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UTILITIES

Xcel Energy Commits to 100% Carbon-Free Electricity by 2050

The utility's ambitious plan could pre-empt a messy policy battle over renewable energy mandates.

JULIA PYPER | DECEMBER 04, 2018

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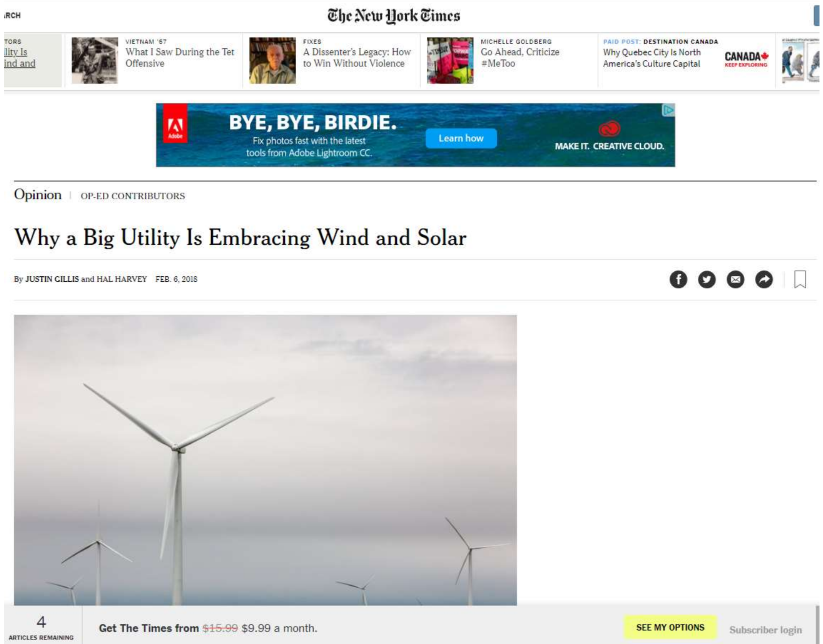


https://www.nytimes.com/2018/02/06/opinion/utility-embracing-wind-solar.html

¢1.81

- $0.0181/kWh
- Median bid of 100 open source project bids received in Q4 2017 in Xcel Colorado for over 4000 MW of new wind projects
  - demonstrates that these low bids weren't one-off outliers, but rather indicative of real industry costs.
  - For projects to be put in place over the next 5 years
  - 1.1 cents/kWh lowest bid..
  - https://assets.documentcloud.org/documents/4340162/Xcel-Solicitation-Report.pdf

And with Storage!

- $0.021/kWh for Wind with Storage
  - 4-10 hours of battery storage
- $0.0295/kWh for Solar
- $0.036/kWh for Solar with Storage
  - 4-10 hours of battery storage

"the median bid for wind plus storage appears to be lower than the operating cost of all coal plants currently in Colorado, while the median solar plus storage bid could be lower than 74% of operating coal capacity."

"CEO of NextEra Energy, Jim Robo, predicted that by the early 2020s, it will be cheaper to build new renewables than to continue running existing coal and nuclear plants. "

- https://www.vox.com/platform/amp/energy-and-environment/2018/1/29/16944178/utility-ceo-renewables-cheaper

2018 updated costs

Xcel Energy's 120-day report to Colorado regulators includes an additional 1.1 GW of wind at 1.1-1.8¢/kWh. Solar power bids have come in at 2.2-2.7¢/kWh, and solar+storage at 3.0-3.2 ¢/kWh

- https://www.pv-magazine.com/2018/06/07/worlds-largest-li-ion-battery-and-707-mw-of-solar-power-in-colorado-proposal/

- move Colorado from 28% renewables as of 2017, to 53% by 2026.

Here are the costs Robo anticipates "early in the next decade":

- Unsubsidized new wind: 2.0-2.5 cents per kilowatt-hour
- Unsubsidized new solar: 3.0-4.0 cents per kilowatt-hour
- Variable operating costs of existing coal or nuclear plants: 3.5-5.0 cents per kilowatt-hour

