There is a Renewable Energy Revolution – Here Is Why

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Series III: Solar Energy and Wellbeing

The Energy Revolution.

Highlights:

- A feasible, affordable path to **30% clean energy** exists.
- More clean energy also means **lower costs**.
- The roadmap to 100% requires **significant solar**.

Using sunshine and wind to power the world is not a new idea. Windmills have been in use for over a thousand years. Earliest solar ovens appeared hundreds of years ago. And thanks to the U.S. space program starting in the 1950s, the have been rapid advances in solar photovoltaics (PV).

As we enter the second decade of the 21st century, renewable energy is playing an ever greater role in the U.S. power supply. In 2017, California utilities supplied over 40% of the power to a major grid via various solar sources, including PV. Renewable energy is no longer a fad. Its use is not just a trend. There is a genuine momentum moving the nation closer to a 100% clean energy future. It's an energy revolution.

The Outlook for Pennsylvania in Solar and Wind

Over 6 years ago the organization which coordinates the electricity transmission grid for Washington, D.C., and 13 states including Pennsylvania, recognized the need to prepare for a future with greater renewables. PJM Interconnection commissioned the Renewable Integration Study (PRIS) to find the best paths to add power from various mixes of solar and wind sources, up to 30%. PJM focuses on making sure that the power supply is reliable under all future circumstances. The study considers a total of 8 scenarios of solar and wind additions to the existing grid.

PJM Renewable Integration Study
Selected Scenarios

	Total RE (GWh)	Wind Capacity (MW)	Solar Capacity (MW)	Coal Displaced (%)
BAU	17,217	5,100	< 100	0
20% Scenario 1	160,490	44,303	18,189	-42%
30% Scenario 5	259,428	66,712	35,097	-66%

BAU > Business As Usual (current path)
Reference: 1 solar MW powers over 160 homes, on average

Data extracted from General Electric International study prepared for PJM Interconnection, LLC, dated March 2014

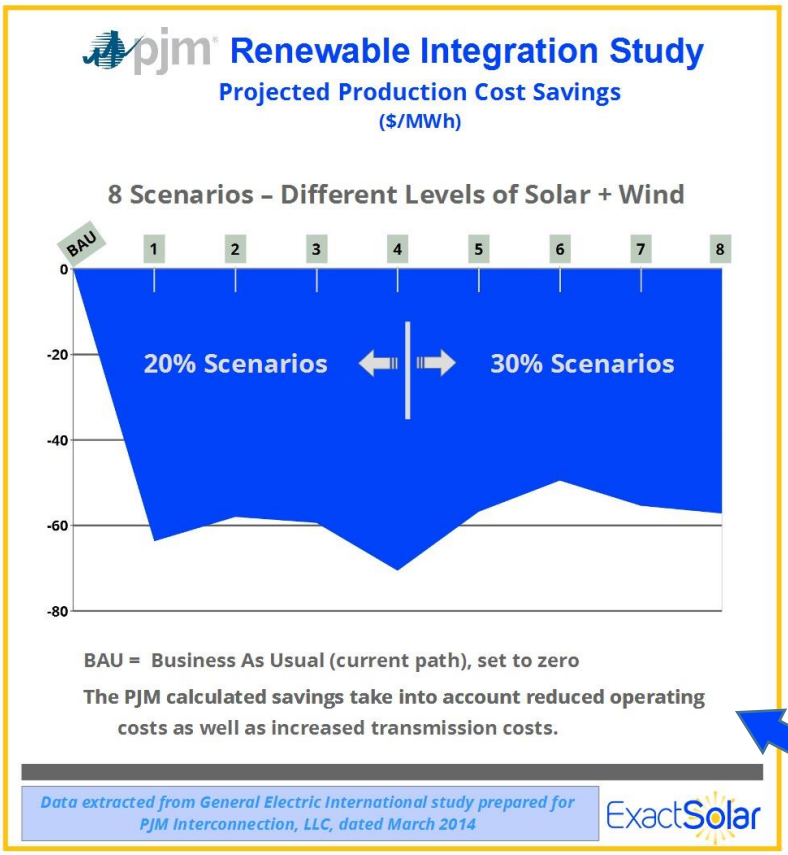
ExactSolar

*Two scenarios from the PJM study best reducing the need for coal power in the region. The **Total RE** shows predicted renewable energy production. Nearly 6 million homes could be solar powered.*

After a full analysis of all of the expanded clean energy options, the researchers made a few general and important conclusions:

- With proper transmission additions for project site locations, current PJM planning and scheduling procedures are likely adequate.
- Every scenario is a path to reducing coal and natural gas production.
- Every scenario is a path to reducing utility operating costs.

Throughout eight combinations of large scale wind and a range of residential rooftop solar to utility solar farms, PJM can reduce emissions while lowering production costs. The investment costs of solar and wind hardware were not considered. However, each project is reviewed to determine the return on investments similar to any conventional plant.



