How Smart Buildings Can Help Build a Greener Grid

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CalPLUGWorkshop
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Highlights

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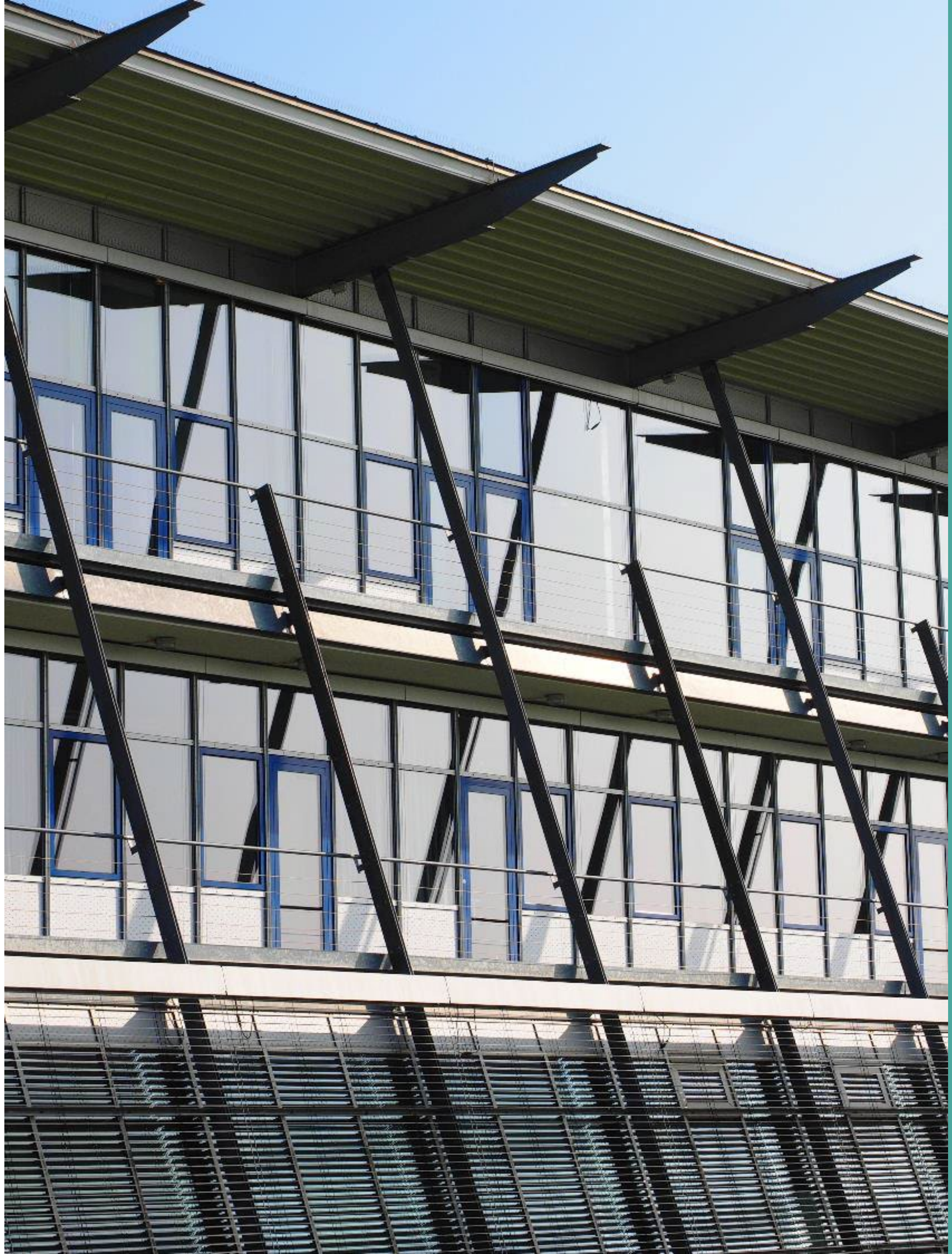
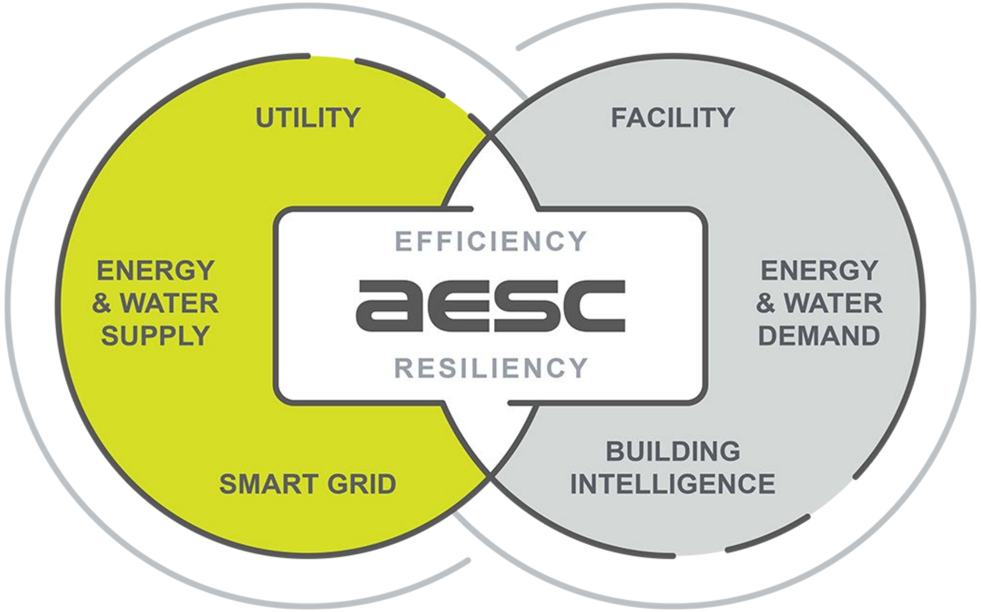


Founded in 1994, AESC has been serving utility, C&I and government clients for 29 years with offices in Carlsbad, Pasadena, Fresno, Oakland, Portland, OR and Charlotte, NC.



Today's complex energy ecosystems require more than just technology to succeed. It takes consumers, utilities and regulators working together. That's what we focus on.