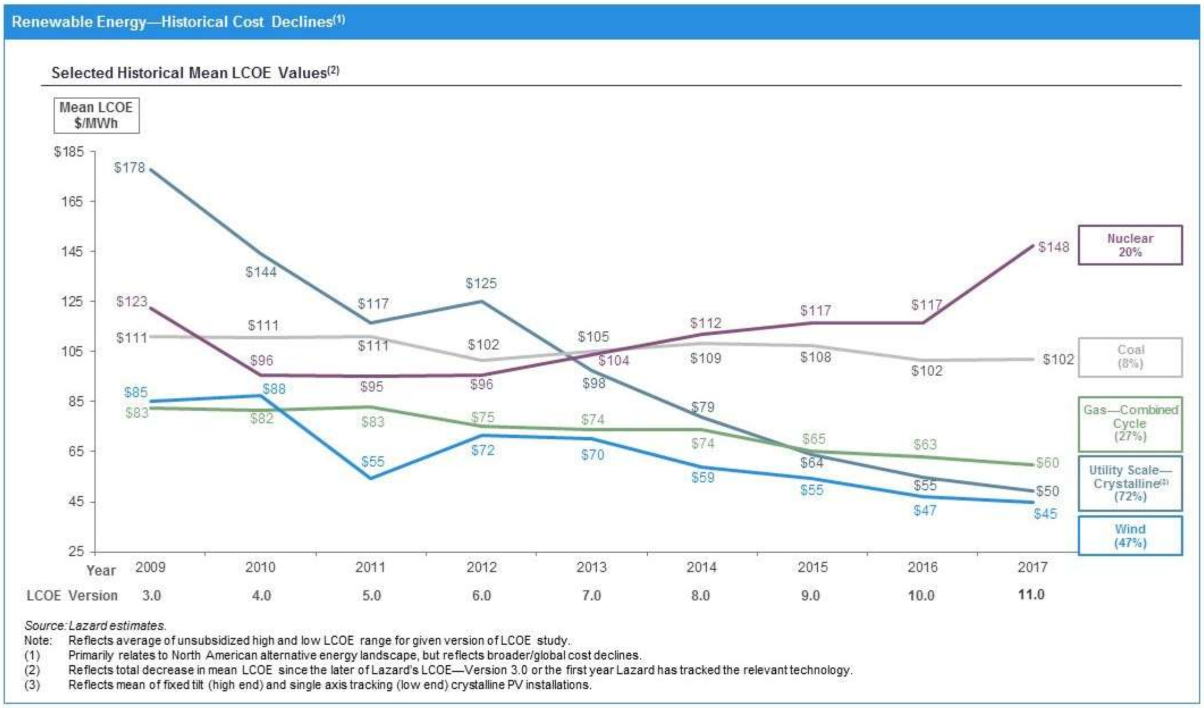
- With the PTC and ITC currently in place, "wind is the cheapest form of energy at 1.2-1.8 cents per kilowatt hour at high wind sites while solar continues to be priced at a discount to other forms of generation at 2.5-3.5 cents per kilowatt hour."

New study reaches a stunning conclusion about the cost of solar and wind energy

Building new renewables is now cheaper than just running old coal and nuclear plants.

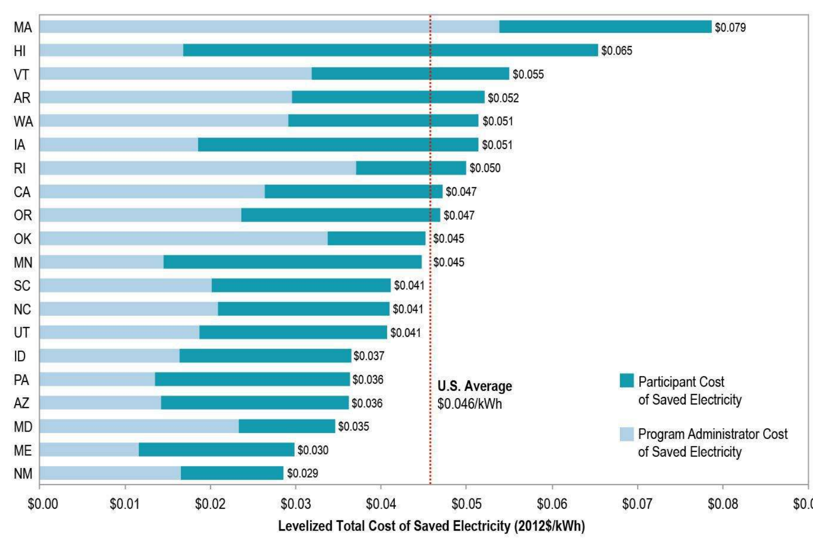
*"A widely-used yearly benchmarking study — the Levelized Cost of Energy Analysis (LCOE) from the financial firm Lazard Ltd. — reached this stunning conclusion: In many regions "**the full-lifecycle costs of building and operating renewables-based projects have dropped below the operating costs alone of conventional generation technologies such as coal or nuclear."***

