

RAPID, AFFORDABLE ENERGY TRANSFORMATION POSSIBLE ACCORDING TO NEW STUDY

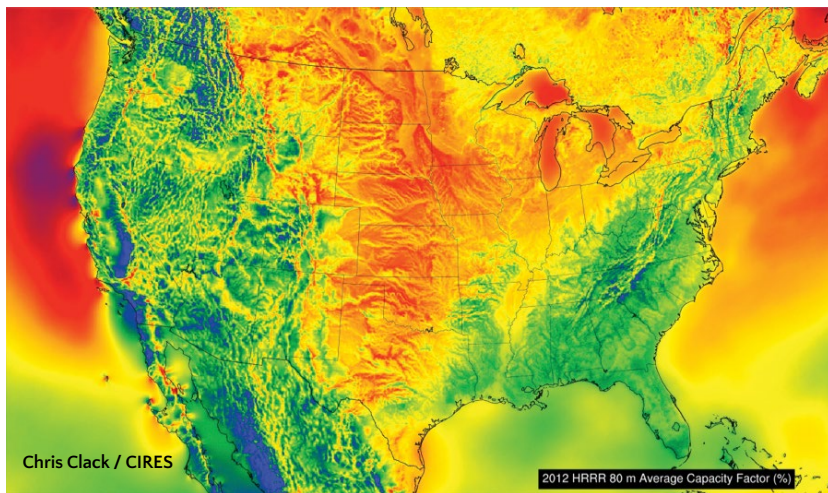
The United States could slash greenhouse gas emissions from power production by up to 78 percent below 1990 levels within 15 years while meeting increased demand, according to a new study by the National Oceanic and Atmospheric Administration (NOAA) and University of Colorado Boulder researchers.

The study used a sophisticated mathematical model to evaluate future cost, demand, generation, and transmission scenarios. It found that with improvements in transmission infrastructure, weather-driven renewable resources could supply most of the nation's electricity at costs similar to today.

"Our research shows that a transition to a reliable, low-carbon, electrical generation and transmission system can be accomplished with commercially available technology and within 15 years," said Alexander MacDonald, co-lead author and recently retired director of NOAA's Earth System Research Laboratory (ESRL) in Boulder, Colorado.

The paper was recently published online in the journal *Nature Climate Change*.

Although improvements in wind and solar generation have continued



A map based on NOAA weather data showing one measure of wind energy potential across the United States in 2012.

to ratchet down the cost of producing renewable energy, these energy resources are inherently intermittent. As a result, utilities have invested in surplus generation capacity to back up renewable energy generation with natural gas-fired generators and other reserves.

"In the future, they may not need to," said co-lead author Christopher Clack, a physicist and mathematician with the Cooperative Institute for Research in Environmental Sciences (CIRES) at the University of Colorado-Boulder.

Since winds are blowing (and the sun is shining) somewhere across the U.S. all of the time, MacDonald theorized that the key to resolving the dilemma of intermittent renewable generation might be to scale up the renewable energy generation system to match the scale of weather systems.

MacDonald, who has studied weather and worked to improve forecasts for more than 40 years, assembled a team of four other NOAA scientists to explore the idea. Using

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NOAA's high-resolution meteorological data, they built a model to evaluate the cost of integrating different sources of electricity into a national energy system. The model estimates renewable resource potential, energy demand, emissions of carbon dioxide (CO₂), and the costs of expanding and operating electricity generation and transmission systems to meet future needs.

The model allowed researchers to evaluate the affordability, reliability, and greenhouse gas emissions of various energy mixes, including coal. It showed that low-cost and low-emissions are not mutually exclusive.

"The model relentlessly seeks the lowest-cost energy, whatever constraints are applied," Clack said. "And it always installs more renewable energy on the grid than exists today."

Even in a scenario where renewable energy costs more than experts predict, the model produced a system that cuts CO₂ emissions 33 percent below 1990 levels by 2030 and delivered electricity at about 8.6 cents per kilowatt hour. By comparison, electricity costs 9.4 cents per kWh in 2012.