Ronald K. Ishii, P.E.

AESC Founder

What We Do

30+
Supported/Administered Utility EE Programs

120+
Energy and Water Audits Performed Annually

2,500+
Engineering Calculation Reviews Annually

Engineering

- Energy Efficiency
- Energy and Water Audits
- Retrocommissioning (RCx) Services
- Measurement & Verification (M&V)
- Water/Wastewater Optimization
- DER Grid Integration

Technologies

- Emerging Technology Studies
- Renewable Technologies
- Grid Intelligence
- Electric Vehicle Infrastructure
- Electrification / Decarbonization
- Virtual Power Plants

Programs

- Program Design and Implementation
- Self Generation Incentive Program (SGIP)
- State of CA Energy Strategy and Support
- PG&E Wastewater Optimization Program
- Strategic Energy Management (SEM)
- CA Emerging Technologies Program
- Energy Resiliency Program Support

Software

- Custom Software Development
- Energy Project Management Platform (*Praxis)*
- Utility Application Processing Platforms
- Online Audits and Customer Engagement

Who We Work With

Investor - Owned Utilities

- Arizona Public Service
- DC Sustainable Energy Utility
- Duke Energy (all territories)
- Energy Trust of Oregon
- Pacific Gas and Electric Company
- San Diego Gas and Electric
- Southern California Edison
- Southern California Gas Company

Federal, State And Local Government

- State of California Departments
- California Energy Commission
- City of Carlsbad
- City of Los Angeles
- City of San Diego
- County of San Diego
- City of Seattle
- Department of Energy
- UC San Diego

Munis & CCAs

- LA Dept. of Water and Power
- Pasadena Water and Power
- Moreno Valley Utility
- Orlando Utilities Commission
- Redding Electric Utility
- Silicon Valley Power
- Silicon Valley Clean Energy CCA
- So. Cal Public Power Authority

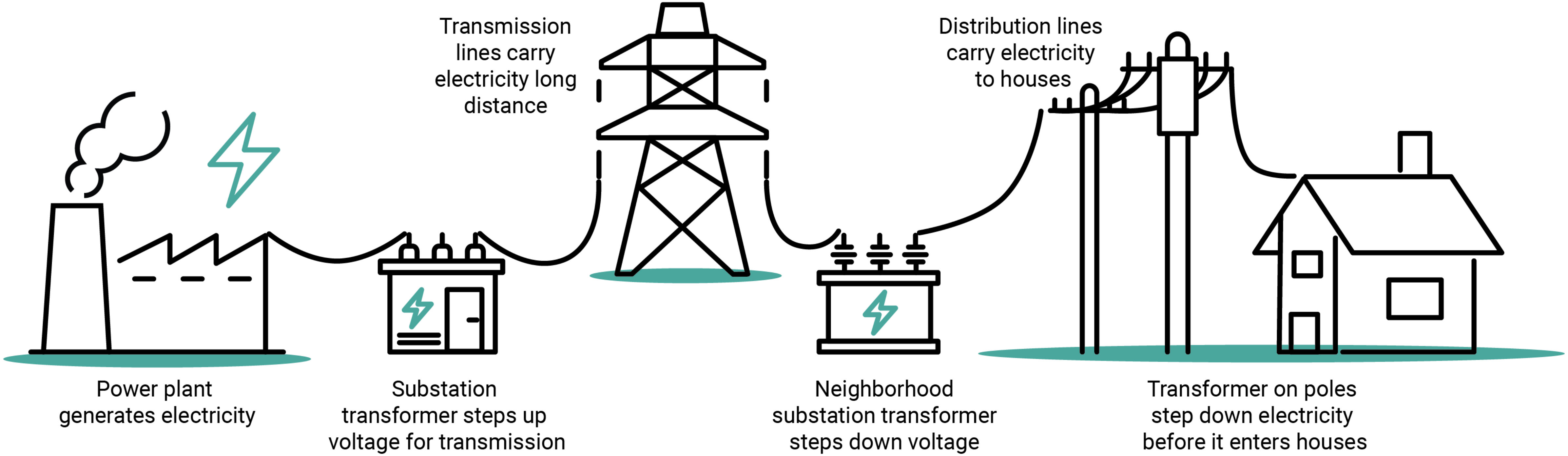
Private Sector

- Center for Sustainable Energy
- Willdan
- Envise/ Southland Industries
- BKM Capital Partners
- TRC Environmental
- Energy Solutions
- Vermont Energy Investment Corporation
- Dr. Bronner’s

How Smart Buildings Can Help Build a Greener Grid

Understanding the Grid

The old power model



Old Energy Efficiency Model

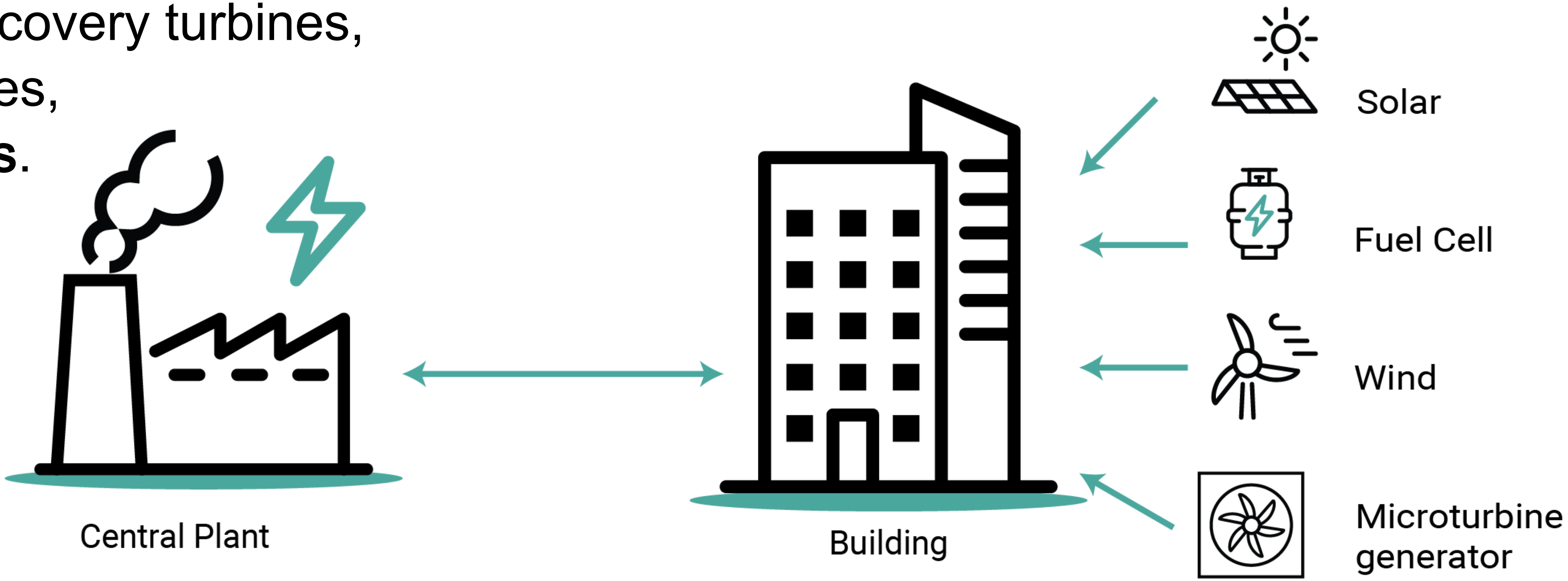
Everything counts: a kWh saved is a kWh saved