https://thinkprogress.org/solar-wind-keep-getting-cheaper-33c38350fb95



Vs Utility costs for energy efficiency programs…

https://emp.lbl.gov/projects/what-it-costs-save-energy



Utility Efficiency at 2.5 cents/kWh

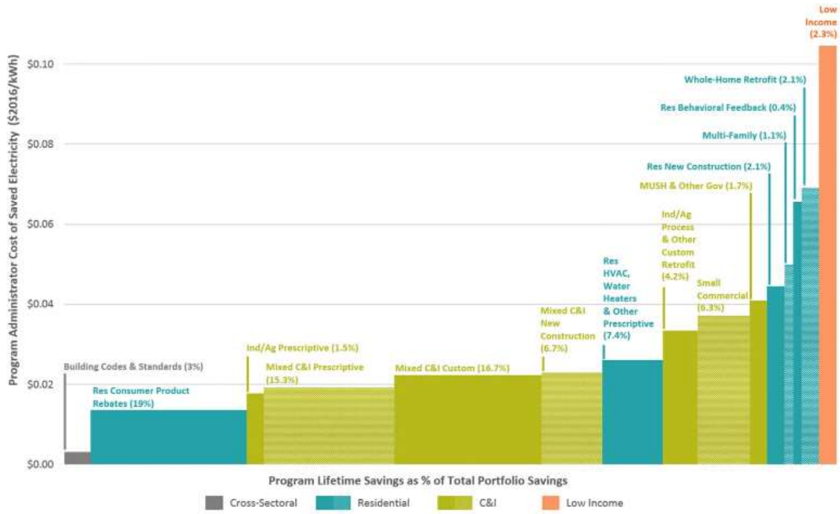
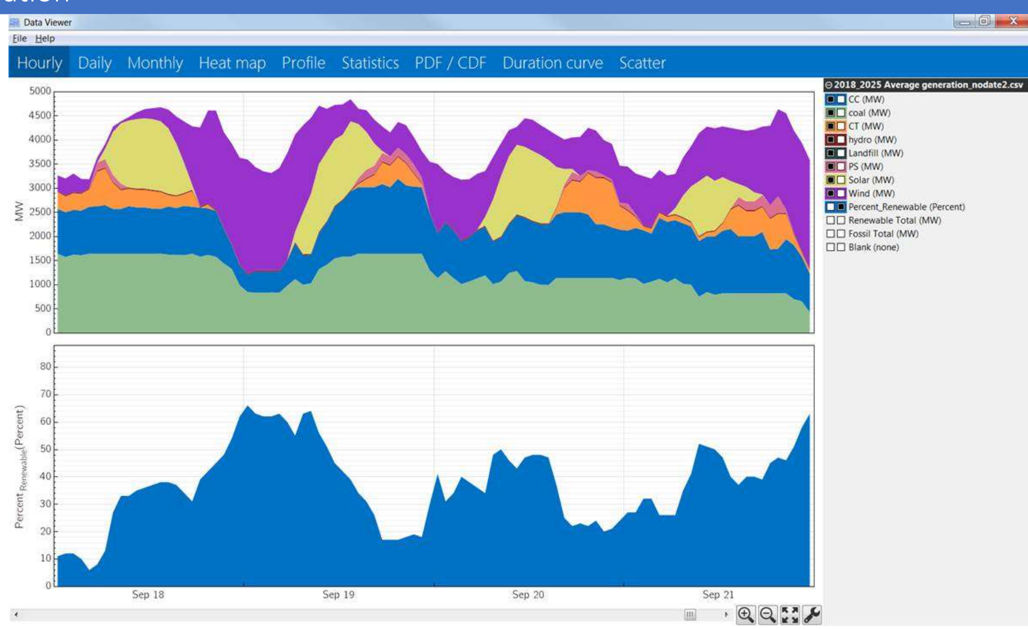


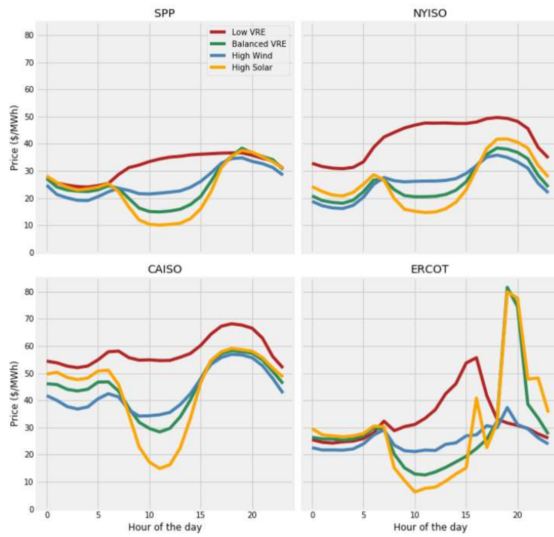
Figure ES - 6. Composite cost curve for electricity efficiency programs funded by utility customers (2009-2015)

