Is Sarah Becker's fully renewable US electricity system a realistic plan?

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Abstract

Sarah Becker et al. just released a new paper (arXiv: 1402.2833) where she and her colleagues including Mark Jacobson suggest a new plan for fully renewable US electricity system. Their title is: Features of a fully renewable US electricity system: Optimized mixes of wind and solar PV and transmission grid extensions. So I think it is worth to discuss their proposal.

Introduction

This article is summary of discussion in researchgate.net on renewable energy plan for USA.
Sarah Becker et al. just released a new paper (arXiv: 1402.2833) where she and her colleagues including Mark Jacobson suggest a new plan for fully renewable US electricity system. Their title is: Features of a fully renewable US electricity system: Optimized mixes of wind and solar PV and transmission grid extensions.
The abstract goes as follows: "Wind and solar PV generation data for the entire contiguous US are calculated, on the basis of 32 years of weather data with temporal resolution of one hour and spatial resolution of 40x40km2, assuming site-suitability-based as well as stochastic wind and solar PV capacity distributions throughout the country. These data are used to investigate a fully renewable electricity system, resting primarily upon wind and solar PV power. We find that the seasonal optimal mix of wind and solar PV comes at around 80% solar PV share, owing to the US summer load peak. By picking this mix, long-term storage requirements can be more than halved compared to a wind only mix. The daily optimal mix lies at about 80% wind share due to the nightly gap in solar PV production. Picking this mix instead of solar only reduces backup energy needs by about 50%."

Answers:

[1] **James Van Damme**

It's an interesting mathematical exercise in balancing solar PV, wind, storage, and loads across the USA. It would be more interesting, and useful, if they could add in more variables to their analysis and arrive at conclusions applicable to our present situation, so that we have a way forward, and answers to burning questions. How many acres of Nevada will this take? Should coal plants be outlawed, or taxed to death? What happens if you put some nukes in the mix? Future improvements in storage, PV cost effectiveness, tidal power? Are there security implications in moving such great amounts of power across the country? Rooftop PV vs. large solar plants? Should we convert everything to hydrogen, pipe H2 to everyone, and take down all the wires??

[2] **Jorge Morales Pedraza**

From 2007 to 2035, it is expected that the use of renewable energy sources for electricity generation at world level will grows by an average of 3% per year, and the renewable share of world electricity generation is expected to increase from 18 % in 2007 to 23 % in 2035; this means an increase of 5 %. However, it is important to highlight that much of the world increase in the use of renewable energy sources for electricity generation will be fuelled by hydro and wind power. Of the 4.5 trillion kWh of increased renewable generation expected up to 2035, a total of 2.4 trillion kWh or 54 % is attributed to

hydroelectric power, and 1.2 trillion kWh or 26 % to wind. Except for those two sources, most other types of renewable energy sources that can be used for electricity generation are not economically competitive with fossil fuels up to 2035, outside a limited number of niche markets. Although they remain a small part of the total renewable generation, renewables other than hydroelectricity and wind —including solar, geothermal, biomass, waste, and tidal/wave/oceanic energy—do increase at a rapid rate over the projection period up to 2035.
Based on the above information and considering the dimension of the US territory, it is very difficult to accept the idea that the generation of electricity for the whole country could be produced using renewable energy source only. In my opinion, the best scenario is the one that shows an important increase in the use of renewable energy sources for the generation of electricity, but in combination with the use of nuclear energy and natural gas, including shale gas. Can not be totally excluded the possibility of the use of some coal power plant with low-emission technologies and,, if necessary other thermal power plants can be also used with the same purpose, but in a very limited scale.

[3] **Victor Christianto**
Thank you, Jorge, for your answer. Yes it is likely that coal and natural gas remain important for energy mix in the near future. Best wishes.

[4] **Aria Tsam**
Good Evening.please read the site:
1-http://arxiv.org/pdf/1401.4298.pdf

[5] **G. Bothun**
Mathematically this is eminently feasible as there are sufficient ambient resources (wind and solar) to meet the needs.

The most practical problem, however, is energy storage as these two sources are highly intermittent in nature.

In addition, due to blade size shipping constraints, your limited to a unit capacity for a land based wind turbine of about 2.5 MW. American reliance on wind energy can only be achieved by also utilizing OFF shore facilities where individual turbines of capacity 8-12 MW could be constructed.

Large Scale solar power is more difficult but a 2% covering factor with CSP (solar troughs) in the Sonoran Desert (shared with Mexico) would produce a 100,000 MW nameplate facility (about 10% of US nameplate).

Finally, there are supply chain issues that limit the build out of all of these components not to mention rare earth mineral shortages for magnetic motors (in wind turbines).

So yes this plan could be executed but would take at least 50 years to put into play and would need both integrated energy storage and a SmartGrid for success.

One should also add Florida Gulf Current power to this mix as well.

Concluding remarks
It seems that fully renewable energy plan in USA is an important one, although it should better include coal and natural gas in energy mix.

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References:
[1] http://arxiv.org/pdf/1401.4298.pdf