No concept of time (mostly): power plants were ramping up and down accordingly to the grid demand

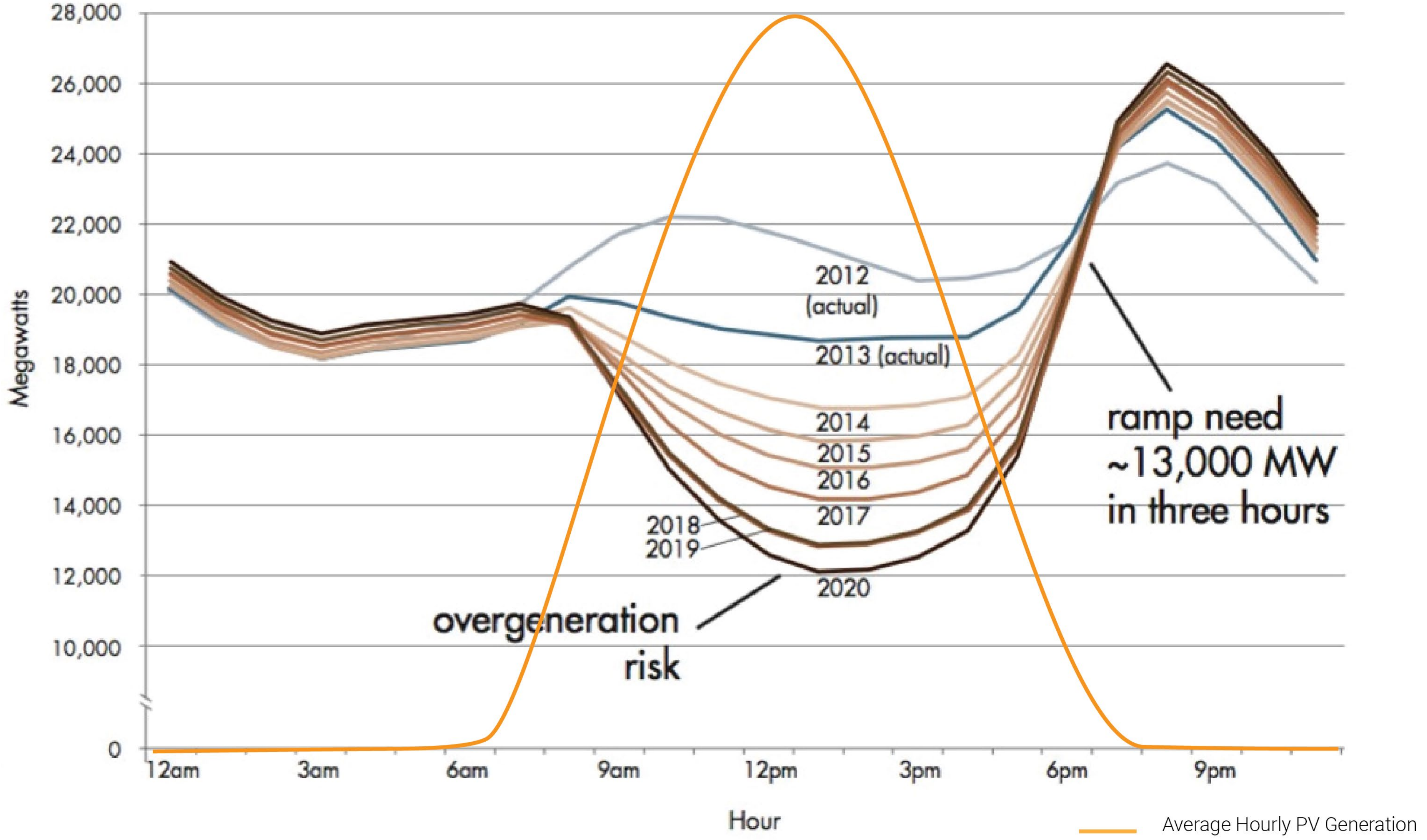
The Arrival of Distributed Energy Resources (DER) and the New Power Model

Small installations start to appear:

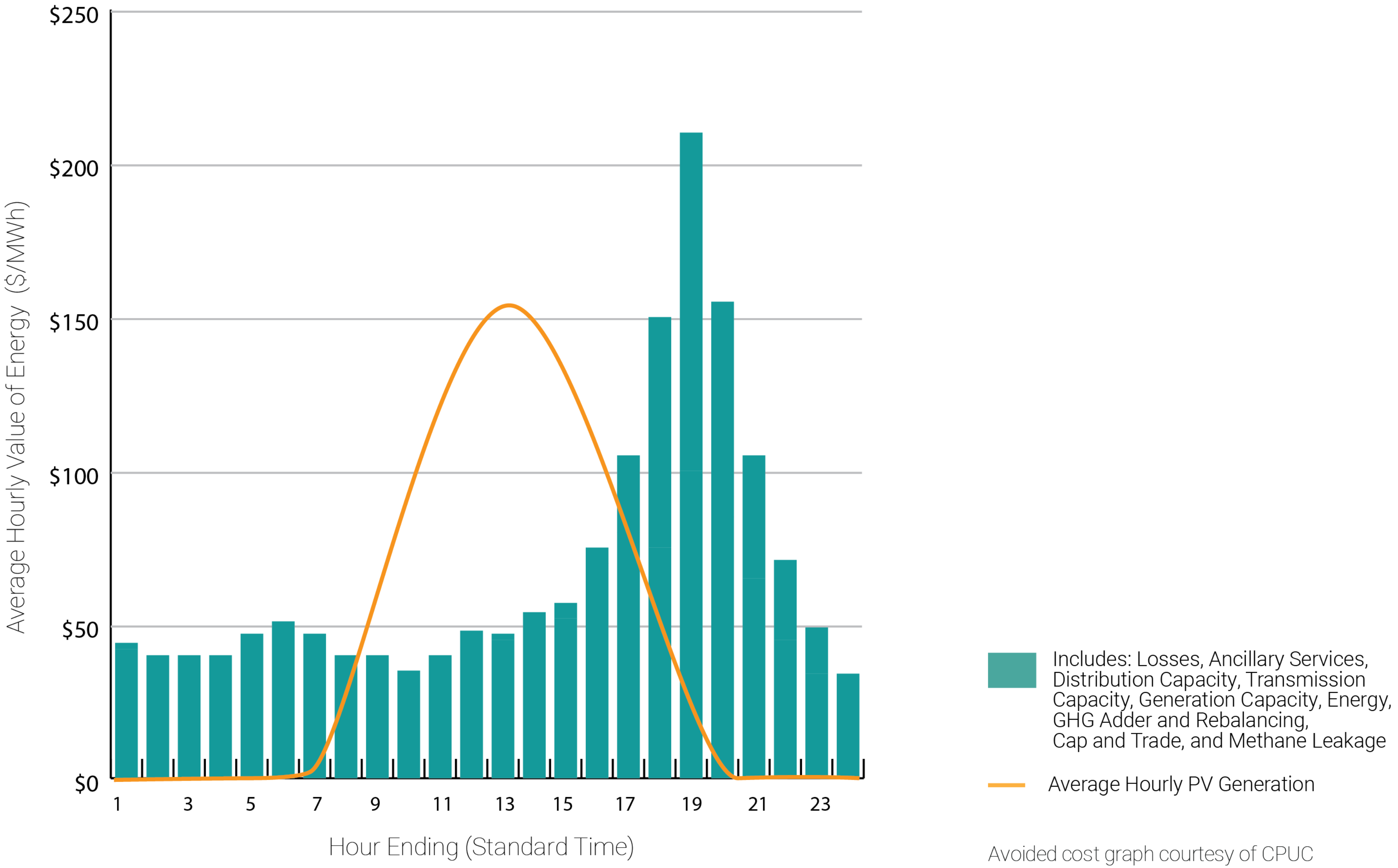
- Internal combustion engines (with or without heat recovery),
- Fuel cells,
- Pressure recovery turbines,
- Wind turbines,
- **Solar panels**.



The Duck Curve



Energy Efficiency in the Solar Era



Avoided cost graph courtesy of CPUC

How Smart Buildings Can Help Build a Greener Grid

By being flexible about when they use energy:

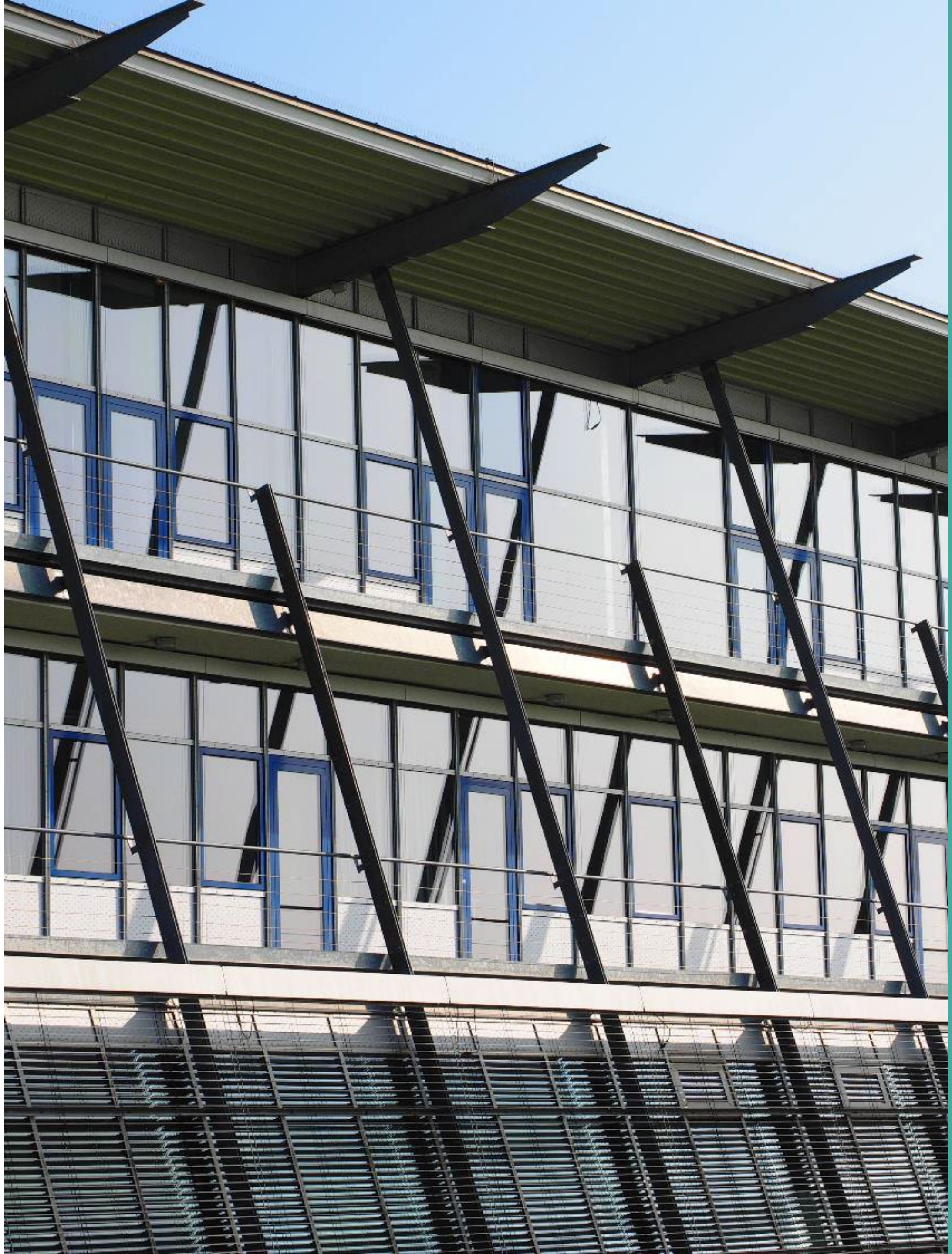
- Schedules (from mechanical clocks to digital timers),
- Energy Management systems,
- Occupancy sensing,
- Flexing consumption,
- Energy storage,
- Electric vehicles batteries,
- Responding to signal (ADR),
- Adapting to transacting energy.

