Zero Net Energy *and* The Power Grid

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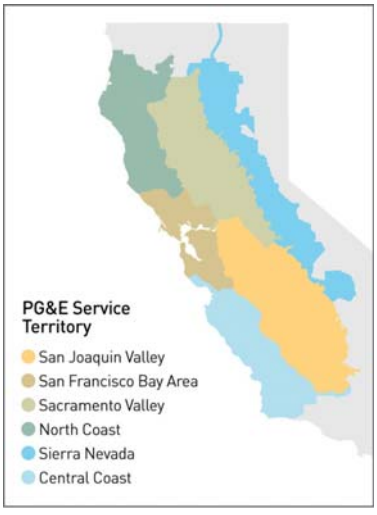
Together, Building a Better California

Pacific Gas and Electric Company

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 transfomers



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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

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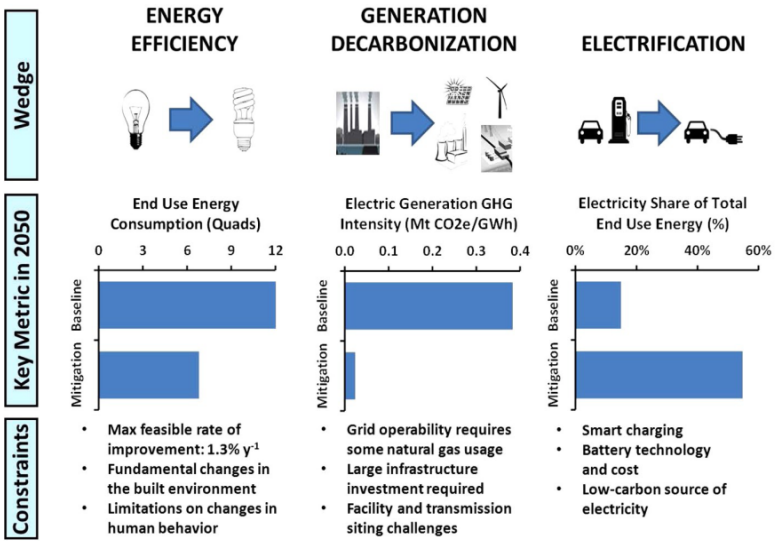
2012 Science Paper: "The Technology Path to Deep Greenhouse Gas Emissions Cuts by 2050" (From E3, San Francisco)



A California Utility's Perspective on ZNE . . .

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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*

Utility Earnings and Ratemaking 101 . . .

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In CA (and many states), utilities do not earn money on commodity throughput: they earn an allowed, adjudicated **rate of return** on **"plant" (capital) investment**

Ratemaking starts with a **revenue requirement (RR)** for the entire enterprise which is filed with the regulators and adjudicated

RR = Capital Investment + Expenses + Earnings (rate of return)

- The cost to maintain and build out the system
- Personnel costs, equipment, taxes, purchased energy

Electric rate = RR / Forecasted Sales

- Of course, there are dozens of rate schedules. Rate schedules simpler for smaller customers; more complex for larger
- The sum total of revenue from all of the rate schedules and their component parts must be designed to equal the RR
- Generally, electricity sales are highly predictable compared to most other commodities—a stabilizing factor.

What Are Some Key Implications of Ratemaking?

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Core idea: collect cost of service fairly, plus "reasonable" rate of return

Balancing accounts: RR = $1.00 billion, collect $1.02? Refund the $0.02 next cycle; same process if under-collected.

Rates are designed to minimize grid costs (peak hour charges, demand charges, inverted blocks, etc.) by holding down capital and expense charges

"Subsidies," "discounts," to any given customer or segment are an undercollection and must be made up by some other customer group or segment because the adjudicated, approved **RR does not change.** Sometimes called "cost shifting"

- Low income
- Economic development
- Special technical incentive rates (e.g., NEM rates)

What Does This Mean for ZNE?

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(Hold that thought!)

