

Market Design and Meteorology

Surprising things that will change our future

Mark Ahlstrom, ESIG and NextEra Energy Resources



Satirical humor – the Onion (www.theonion.com)

NEWS

Incredible Humility: Warren Buffett Just Revealed That He Always Flies Cargo Instead Of First Class

3/20/19 2:10pm • SEE MORE: WARREN BUFFETT ▾



Study: Universe Probably Not Computer Simulation

10/12/17 9:47am • SEE MORE: OPINION ▾



By studying the quantum behavior of particles, two physicists claim to have disproved a theory that our physical universe is just an elaborate simulation. What do you think?



“I’m going to have to start making better decisions then.”

RICHARD PROKASH • SHELLAC APPLIER



“It’s nice to know I’m not part of a random, meaningless simulation but rather a random, meaningless reality.”

DAN WIEDEMAN • BOAT VALET



“No computer would be this cruel.”

SARAH BALISTRERI • SHOT PUT JUDGE

Energy Systems Integration Group

Charting the Future of Energy Systems Integration and Operations



Also from the Onion?



JILLIAN GOULD • JOIST MAKER

Idaho Power Sets Goal Of 100% Clean Energy By 2045



CAINE DONOVAN • CARPETING SALESMAN

With Cincinnati On Board, 100 U.S. Cities Now Committed To 100% Clean Energy



LEVISON KEMP • COCKTAIL INSPECTOR

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

The 80 percent by 2030 goal will be fairly easy and affordable to meet with currently available technologies... incremental cost of renewable energy generation is now less than the embedded cost of existing fossil fuels.

The BIG list – things that change everything

Getting to 80% clean energy

- Critical and possible, and yet a really big lift in terms of investment and grid transformation

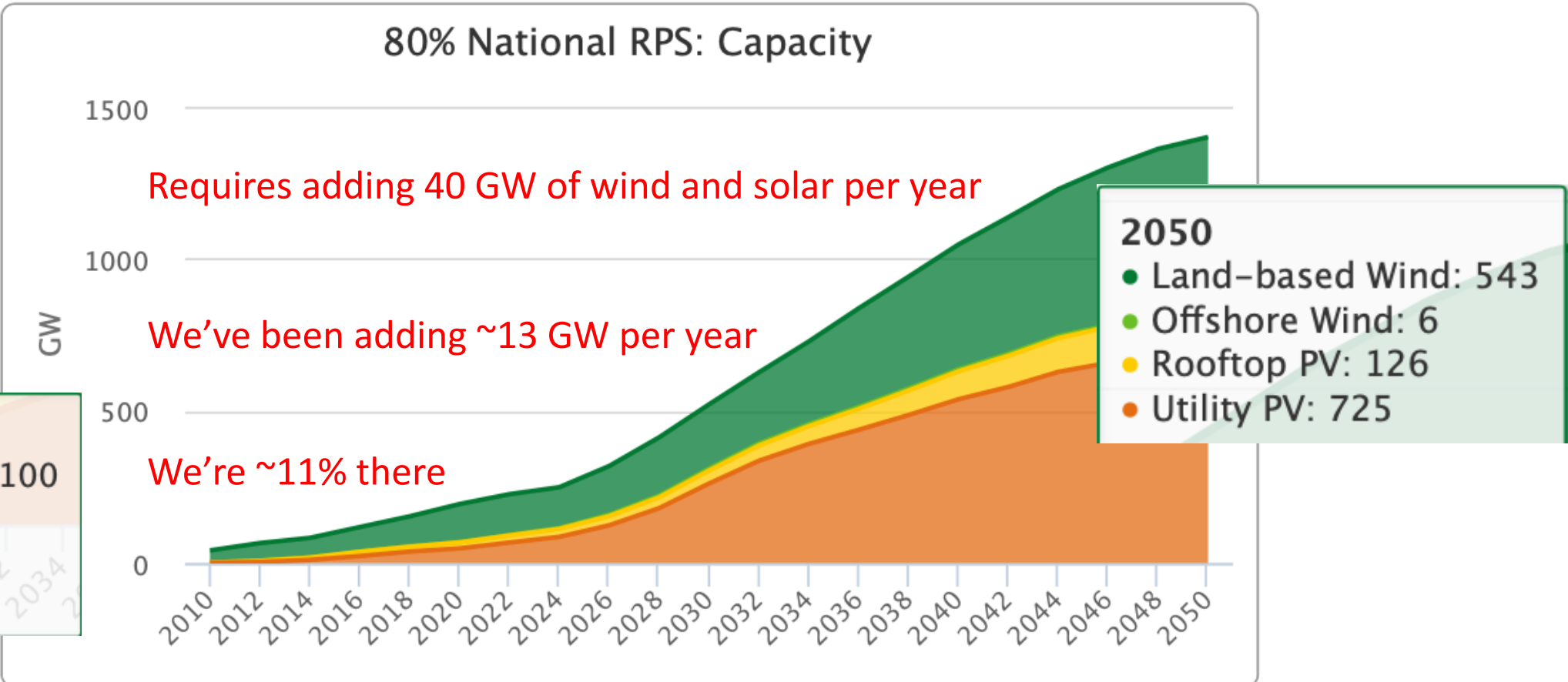
Storage, hybrids, and virtual power plants (our digital revolution)

- Changes forecasting value points, customers, and market design

Climate change

- How might it affect the renewable power plants that we are building to slow it down?
- How can meteorology and climatology overcome investment risk to get the job done?