The study authors considered costs to produce energy as a guide in choosing the scenarios in the comprehensive look. PJM manages real costs moment by moment, and the organization provided great insight into generation and transmission cost factors. Unlike traditional power plants, clean energy systems' prices are falling. And system ownership varies from utilities, to third parties, to homeowners. So they chose to avoid capital costs and simply focus on the other factors. Fuel costs, variable operating and maintenance costs (O&M), regional taxes or fees, etc. were factored. Estimated transmission expansions and upgrades were added, too.

The PJM study finds savings a greater than all additional grid transmission costs.

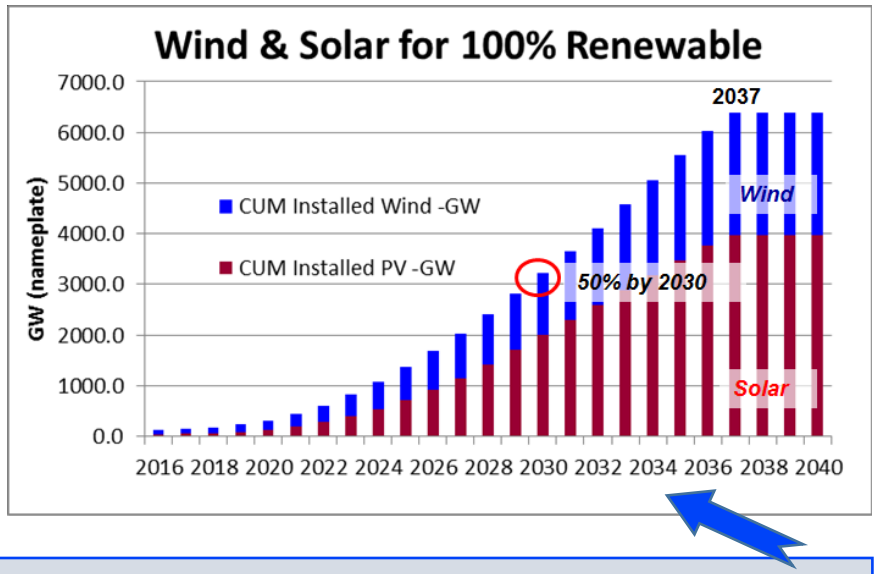
It was not surprising that 30% scenarios resulted in marginally less savings. As greater amounts of utility scale solar and wind farms are added, upgrades are needed to transport the energy greater distances. That is a similar to traditional power plants. However, even the worst case 30% scenario may deliver a savings of $49/MWh as seen in the graph.

Two Definitions of 100% Renewable Energy

Organizations, analysts, and policymakers talk about a 100% renewable energy goal. What is meant might be different, and it can be confusing. In one case, the goal is to replace current electricity generating methods with power derived exclusively from renewable energy sources. This typically includes the anticipate growth in consumption, such as the gradual increase in electric vehicles (EV), etc. In the other case, the goal is to fully replace additional energy sources used for heating and cooling, transportation, and any other small or large scale use of a fossil fuel. While the latter is much more ambitious, it is the surest way to maximize the benefits derived from eliminating the use of fossil fuels.

The effort and cost to replace all energy sources with renewable sources, usually referred to as wind, water, and sunlight (***WWS***), requires a big effort. Still, most analyses focus on this complete transition. It is a logical, best case target for the three sources of clean energy.

One aggressive plan for the U.S. was published in 2016 in Cleantechnica by retired Intel engineer Tom Solomon. The author considers a well-regarded academic study from Stanford, published in 2015. That study looks at the path to achieving 100% renewable energy by 2050. By accelerating investment in what are called *gigafactories* Mr. Solomon finds a path to reach 100% in 2037. A gigafactory essentially builds enough solar or wind products to exceed generating over 1GW of power each year.



A private proposal to accelerate a plan to achieve 100% renewable energy requires a significant expansion in solar capacity.

The original Stanford study authors, led by Prof. Mark Jacobson, defined a more moderate but sill aggressive path to achieve 80% by 2030, and a final 100% target by 2050. This study has become the foundation for organizations that champion an all renewable energy future, such as The Solutions Project. Being a thorough and well-documented academic effort, it provides a roadmap that can lead to actions for grassroots groups all the way to policymakers.