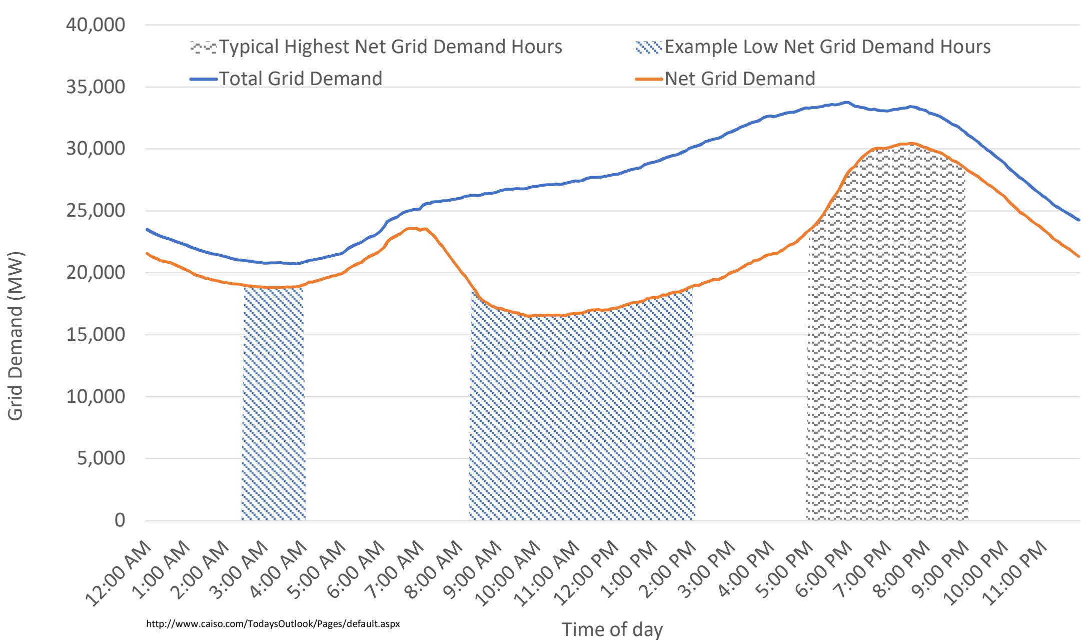
https://emp.lbl.gov/publications/cost-saving-electricity-through/?utm_source=newsletter105&utm_medium=email&utm_campaign=Constant%20Contact

Colorado Grid at 39% Renewables (now has plans for 55%) Hourly Energy Hourly Generation

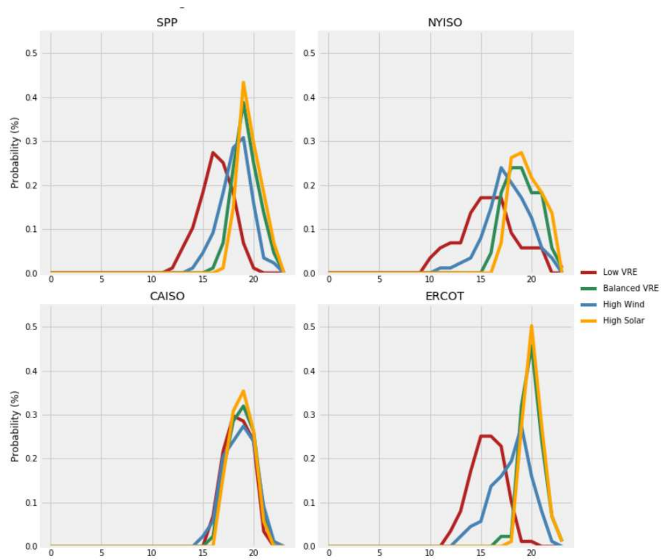


Simulated Annual Mean Diurnal Energy Price Profiles for Weekdays Across Four Regions - Southwest Power Pool (SPP), New York (NYISO), California (CAISO) and Texas (ERCOT)[1]





Simulated Probability that Hour is within the Highest 100 Net-Load Hours of the Year Across Four Regions - Southwest Power Pool (SPP), New York (NYISO), California (CAISO) and Texas (ERCOT)[1]



But what about energy efficiency?

- ?

