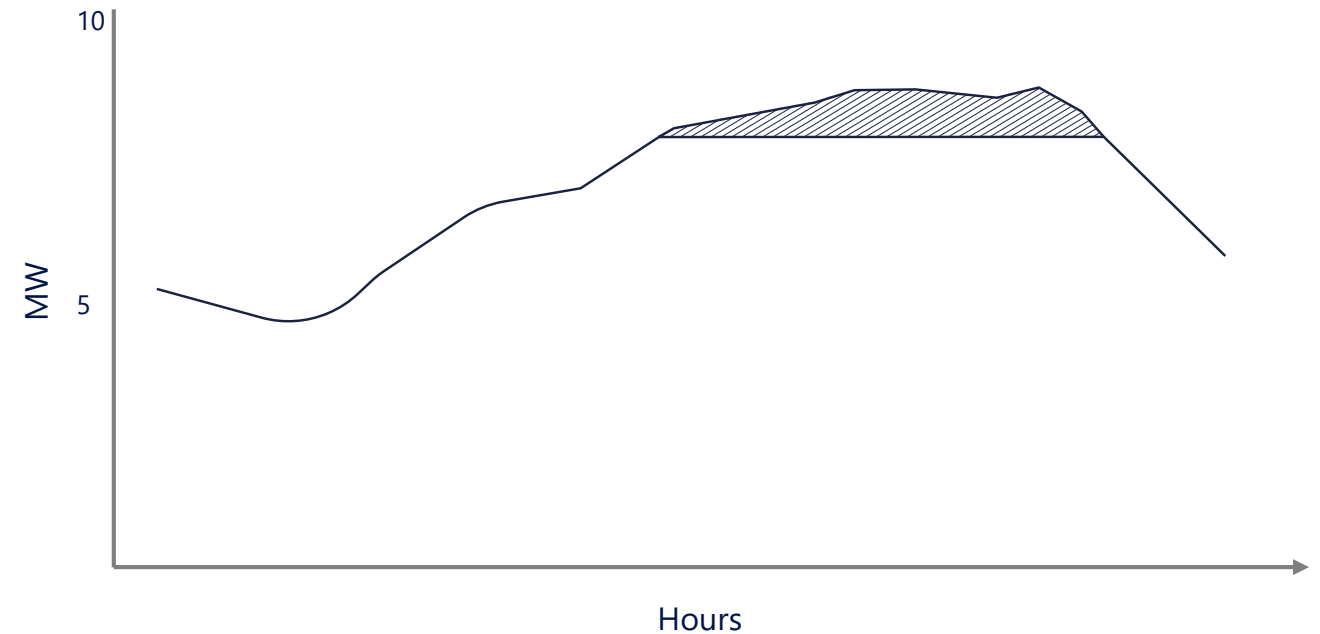
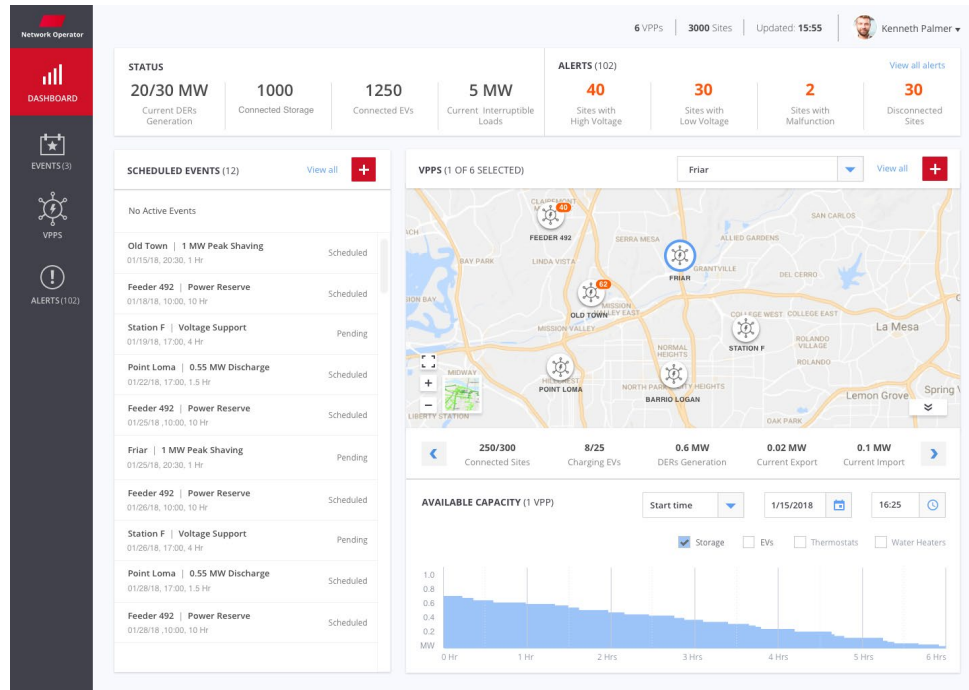
Protection from energy price peaks to save \$30-80/kW<sub>storage</sub>/year