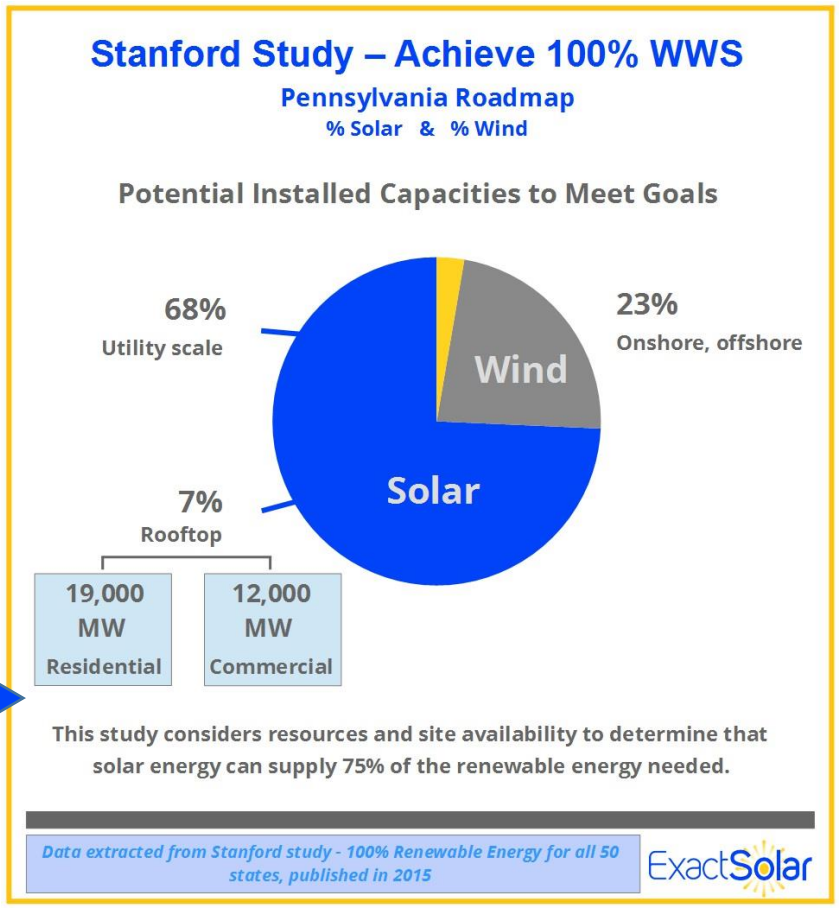
More useful, the study isolates the needs of each state and recommends options that eliminate all harmful emissions that result from the use of fossil fuels in all forms.

While the first author recommends an extremely rapid build out of factories, the Stanford study claims a more gradual schedule will be more practical. It defines the scale up of capacity in terms of units, or WWS generators. So the roadmap has a clear vision of systems needs and therefore product manufacturing levels required to reach the targets.

It is clear that the earlier PJM design to reach 30% and the hypothetical studies to reach 100% clean energy both rely on large amounts of solar energy. The authors of the Stanford work are careful to take into account all factors in arriving at values for the amount of solar, wind, and other minor sources of renewable energy.

For Pennsylvania, the Stanford authors find that nearly 75% of the energy mix should be provided by solar systems. And although the bulk should come from utility scale sites, approximately 19,000 MW is possible from residential rooftops. That translates to well over 3 million homes.

The detailed study of the roadmap to 100% clean energy for all uses finds solar best fits Pennsylvania, at every scale.



It is important to note that every study referenced so far only considers wind systems of a certain size. Unlike solar power, wind power is more efficient and effective as the individual wind turbines increase in size. Utility scale wind farms are almost exclusively favored. In contrast, solar panels and the associated power control hardware scales very well from distributed projects – typically residential and commercial systems – to the largest utility solar farms.

Combining recommendations and lessons from each of the analyses, the future energy picture comes into focus. Utilities and authorities like PJM accept their roles in finding solutions to accommodate growing clean energy markets. Researchers create scenarios and optional pathways to reach renewable energy levels from 20% all the way to 100% of the country's total energy needs. And the driver for this is simple: The energy revolution is now essentially grassroots. Over 80% of the public wants to see more solar and wind energy in use.

The Importance of Increasing Levels of Renewable Energy

The public so highly values increasing the adoption of solar and wind for a variety of personal reasons. But chief among those is the health and well-being of the country. So it is important to note the role clean energy plays in improving people's lives. No matter what emissions goals might be set, the great value of renewable energy systems comes from the reduction of every negative emission society wants to limit and reduce from traditional power plants. Whether nitrous oxides (NO_X) or greenhouse gases (GHG) are important to evaluate, replacing fossil fuel production with green energy naturally reduces all.

It is difficult to quantify the health benefits for incremental increases in clean energy. But here is a list of the known areas of impact from the usual power plant emissions:

Asthma, Bronchitis

Pneumonia

Chronic Lung

Other Lower Respiratory Issues

Other Upper Respiratory Issues

Heart Attacks

Certain Mortalities

According to EPA research, as the clean energy revolution expands associated costs for these health concerns will decrease. How much less they affect the population depends only on the speed at which each region of the country is able to reduce reliance on fossil fuel power svstems.

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