If renewable energy costs were lower and natural gas costs higher, as is expected in the future, the modeled system would cut CO₂ emissions by 78 percent from 1990 levels

and delivered electricity at 10 cents per kWh. The year 1990 is a standard scientific benchmark for greenhouse gas analysis.

A scenario that included coal yielded lower cost (8.5 cents per kWh), but the highest emissions.

At the recent Paris climate summit, the U.S. pledged to cut greenhouse emissions from all sectors up to 28 percent below 2005 levels by 2025. The new paper suggests the U.S. could cut total CO₂ emissions 31 percent below 2005 levels by 2030 by making changes only within the electric sector, even though the electrical sector represents just 38 percent of the national CO₂ budget. These changes would include rapidly expanding renewable energy generation and improving transmission infrastructure.


In identifying low-cost solutions, researchers enabled the model to build and pay for transmission infrastructure improvements — specifically a new, high-voltage direct-current transmission grid (HVDC) to supplement the current electrical grid. HVDC lines that are used around the world reduce energy losses during long-distance transmission. The model did choose to use those lines extensively, and the study

found that investing in efficient, long-distance transmission was key to keeping costs low.

MacDonald compared the idea of a HVDC grid with the interstate highway system that transformed the U.S. economy in the 1950s.

"With an 'interstate for electrons,' renewable energy could be delivered anywhere in the country while emissions plummet," MacDonald said. "An HVDC grid would create a national electricity market in which all types of generation, including low-carbon sources, compete on a cost basis. The surprise was how dominant wind and solar could be."

The new model is drawing interest from other experts in the field.

"This study pushes the envelope," said Stanford University's Mark Jacobson, who commented on the findings in an editorial he wrote for the journal *Nature Climate Change*. "It shows that intermittent renewables plus transmission can eliminate most fossil-fuel electricity while matching power demand at lower cost than a fossil fuel-based grid — even before storage is considered." 

— Source: *Cooperative Institute for Research in Environmental Sciences (CIRES)*

For more information, go to www.cires.colorado.edu.

COMMUNITY CONSENT AND LAND RIGHTS KEY TO GROWTH OF RENEWABLES

According to a recent announcement by the nonprofit organization Equitable Origin (EO), conflicts over land rights and consultation with local communities present mounting risks to the global expansion of renewable energy. The announcement accompanied the organization's release of a case study on wind development in the Mexican state of Oaxaca, which is fraught with resistance from local and indigenous communities. The case study, "Defining and Addressing Community Resistance to Wind Development in Oaxaca," is available for download from the Equitable Origin website.

Community protest and a delayed wind energy project in Oaxaca represent a broader trend, according to EO's CEO Soledad Mills.

"Because most utility-scale renewable energy projects require vast areas of land, they carry a high likelihood of causing conflicts over land rights and land use, in addition to other local-level social and environmental impacts," Mills said. "As the important global push toward renewable energy ramps up and development expands to new parts of the globe, the potential for conflicts that delay projects and increase costs will grow."

Mills also said that developers of and investors in renewables projects have a unique opportunity to avoid the pitfalls of the past 100 years of energy development.

“The risks to renewables projects presented by land rights conflicts and community opposition are manageable, but if ignored, they could bring about a slow-down in renewable development at a time when the world needs it most,” Mills said. “Credible, independent standards for observing land rights and productively consulting with local communities can streamline projects and facilitate the rapid development that’s required to achieve climate goals and meet growing demand for clean energy.”

Mills added that EO’s case study on conflicts in Oaxaca offers insights into how to address them in other parts of the world.

“Our recommendations in the study for more inclusive, complete, and culturally sensitive engagement efforts can lead to better outcomes for communities and more efficient project implementation,” Mills said. “EO’s voluntary, community-oriented EO100 standard for responsible energy development, associated services, and experience in engagement with local and indigenous communities can help identify and implement best social practices with project stakeholders.”

According to Mills, the global renewable energy boom that received a major boost from the COP21 agreement offers great hope for mitigating climate change as well as an opportunity to raise the bar for social practices.

