Zero Net Energy,
Flexible Loads

and

The Biggest Machine in the World

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Carbon Smart Buildings
Our mission:

*To safely and reliably deliver clean energy to our customers and communities every single day while building the energy network of tomorrow*

- Service area population of ~16,000,000
- ~110,000 miles of distribution grid
- ~1,000,000 distribution transformers
A Little Review . . . Why “Zero Net Energy”?

**AB 32:** “The Global Warming Solutions Act” . . . 2006

*Chief requirement AB 32—GHG emissions 20% below 1990 levels by 2020*

**SB 32:** An extension and expansion of the AB 32 legislation, 2016

*Chief requirement SB 32: GHG emissions 40% below 1990 levels by 2030*

**Long term goal:**

*GHG emissions 80% below 1990 levels by 2050*

**Wedge**

**Key Metric in 2050**

**Constraints**

**ENERGY EFFICIENCY**

- Max feasible rate of improvement: 1.3% y⁻¹
- Fundamental changes in the built environment
- Limitations on changes in human behavior

**GENERATION DECARBONIZATION**

- Grid operability requires some natural gas usage
- Large infrastructure investment required
- Facility and transmission siting challenges

**ELECTRIFICATION**

- Smart charging
- Battery technology and cost
- Low-carbon source of electricity
What Does a Utility Want?

• To be responsive to policy and regulatory initiatives and to be perceived as such by the public—GHG reduction is front and center

• To have satisfied customers who believe they receive good value for what they pay for

• Financial perspective: To collect sufficient revenue to “run the business” and meet investor earning expectations—the basic regulatory compact

• Operational Perspective: To have tools, equipment and processes to “run the grid” effectively
A Tale of 2 Buildings . . . Both ZNE
A Tale of 2 Buildings . . . Both ZNE

Solar PV

Energy Efficiency, Demand Response, then Solar PV
A Tale of 2 Buildings
A Tale of 2 Buildings

Which is the easier, less costly building to serve for a utility?

- Infrastructure build-out
- Purchased or generated power

For the customer: which building would have the lower bill?
Note degree of change in just five years
Dynamic quality of change—we would expect change to continue

• In 2012, it looks fine to charge your car at night
• In 2016, not so much!
• Under NEM, no incentive to charge your car in the afternoon
Thank you!

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Questions to consider . . .

- Is grid connectivity essential to take ZNE “to scale”?
- If we could instantly (tomorrow) make half of all buildings ZNE, would it reduce utility grid costs?
- At scale, what is a fair and reasonable method of (1) determining and calculating, and (2) collecting utility costs to serve ZNE customers?
- Is “Net Positive” always “good”? Is it ever “good”?
- Is incremental energy savings ever “bad”?
- Who should pay for microgrids?
- How should we handle storage?