A Tale of 2 Buildings . . . Both ZNE

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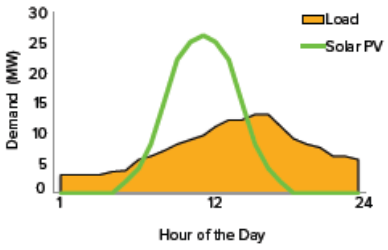
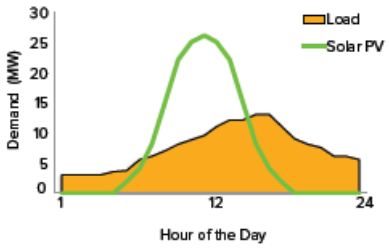
Solar PV



Solar PV



A Tale of 2 Buildings . . . Both ZNE

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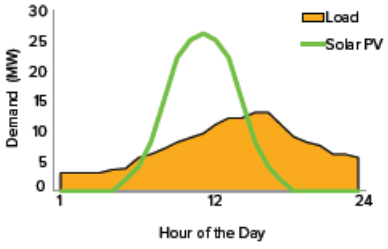
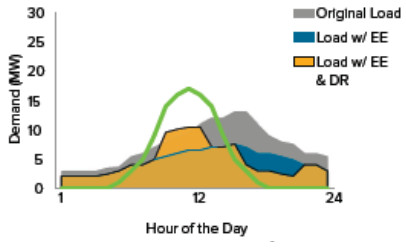
Solar PV



Energy Efficiency, Demand Response, then Solar PV



A Tale of 2 Buildings

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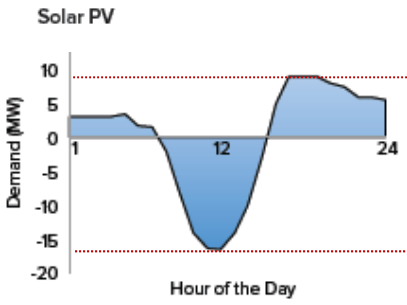

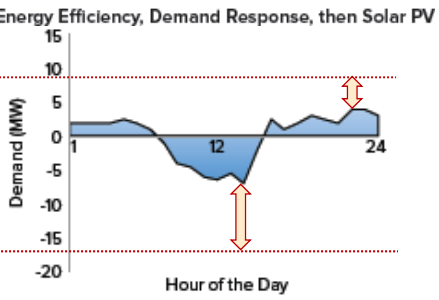

A Tale of 2 Buildings

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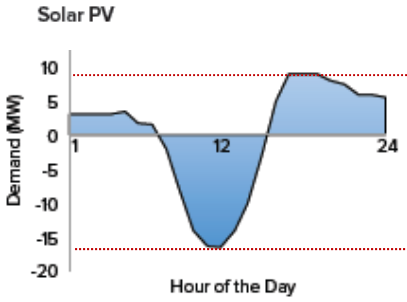
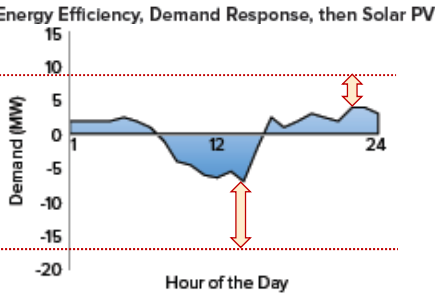
Which is the easier, less costly building to serve for a utility?

- *Infrastructure build-out*
- *Purchased or generated power*

For the customer: which building would have the lower bill?





What Does This Mean for ZNE?

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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?
- If we start abandoning natural gas, how do we handle infrastructure cost recovery?

GHG Emissions Perspective

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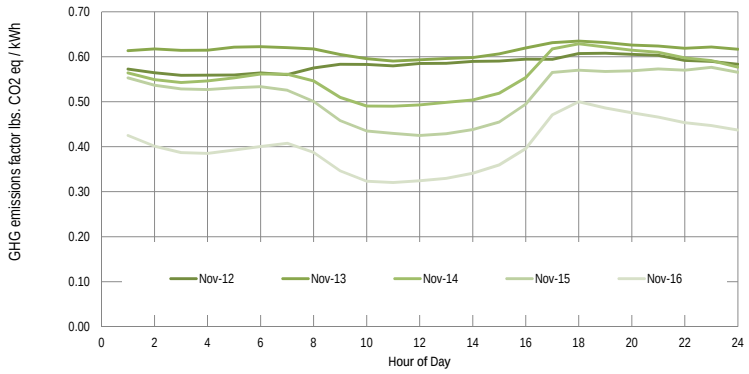
CAISO hourly GHG emissions factor, Nov 2012-2016



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

Summary Points . . .

As a practical matter, ZNE only works with a robust, well-functioning grid; utilities need to recover their costs

Competing forces:

- Grid investment requirements (upward cost pressure)
- Lower throughput (downward revenue pressure)

Grid-friendly buildings require lower grid investments than non-friendly buildings

Saving energy will always be valuable; BTM renewables may reach a point where their value is diminished; flexibility is key

Utility economics 101: It starts with a **Revenue Requirement**

Rates = [(authorized grid investment) + (expense) + (earnings)] / (forecasted kWh sales)

Thank you!

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