Getting to 80% renewable energy in the U.S.



Source: NREL Standard Scenarios Report, <https://www.nrel.gov/docs/fy19osti/71913.pdf>, generated by <https://openei.org/apps/reeds/#>



Our digital revolution – disruptive change

Non-synchronous resources are electronically coupled to the grid

- This is a digital revolution in power generation, with the ability to program the behaviors that we desire, but the need to understand exactly what we want

Storage – What is it?

- We are used to generators and loads, but storage is both and neither
- Does a bit of storage enhance everything? Separate or embedded? Everywhere?

Storage Hybrids – Even more disruptive?

- Hybrid “storage + solar” power plants... or “storage + anything” power plants
- Virtual power plants – including aggregated distributed energy resources (DERs)

Given enough of three key ingredients
(energy, electronics, software)...
we can emulate any “machine” that we want or need
(real or imagined).

If we can make what we want, then why not make more “ideal” resources?

What might a more ideal resource be?

- Starts instantly, ramps quickly and on command between 0 MW and its maximum MW
- No startup time, no minimum run time, no minimum down time, etc.
- Linear operational characteristics without discontinuities/non-convexities

How can we make them?

- Current resources plus storage services could become ideal resources (physically or virtually)
- Grid-forming inverters to standardize electrical properties, even with diverse technologies
- Examples:
 - PV + Battery + Gas Hybrid Power Plants
 - Aggregated DERs or Distribution System Operators

Hybrid resources – complete game changers

Renewable hybrids are getting surprisingly affordable

- Leads to dramatic internal design changes and higher effective renewable capacity factors
- Oversizing generation, using “planned” self-curtailment, efficiency/optimization/analytics

Hybrids dramatically increase the value of better forecasts

- High quality forecasts of renewable generation and energy prices are critical to the hybrid plant’s operating and bidding strategy (better forecasts are directly monetized)

Hybrids may change market products, market design and market participation

- Offer prices are based on the hybrid’s perception of future opportunity cost
- Conventional assumptions of offers being based on marginal fuel cost are no longer sufficient
- System operator will not know (nor nor should they know) the hybrid's internally optimal performance strategy, and this strategy will vary based on forecasts and risk tolerances

Hybrids can provide the “Grid Services” that system operators really want

Grid Services

The concept

- In the long run, can we allow markets and system operators to focus on the services that they really want rather than technology-specific “snowflakes” they are offered?
- How would they define these desired, high-level services from scratch today?
- Can we directly align services with the “prime directives” of the system operator – maintaining a balanced and reliable system across planned and unplanned conditions in an economic way?

The example (admittedly at the highest level and in a futuristic sense)

- The real time operator in the control room (and therefore, the market software and energy management software) wants to know that they have sufficient *energy, flexibility and contingency reserves* available to maintain a desired level of reliability at all times and places
- Expecting the system operator (or the market) to be responsible for technology-specific quirks could become a historical artifact when sufficient future resources (both conventional and renewable) can directly provide Grid Services at low cost

Once we have the *capability* to make an ideal resource, does it become an *obligation* to perform like one to participate?

No, the market can still construct what it needs from non-ideal parts.

But should we use Grid Services as the basis for assigning value?

Probably yes, because if a hybrid can construct the Grid Service cheaper than the market can, then we should allow it to do so.

This makes better forecasts more valuable to more participants, and done right, should result in better prices, better performance, and better results for customers.

The Regulatory Debate About Energy Storage Systems

(IEEE Power & Energy Magazine; Sep/Oct 2017; Enés Usera, Pablo Rodilla, Scott Burger, Ignacio Herrero, Carlos Battle)

Guiding principles as summarized in this paper:

- Technology-specific restrictions and products should be avoided where possible
- Only technical requirements based on actual physical limitations of the system should be preserved
- Energy and flexibility:
 - Bring market-clearing closer to real time to allow agents to exhaust their ability to correct forecasting errors and renewable energy variability—an area where energy storage resource could excel
 - Short-term flexibility market products through technology-neutral market products that respond to actual system needs; long-term frequency reserve markets as call options to facilitate storage/VER participation
- Capacity: Design products that more closely reflect system operations and flexibility requirements

Climate change

There is a growing need for an understanding of the potential impacts of climate change on our portfolios and future renewable investments

NextEra's analysis is seeing preliminary evidence of climate change

- No clear wind speed annual trend, but changes in seasonal shapes are evident
- While sample size is still limited, growing evidence that wind resource characteristics are changing

This could become an important issue for the renewables industry

- Seasonal shifts have impacts beyond gross energy
- Potential impacts on curtailment, contracts, basis risk, O&M, resource assessment, long-term normalization methods, storage, investment decisions and perceived risk
- Could affect power system planning/operations, and even market design

Climate change

NextEra is looking to you, the ESIG community, to mutually explore these issues and work together on better understanding

- Analysis should eventually include wind, solar, hydro, load and electrification

If you have similar interests and analysis that could contribute to mutual understanding of climate and extremes, let's collaborate

- Aaron Bloom can connect you with the NextEra Analytics sciences team



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