“At this exciting historical moment when there has never been more focus on combating climate change, we can facilitate efficient renewable energy development while ensuring that the benefits of a safer, cleaner energy future are shared with local and indigenous communities,” Mills said. “Now is the time for communities, companies, regulators, investors, and NGOs



[non-governmental organizations] to come together in support of responsible renewable energy development, in Mexico and around the world.”

— Source: *Equitable Origin*

For more information, go to www.equitableorigin.org.

WIND ENERGY WAS A TOP SOURCE FOR NEW ELECTRIC CAPACITY IN 2015

Wind energy installed more electric generating capacity last year than any other energy source in America.

The 8.6 GW of wind power capacity installed surpassed the 7.3 GW of new solar photovoltaic capacity and 6 GW installed by natural gas, according to data

from the American Wind Energy Association (AWEA) and the recently released Business Council for Sustainable Energy (BCSE) and Bloomberg New Energy and Finance (BNEF) 2016 Factbook. Wind accounted for more than 35 percent of new generating capacity, while all renewable resources

together provided 68 percent of the new capacity, according to the factbook.

“Wind’s growth is being propelled by cost reductions of two-thirds over the last six years, which now makes wind the lowest-cost source of new generation,” said Tom Kiernan, CEO of AWEA,

at the annual winter meeting of the National Association of Regulatory Utility Commissioners (NARUC) in Washington, D.C. “It’s one of the biggest, fastest, and cheapest ways we can reduce U.S. carbon emissions, and it’s the low-cost solution for power sector reductions. Utilities and other purchasers are turning to wind energy because it provides stably-priced energy with no fuel price risk and protects consumers by creating a more diverse energy portfolio.”

After a strong finish last year, wind energy is off to a good start in 2016 with an additional 9.4 GW under construction, an additional 4.9 GW in advanced stages of development, and a predictable federal production tax credit for the next several years.

“With long-term policy certainty in place, wind power is ready to keep this American success story going,” said Mike Garland, CEO of Pattern Energy and current AWEA board chair. “Further investments in our technology will enable utilities to cut costs and pass on the savings to American homeowners and businesses.”

According to Chris Brown, president of Vestas Americas, these impressive results drive home the point that wind is a cost-effective solution that makes business sense.

“More than 500 wind industry factories in 43 states are turning out taller turbines, longer blades, and other components that capture more energy, helping further drive down our costs and opening up new parts of the country for utility-scale wind farms,” Brown said.

When the U.S. Supreme Court put a temporary stay on certification of state plans under the federal Clean Power Plan, states and utilities continued to develop solutions to reduce carbon pollution from fossil power plants. Many utilities

have already indicated that the stay will not affect their planned generation changes. Many recognize that carbon reductions are inevitable, and the Supreme Court has already affirmed in multiple rulings that the EPA has the authority and obligation to regulate greenhouse gas emissions.

In a recent statement in which Xcel Energy said that it plans to invest \$6 billion in wind and solar energy, the company also said that while the Supreme Court’s ruling is a significant development in this case, the merits of the case have not been decided and the legal proceedings will continue.

“Xcel’s analysis of the strategy, which speeds up wind and solar investment in this decade, shows it to be a cost-effective way to reduce greenhouse gas emissions by 60 percent by 2030 — likely beyond Minnesota’s requirements under the Clean Power Plan,” said Laura McCarten, regional vice president for Xcel.

After the stay, Xcel said it would continue to work with states and stakeholders on plans “to create sustainable and affordable energy futures... This approach will not only ensure compliance with existing and new regulations, but also take advantage of new technologies, recognize evolving customer needs, and continue to drive improvements in how we produce and deliver energy.” Grid operators such as PJM Interconnection have also indicated that they plan to proceed with planning to accommodate the Clean Power Plan, as have many states.

With wind energy costs at an all-time low and the recent extension of key federal tax incentives for wind and solar, a new analysis using a Department of Energy modeling tool concludes that the tax extenders allow states to meet

pending carbon dioxide regulations almost exclusively with zero-emitting renewables.

Zero-emission wind energy also provides states and utilities with more flexible options for reducing pollution, relative to energy sources with some emissions that would require the replacement of far more existing generation to achieve the same level of emissions cuts.