Building Energy Efficiency in the era of cheap renewable baseload

- Utility Efficiency programs investments will go down…
  - ~$9 Billion/year in 2016
  - $0.046/kWh saved average cost for efficiency programs
- Saving energy during hours of high renewables on the grid will not be a benefit…
- IF energy efficiency costs more that baseload grid renewables with storage, guess what happens…
  - We all win!
    - Except those of us that have spent a career researching and fighting for principles around only using what you need and energy efficiency in buildings…

An EE path forward…

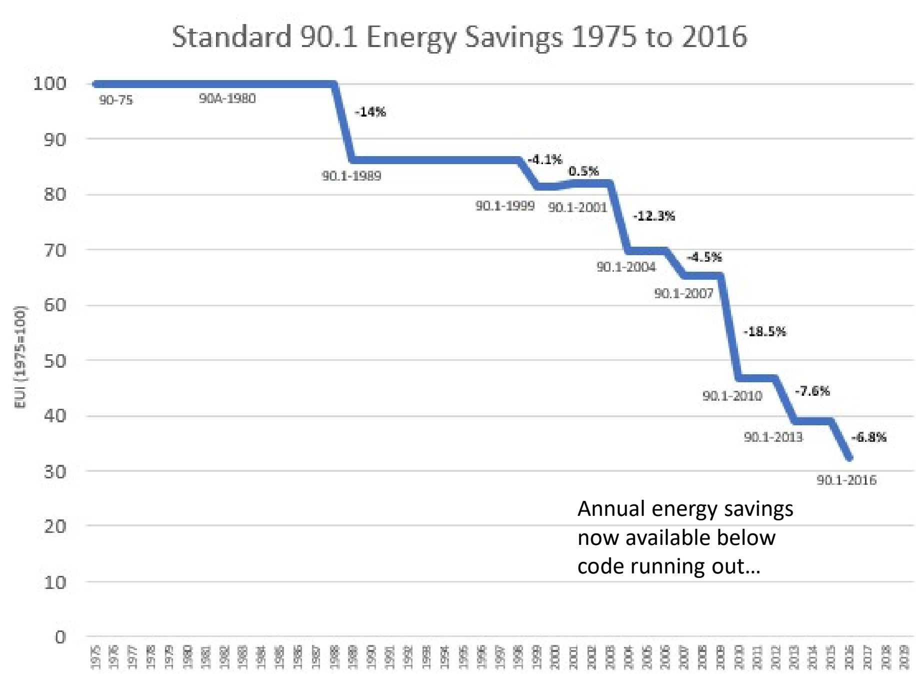
- Saving energy during peak fossil hours and peak congestion hours will still be of high value
  - "kWh savings anytime, anyplace" will be become "kWh savings at the right time, in the right place"
- Using energy during high renewable hours will reduce curtailment/increase use of grid scale renewables/reduce grid scale storage costs
  - Demand Flexibility and GEBs
- EE for enhancing on-site resiliency
- Just because its cost effective on paper or in the model, lots of work to be done to actually realize savings potential
  - Disconnect between aggressive codes and actual designs EUIs
  - Disconnect between design EUIs and actual operations
- Lots of existing buildings that need savings sooner

- AND – EE now becomes more focused on saving $ for a customer
  - Not about saving energy anymore, its about saving $
  - your bills won't go down just because there is more cheap renewables on the grid
  - Save more $ by using kWh and saving kWh at the right time

"The new EE is $E"

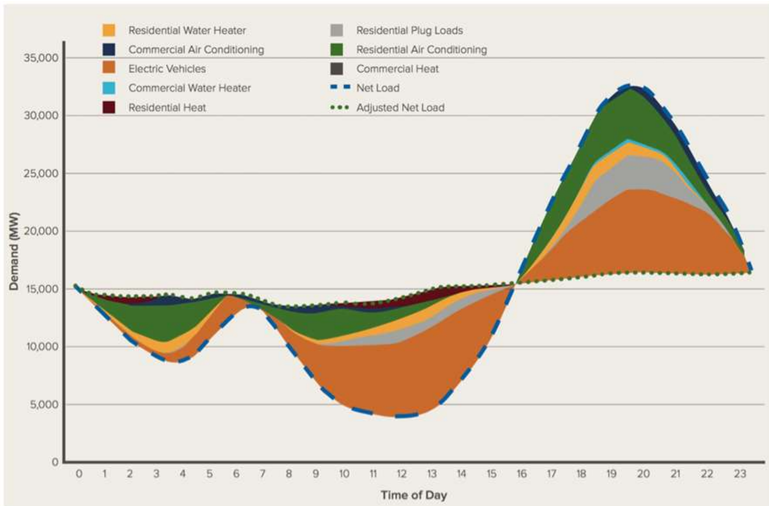
Good ideas for using excess cheap renewables