# Scenario: Energy Supply Shortage



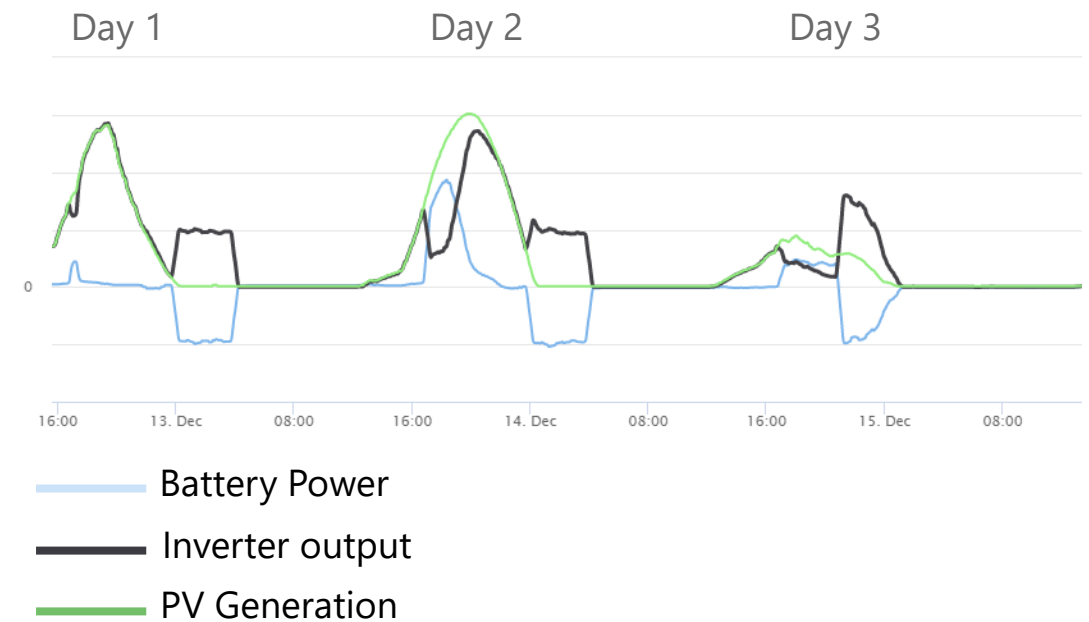


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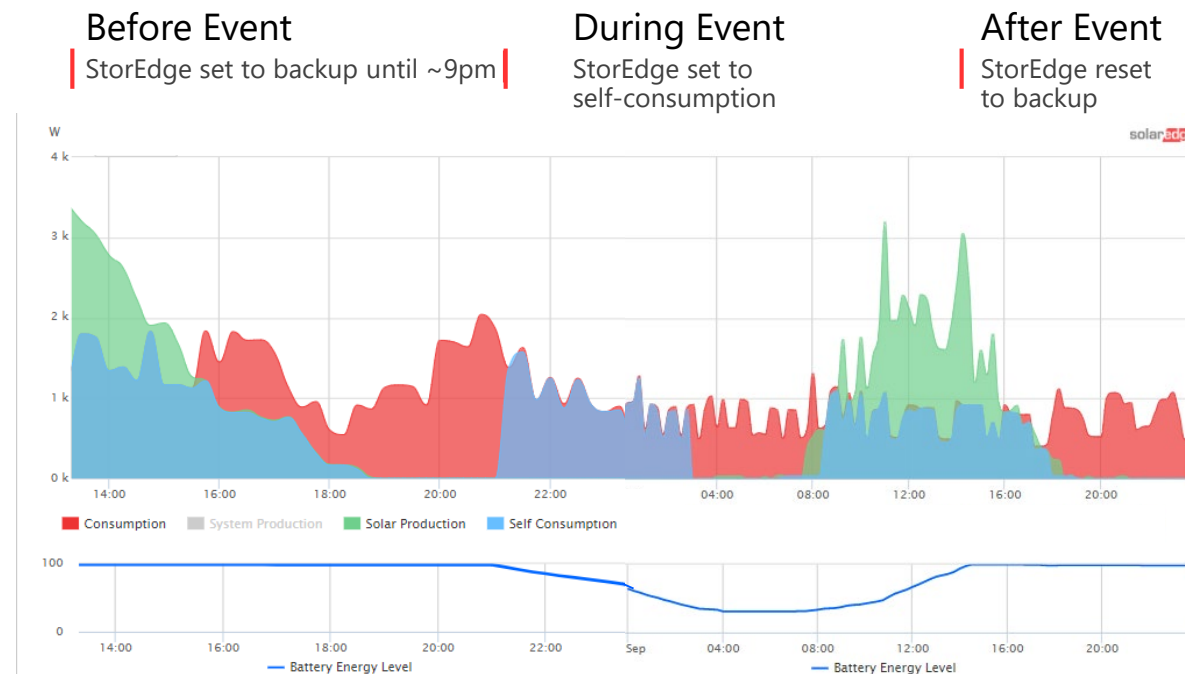
# Case Study 1: Demand Response Event

- Californian utility required load shedding for a ISO-triggered demand response event
- SolarEdge provided VPP access to a fleet of residential StorEdge systems
  - 3 events pre-scheduled a day in advance for 3 consecutive days
  - Batteries discharge at desired power and duration to provide power to the grid over 4 hours
  - Batteries only charged from PV
    - Day 3 is distinctive due to decreased PV product in addition to discharge being pre-scheduled for an earlier time
  - Batteries were allowed to feed into the grid



# Case Study 2: Demand Response Events

- Massachusetts utility required load shedding during 3 hours of peak demand
- SolarEdge provided VPP access to a fleet of pre-installed residential StorEdge systems
- During load shedding event, batteries provided site-level energy supply, with no grid export, to match site load



# The Pathway to Solar + Storage in Israel

# Regulations and Standards

## Regulations

- Allow batteries to export to the grid
- Permit metered battery charging
- Encourage network operators to create demand response management programs

## Standards

- Certify inverters as Revenue Grade Meter to minimize the metering costs of advanced use-cases
- Regulate dual-source inverters

# Thank You!

## Cautionary Note Regarding Market Data & Industry Forecasts

This power point presentation contains market data and industry forecasts from certain third-party sources. This information is based on industry surveys and the preparer's expertise in the industry and there can be no assurance that any such market data is accurate or that any such industry forecasts will be achieved. Although we have not independently verified the accuracy of such market data and industry forecasts, we believe that the market data is reliable and that the industry forecasts are reasonable.

Version #: V.1.0