Programmable Thermostats

They need to be programmed!

Example
Office operating hours from 8 am to 6 pm

Thermostat schedule should be:
7 am – 8 am: 70F – 74F,
8 am – 4 pm: 70F – 76F,
4 pm – 6 pm: 60F – 80F,
6 pm – 7 am: 62F – 85F.



Smart Thermostats

Marginally better than programmed thermostats if operate correctly, otherwise can be much worse:

Occupants should not have access to thermostat settings

Occupancy based Thermostats

Widely used in the hospitality industry, they have not been adopted in the commercial office type environment.

Emerging technology studies showed up to **12% energy savings** most of which happen in the shoulder hours!

Demand Control Ventilation

Most HVAC system built in the last 15 years have a connection port to a CO2 sensor to adjust the economizer for the appropriate percentage of outside air, most units do not have such sensor connected.

Plug Load Management

Plug load management is evolving from the “simple plug load appliances” (studied in 2015 in a collaboration with CalPlug) to expand into other loads that can go beyond the on-off status.

Communication protocols still represent the biggest barrier.

Manufacturers do not want --or let--other people control their devices.

Those plug loads in most cases are small.


TIER 2 ADVANCED POWER STRIPS IN RESIDENTIAL AND COMMERCIAL APPLICATIONS

San Diego Gas & Electric
Emerging Technologies Program
Technology Assessment Report
Project IDs ET14SDG8021 & ET14SDG8031

Prepared for:
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April 2015

Advanced Controls

Software that can talk with several different devices (mostly HVAC) to have a higher impact.

Case Study

Advancing Software-enabled Load Flexibility and Demand Response in Commercial Buildings

Outcomes

16%

Reduction of HVAC energy demand and related charges

14%

Demand reduction during demand response (load shed) event

51 kW

(28%) - Demand reduction (load shift) during morning peak

23 kW

(13%) - Demand reduction (load shift) during evening peak

Overview

Southern California Edison asked AESC to investigate a novel building control software for commercial demand flex and response – furthering California's resource adequacy, future load management initiatives, and load shed & shift strategies. As emerging technology consultants, we provided pilot implementation support and Measurement and Verification (M&V) for the project.

What We Did

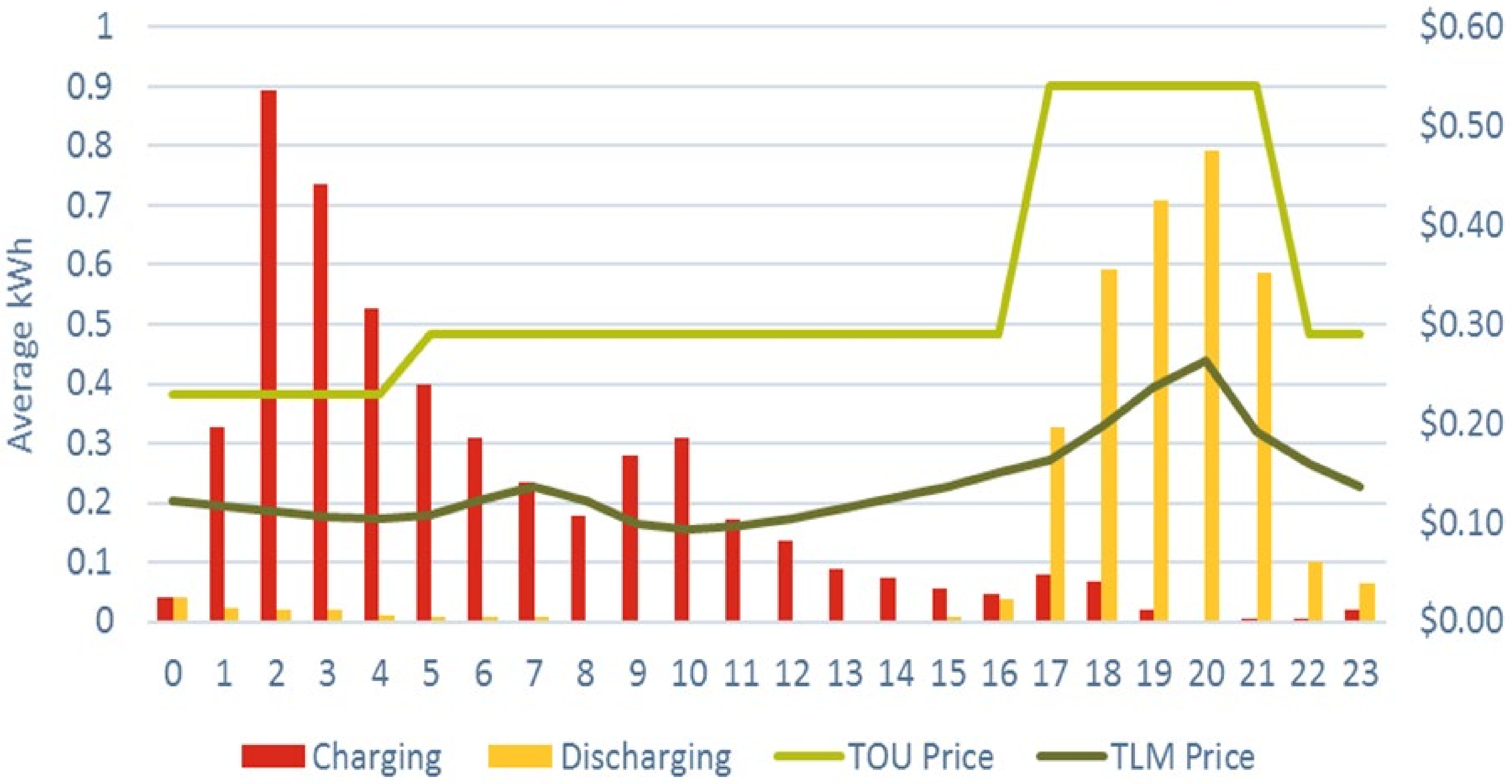
- Normalized Metered Energy Consumption (NMEC)
- Daily Peak Hour Demand Analysis
- Load Shift
- Load Shed
- Reduced HVAC Demand