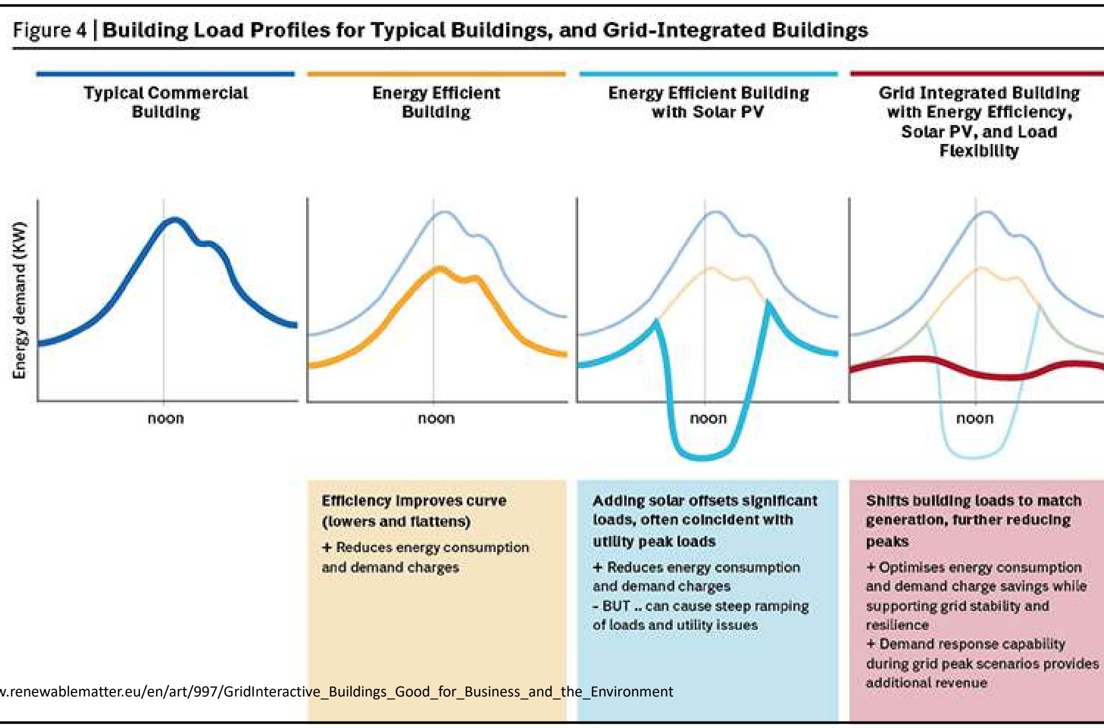
- Expand utility balancing regions
- Electrify transportation with smart deployment of EV charging infrastructure
  - Workplace charging with demand management controls to align with PV
  - Home charging with aggressive TOU rates (free during the day and late at night, very expensive 4-9 pm)
  - Charge car full every day and Vehicle to home partial discharge every night
- Electrify heating and hot water end uses in homes and buildings with heat pumps and heat recovery
- Electrify cooking with full induction solutions (70% more efficient than typical electric ovens)
- Electrify clothes drying with heat pump dryers (50%+ more efficient than typical electric dryers)
- Water desalinization during excess renewable hours (utilize large water tanks to buffer clean water flows)
- Grid scale and distributed scale daily battery storage
- Enhance existing grid scale energy solutions
  - Repower pumped hydro
- Make renewable Ammonia
  - H2 and n from water and air
  - Existing seasonal generation, storage, distribution, and uses infrastructure in place already
  - Carbon free when burned or used in fuel cells
- Make renewable natural gas
  - Not carbon free, but can use existing seasonal storage and distribution infrastructure
- All the other cool things to do with renewable h2
  - Long hall trucks
  - Planes
  - Shipping tankers
  - Trains
  - Fool cells
  - Rockets



RMI: How Demand Flexibility Can Grow the Market for Renewable Energy

https://rmi.org/news/demand-flexibility-can-grow-market-renewable-energy/





http://www.renewablematter.eu/en/art/997/GridInteractive_Buildings_Good_for_Business_and_the_Environment

ACEEE’s Perspective

http://aceee.org/blog/2018/05/efficiency-and-renewables-dream-team

“ If efficiency is used to reduce total utility system loads, the cost of a grid with a high percentage of renewable generation can be substantially reduced”

“High cost efficiency programs should look for additional funding sources…such as those that combines weatherization and health funds to make weatherization and other improvements to multifamily buildings with high incidences of asthma-related emergency room visits and hospital admissions.”

ACEEE
American Council for an Energy-Efficient Economy

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Efficiency and renewables: the dream team for a clean energy future

BLOG POST | May 02, 2018 - 4:24 pm
By Steven Nadel , Executive Director

With the promising trend of plunging prices for renewable energy, there may be a temptation to wonder whether energy efficiency is still cost effective. The answer is a very affirmative “yes.” As companies, cities, and states work to keep energy costs down and meet ambitious greenhouse gas emission reduction goals, the choice should not be energy efficiency versus renewable energy. To meet these goals, we need to maximize both resources.