WIND POWER CUTTING COSTS

The rapid growth of renewables and the continued retirement of coal plants have not significantly impacted retail prices, according to BCSE and BNEF’s 2016 Factbook, which reported that retail electricity rates across the country remain 5.8 percent below the recent peak (2008).

Innovations by the wind industry have helped lower wind power’s costs by two-thirds in the last six years, as shown by the Lawrence Berkeley National Laboratory. The Wall Street investment firm Lazard also found a cost decline of more than 60 percent and notes that wind energy is the lowest-cost energy source for reducing emissions, even before tax incentives.

MidAmerican Energy recently obtained approval from the Iowa Utilities Board for the addition of 1,050 MW of wind energy in Iowa, for example. The expansion is planned to be built at no net cost to the company’s customers and will help stabilize electric rates over the long term by providing a rate reduction totaling \$10 million per year by 2017 with a \$3.3 million reduction in 2015, according to MidAmerican.

When Southern Company’s Alabama Power made its first wind power purchase, it said that the price of energy from the wind facility is expected to be lower than

the cost the company would incur to produce that energy from its own resource with the resulting energy savings flowing directly to the company's customers.

"The levelized cost of energy (LCOE) from wind has fallen dramatically in recent years," said David Engels, senior manager of operations renewable asset strategy for Alliant Energy and session chair for utility issues during this year's Windpower event in New Orleans from May 23 to 26. "Increases in overall turbine efficiencies coupled with reduced turbine costs have made wind competitive with alternate sources of generation. Independent power producers and utilities alike continue to evaluate and make investments in their wind portfolios."

WIND POWER HELPING UTILITIES KEEP THE LIGHTS ON

With today's installed capacity, wind energy produces enough electricity to power more than 19 million U.S. homes.

Iowa, South Dakota, and Kansas all source more than 20 percent of their annual electricity from wind. Wind power already provides a total of nine states with 12 percent or more of their annual electricity production.

The Electric Reliability Council of Texas (ERCOT), the primary grid operator in Texas, has seen wind reliably meet as much as 44.7 percent of its electricity demand at certain points in time, peaking at 13,883 MW in December 2015. Wind supplied 18.4 percent of ERCOT's total demand for the full month of November 2015 and surpassed nuclear as the third largest source of generation in ERCOT for all of 2015. Wind has supplied as much as 12,720 MW in MISO, the grid operator for parts of 12 Midwest states. Last December,

wind production hit 9,948 MW in the Southwest Power Pool (SPP), the grid operator for all or parts of eight states. On the main Colorado grid, wind provided 66.4 percent of the electricity at one point in November 2015. These real-world examples demonstrate how utilities are reliably integrating large amounts of wind energy today.

However, barriers remain to spreading wind energy's low-cost benefits to all corners of the country. Access to sufficient transmission infrastructure will be an important catalyst for future growth of wind energy. Analyses by grid operators SPP and MISO confirm that transmission provides billions of dollars in net benefits to consumers by reducing costs and improving reliability, by gaining access to America's best wind resources.

The Department of Energy's (DOE) Wind Vision report shows a path for wind power to double in the next five years and supply 20 percent of U.S. electricity needs by 2030, creating tremendous economic and environmental benefits along the way. Consumer savings from wind are projected to reach \$14 billion a year by 2050, with cumulative savings on electricity bills reaching \$149 billion.

2015 ranks as the third highest year for wind installations on record. American wind power has installed as much as 13,124 MW in a single year (2012) when wind also was the largest source of new electrical generating capacity as it was last year. ↴

— Source: AWEA

For more information, go to www.awea.org.

MAEDC AREA

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Amazing Transportation Access

- Air: Local Airports
- Truck: Interstate 70
- Port: Via Missouri River
- Rail: Multi Rail Access

7th BEST economic competitiveness

Our region is located near the center of the population of the US called the population mean. Making distribution centralized.

Missouri is ranked 7th by the American Legislative Exchange Council

Our region is a beautiful historic area

10th Regulatory Environment

US v MAEDC Average Wage

US: \$22

MAEDC: \$14

Broadband + 4G

Thousands of Skilled Laborers

State and Local Incentives