Electric Vehicles

- Massive load: potentially as big as the rest of the facility
- The charge can be delayed to a point
- Next step vehicle to building: bidirectional (not only about charging but also discharging)
- Then vehicle to grid
- Communication standard IEEE2030.5 to bring all vehicle to the same common communication protocol

Batteries

Within a few parameters: speed of charge and discharge and limit on the lower charging level (20%), batteries can really help smooth the ride.



Putting it all together

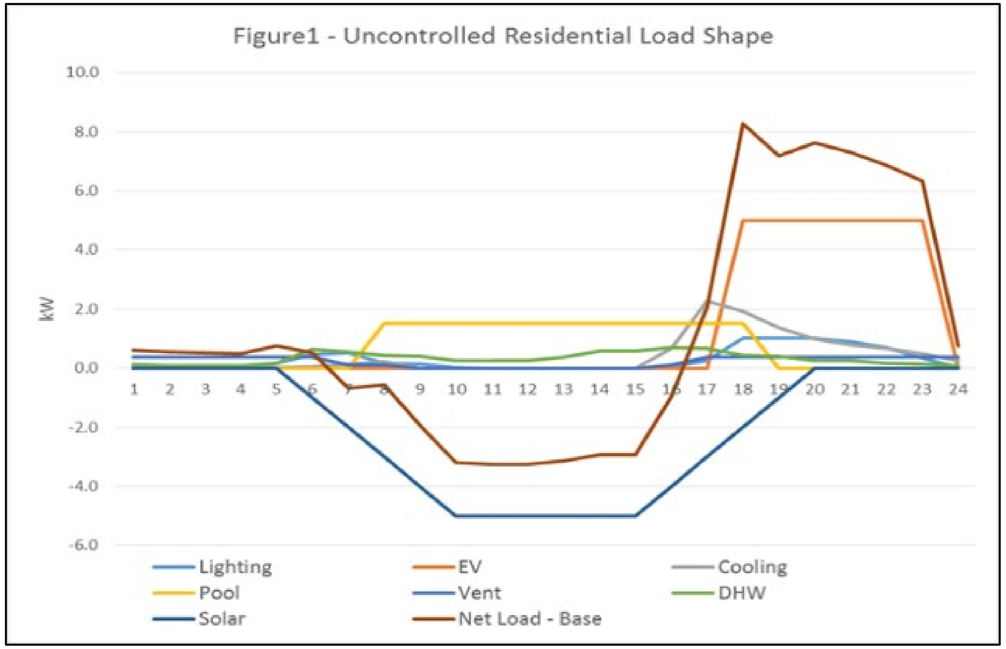
A controlled building can help the grid:

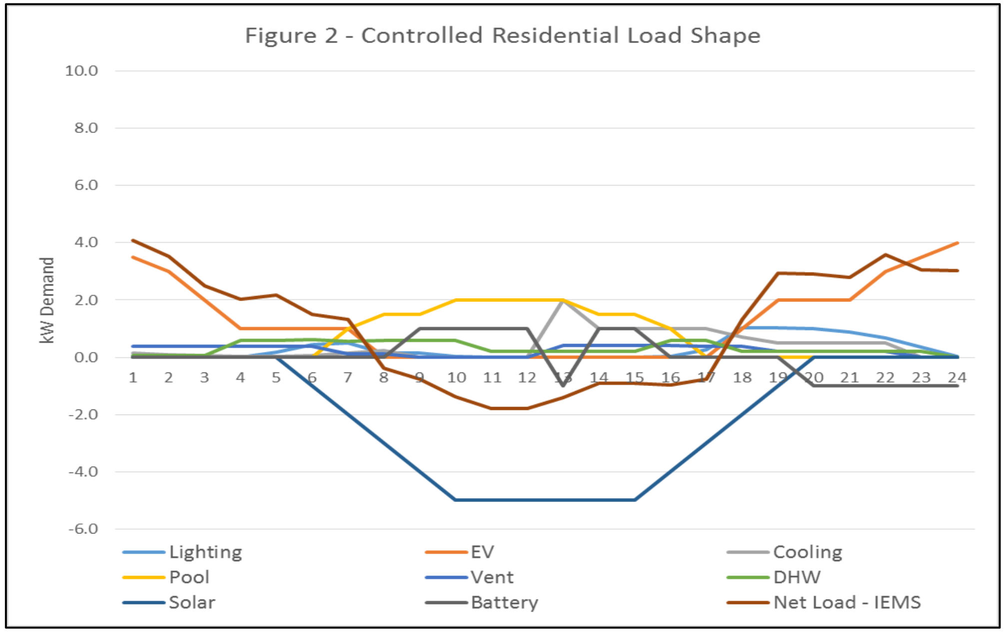
- Limiting overgeneration in the “solar hours”
- Eliminating the most problematic part of the duck curve: the neck
- Aligning the building consumption with the building TOU costs