Energy efficiency remains generally less expensive than renewable energy, so even if renewables are plentiful, using efficiency to reduce electrical loads can still save money. While there have been a few bids of 2-3 cents per kWh for utility-scale renewable power, they include federal renewable energy subsidies that will soon end and do not reflect all of the costs of a renewable energy grid. Yes, renewable prices are coming down, but a hefty dose of efficiency is still needed to minimize both long-term costs and emissions. And incorporating efficiency also brings many other benefits including improved comfort, health, and worker productivity, reduced energy burdens, new jobs,

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“For example, this November 2015 NREL paper explored the duck chart in detail, and suggested two ways to change system planning and operational practices to re-shape the curve and allow more PV on the grid.

- The first is to "fatten" the duck, growing its belly by increasing the flexibility of the power system—which means changing operational practices to enable more frequent power plant cycling, starts and stops, and so on.
- The second is to "flatten" the duck, shrinking its belly by shifting supply and demand so solar can meet parts of the load that wouldn’t normally be provided in the middle of the day. Flattening the duck typically involves adding energy storage or demand response—both options that are already being deployed in various locations around the United States.”

https://www.nrel.gov/docs/fy16osti/65023.pdf

Overgeneration from Solar Energy in California: A Field Guide to the Duck Chart

Paul Denholm, Matthew O’Connell, Gregory Brinkman, and Jennie Jorgenson
National Renewable Energy Laboratory

Grid Friendly Ready Buildings

- Based on the planned US electric grid evolution with realistic future consideration for loads, existing and new planned renewables, and storage over the next 20 years across 4 large regional US grid balancing areas[1], we propose the following generic concepts for grid-friendly buildings:
- **GF Rule #1: Minimize use (and/or maximize export) of electricity in the building during highest typical net load hours on the grid. Currently and in the near future across utilities in the US, this occurs during the lowest renewable hours and highest typical load hours of later afternoon and early evening hours.**
- While GF Rule #1 is provided in a generic form, the following further rule considerations are noted:
  - local renewable resources may vary seasonally.
  - Actual utility rates may not yet fully align with Rule #1
  - Actual local renewable resources may vary daily
  - Future peak net load on the grid may shift off 5-9pm (e.g. if certain end uses are electrified like morning winter electric heat or EV charging)
- [1] https://emp.lbl.gov/publications/impacts-high-variable-renewable

Grid Friendly Ready Buildings

- **GF Rule #2: Maximize a building's load flexibility to respond to the future uncertainty in local utility rate structures and future utility costs.**
  - As the electric grid evolution progresses over the life a building, we expect local utility rates to respond and evolve. As more low-cost grid scale renewables are added to regional utility grids, we expect utility rates to respond in a way that rewards a building owner that can shift building loads to hours of low-cost renewables and away from hours of high cost electricity.

Basic Approach to GF-Ready Loading Order

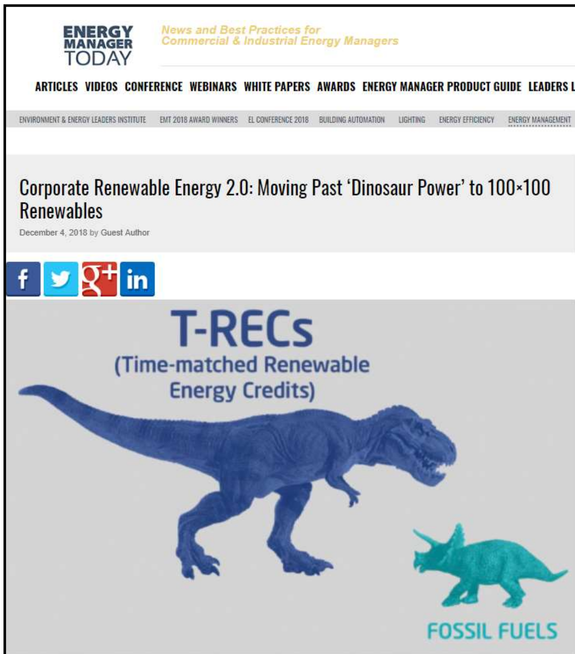
Given the 2 general GF rules, we have developed a set of building design and operations strategies that can be considered, presented in a qualitative loading order based on possible cost implications, synergies with other benefits, and conceptual ease of implementation.

1. Strategies that include basic energy efficiency year-round – 50% annual energy savings in new construction is often feasible, saving energy at all times over the year.
2. Strategies that include "no-regrets" applicable Solar Ready Buildings design strategies
3. Strategies that focus on saving energy between 5pm-9 pm.
4. Passive design strategies that include flexible and controllable loads that can enable the shifting of loads from peak net demand utility hours to off-peak hours and to high renewable hours.
5. Active design strategies that include flexible and controllable loads that can enable the shifting of loads based on local utility price and control signals, typically off-peak hours and to high renewable hours.

https://www.nrel.gov/docs/fy10osti/46078.pdf

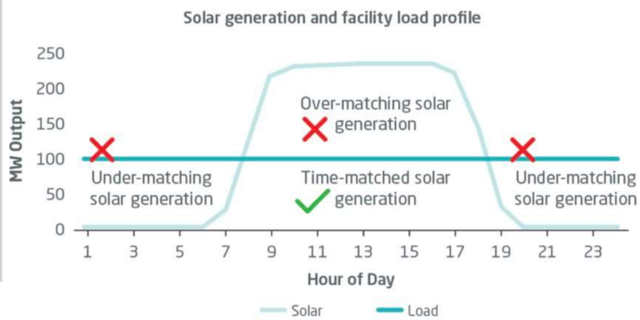
Zero Energy Buildings 2.0

- 100% renewable net basis over a year was 1.0
  - Focus of our research for the last 15 years
  - Net Zero Energy
- 100% renewable each hour of the year is 2.0
  - https://www.energymanagertoday.com/corporate-renewable-energy-2-0-moving-past-dinosaur-power-to-100x100-renewables-0180556/
  - Google's new corporate goal
    - https://storage.googleapis.com/gweb-sustainability.appspot.com/pdf/24x7-carbon-free-energy-data-centers.pdf
  - Load coverage factor (LCF) = 100% load covered by renewables
    - including on-site, and off-site (Virtual PPAs, grid scale) real time renewable contribution
- Over the next 10 years, "research out the net" to get to 100% Renewable 100% of the time
  - Will need to understand the grid integration of Zero Energy 2.0
  - 100% x100% will consider and include on site RE and off-site owned RE and grid scale RE



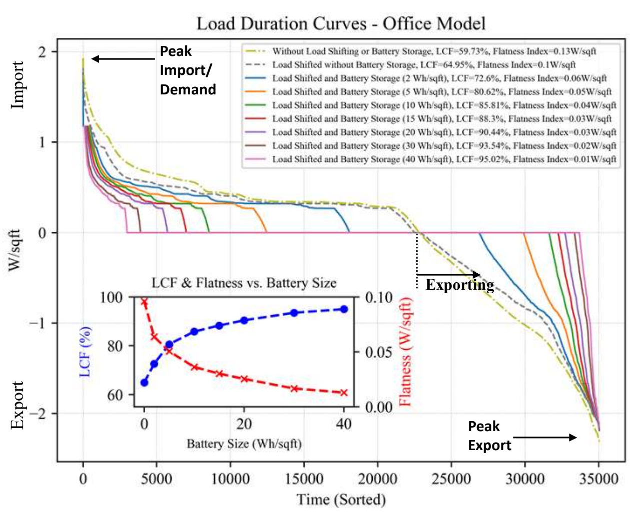
The New Goal: 100×100

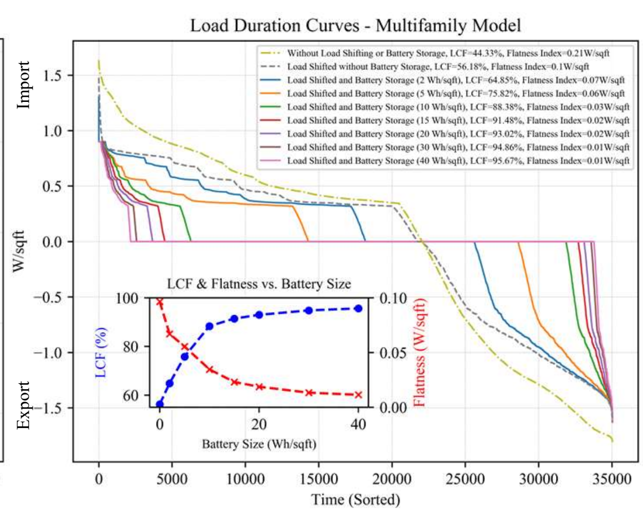
- "Achieving 100% renewable energy on a net basis is a great start – the stretch goal is achieving 100% renewable energy 100% of the time, or 100×100. This could be accomplished using Time-matched Renewable Energy Credits, or T-RECs. Reaching 100×100 will certainly be a difficult task, but reaching 100% renewable energy on a net basis also seemed daunting 10 years ago."
- "Based on the economics of energy storage and renewables, our modelling shows that 80-90% time-matched renewable energy consumption (LCF) is realistic today for a facility with a 24/7 flat load using a combination of wind, solar and storage. Additionally, it would provide a stepping stone to achieving 100×100."



https://www.energymanagertoday.com/corporate-renewable-energy-2-0-moving-past-dinosaur-power-to-100x100-renewables-0180556/

Net Zero: Battery + Active Load Shifting : Model Results





Net Zero: Battery + Active Load Shifting : Model Results vs Baseline