Report Summary - CEC-500-2020-057

Smart Home Study

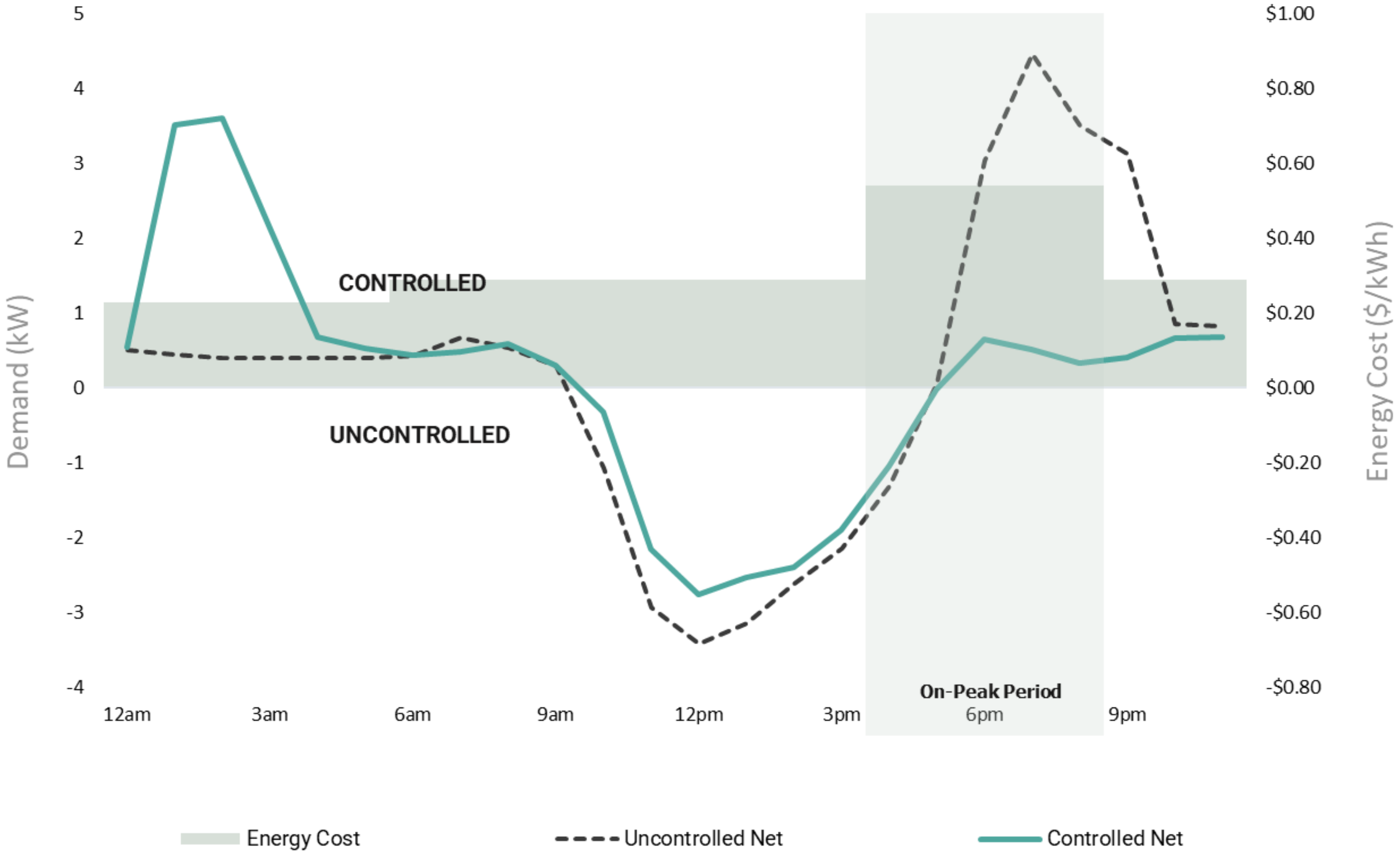
Understanding how connected homes can serve the smart grid





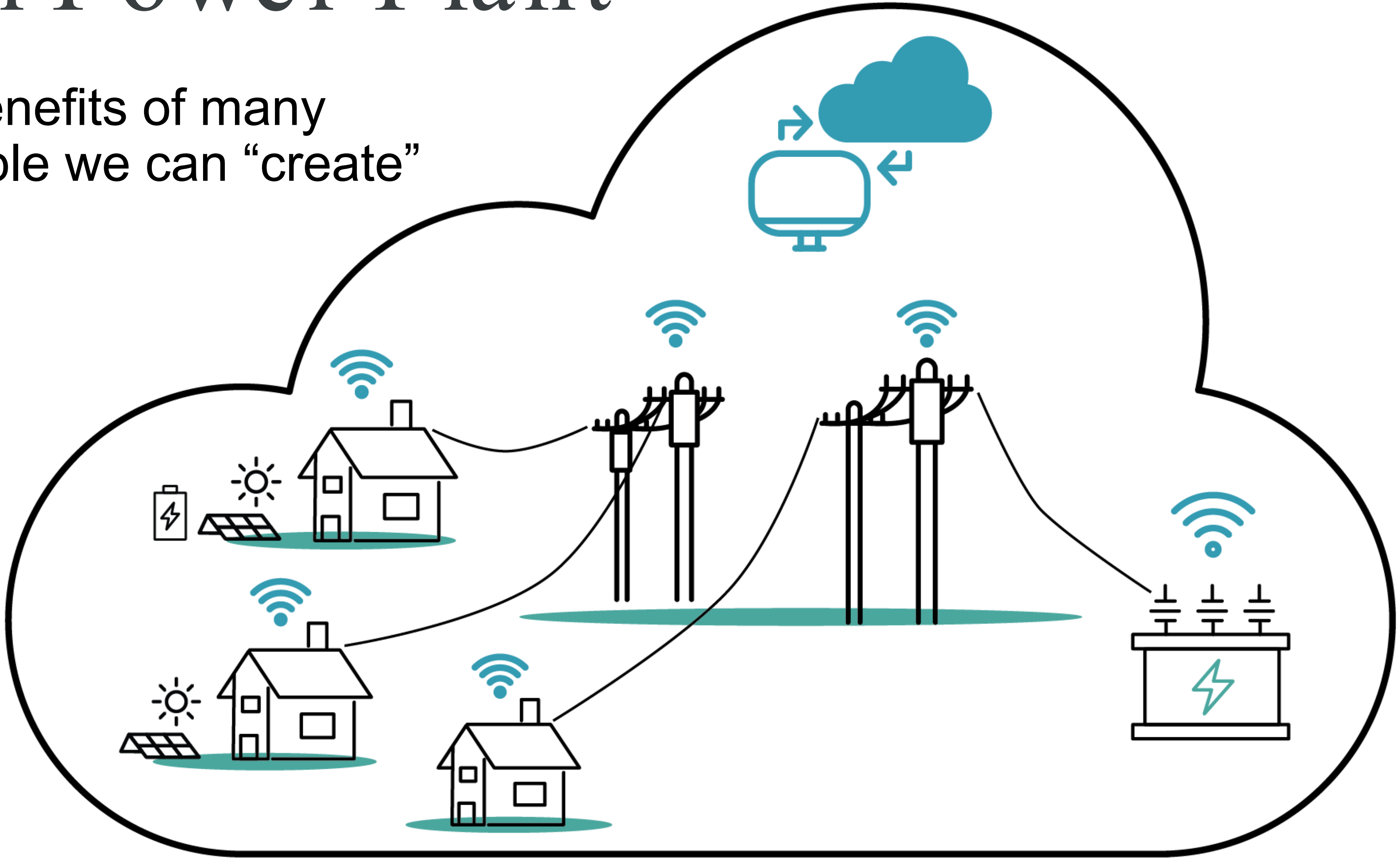
Another way to look at it

A controlled building can help the grid:



From one building to many: the Virtual Power Plant

By combining the benefits of many buildings, it is possible we can “create” virtual power plants.



Adapted from SDG&E graphic

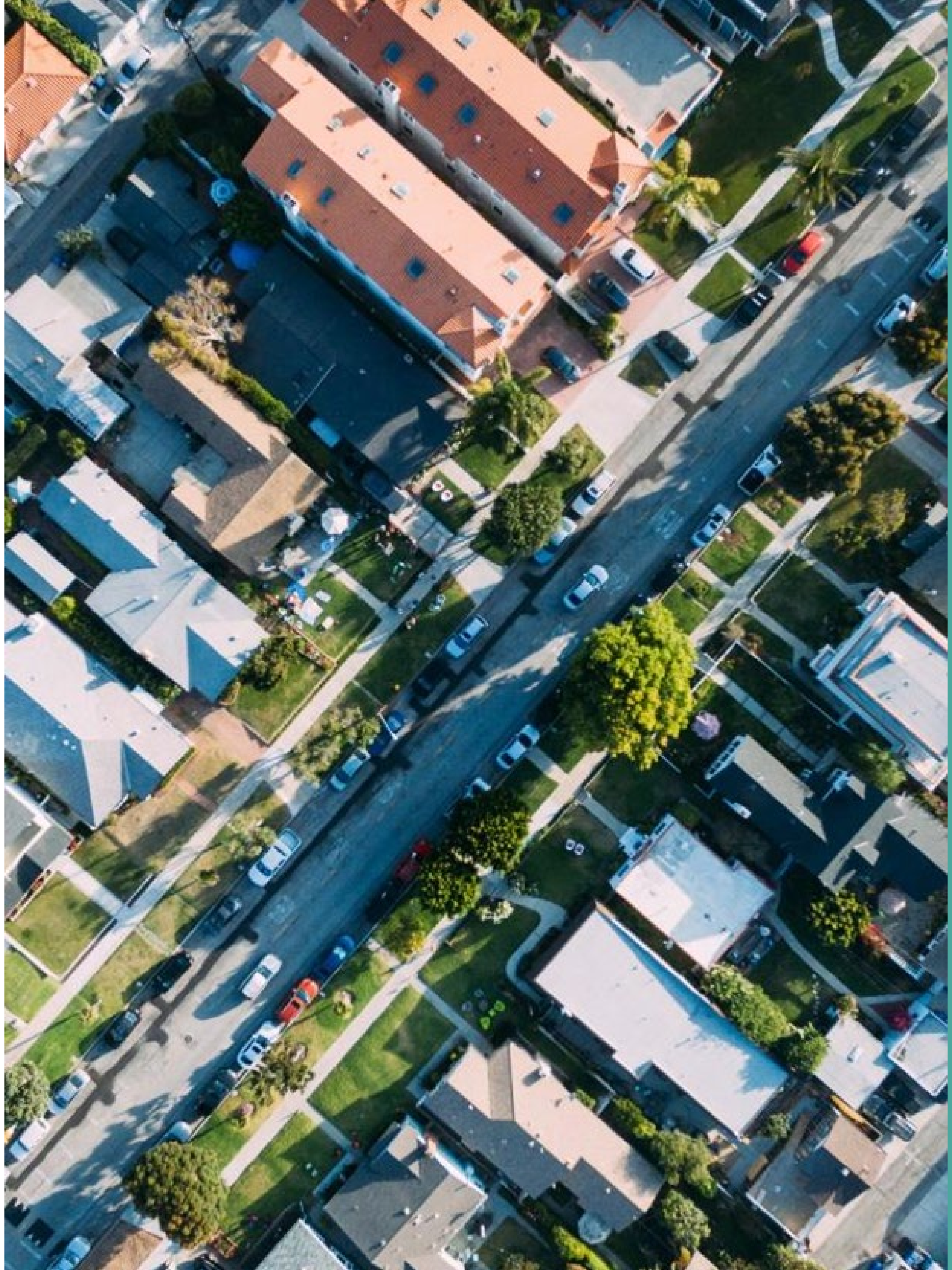
Conclusion

The Concept works

- Smart building can have intelligently controlled devices
- Managed and shifted load to optimize for costs or GHG
- Demonstrated Smart EV Charging
- Successful dynamic tariff deployment
- Successful device manufacturer partnerships
- Relationship supported strategic thinking and joint pursuit of goals

For future consideration

- Communication protocols (interoperability)
- Original Design Components
- Storage optimization
- Different devices, regions, constraints
- Scaling
- Transactive real-time pricing energy complexities



Thank you!

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