

# VIBRANT CLEAN ENERGY, LLC

**CONFIDENTIAL**

**Embargoed for release until**

19<sup>th</sup> June, 2017 at 3pm ET

Contact: Christopher Clack at [christopher@vibrantcleanenergy.com](mailto:christopher@vibrantcleanenergy.com) or (720)668-6873  
For copies of the paper contact [pnasnews@nas.edu](mailto:pnasnews@nas.edu)

## **New paper says a wider range of technologies are better for tackling climate change**

**Boulder, CO** – The climate crisis can only be solved if the entire global economy is transitioned to one that emits almost zero greenhouse gases into the atmosphere. Currently, renewable energy is one of the cheapest additions to the electricity grid in the US, and achieving 80% reductions in emissions reliably by 2030 is attainable. The most cost-effective reductions in greenhouse gas emissions (GHG) from the electricity sector in the US are found with a national High-Voltage Direct Current (HVDC) transmission system, which can supply the demand reliably using over 60% renewable generation. The national HVDC transmission takes advantage of the variability of wind and solar over large scales; opening up more diverse and transparent markets.

The current study, from a group of 21 top researchers was published by the *Proceedings of the National Academy of Sciences*. The new paper's coauthors include Dr Christopher T M Clack, of Vibrant Clean Energy LLC, and 20 other experts hailing from Stanford, UC Berkeley, UC San Diego, Carnegie Mellon University, and other universities, many of whom have devoted great effort to demonstrating how variable renewable energy, such as wind and solar, can play a dominant role in meeting our energy needs. The group show that solving the climate problem cost-effectively will depend on making use of all possible clean energy technologies, correcting a misleading 2015 research roadmap by Jacobson et al. that indicated the entire United States could be powered almost exclusively by solar, wind, and hydroelectric energy.

"Our energy system is leaking waste carbon dioxide into the atmosphere. When you call a plumber to fix a leak, perhaps you shouldn't suggest that she leave some of her tools at home," said Caldeira, Carnegie scientist and climate modeling expert. "Having a full toolbox means you are more likely to be able to solve the problem."

Policy makers should carefully scrutinize the visions of entire energy systems that rely almost exclusively on wind, solar and hydro-electric power that do not take into account transmission expansion, reserve requirements, costs of new infrastructure, high resolution weather data (spatially and temporally), commercial scalability of technologies, and physical constraints on the system. Studies that do consider these factors show that a transition of the electric sector that emits 80% less GHGs by 2030-2050 is feasible and cost-

# VIBRANT CLEAN ENERGY, LLC

effective. Further, the current system is only 19% carbon-neutral and continued rapid deployment of wind and solar is of paramount importance.

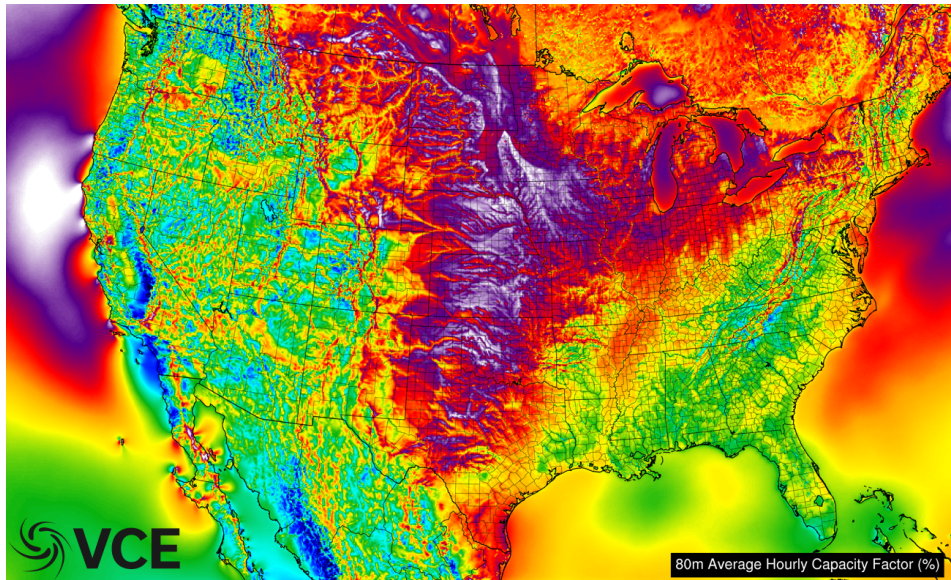
“When we talk about reducing the amount of carbon in the atmosphere — decarbonization — there is an increased recognition that a diversity of approaches is not only smart, but necessary,” said Victor, who is also co-director of the Laboratory for International Law and Regulation at UC San Diego and co-chairs the Energy Security and Climate Initiative at the Brookings Institution.

Recent science and international agreements call for the almost complete elimination of GHG emissions from the global economy by mid-century to keep Earth’s climate stable. In developing a strategy to effectively mitigate global energy-related GHG emissions, it is critical that the scope of the challenge to achieve this in the real world is accurately defined and clearly communicated. The new paper, ***Evaluation of a proposal for reliable low-cost grid power with 100% wind, water, and solar***, reviews some previous studies showing why deploying a combination of many low carbon technologies and approaches; such as improved operational research, energy efficiency, renewable energy, nuclear energy, and scrubbing of carbon from fossil fuels where necessary – will be needed to achieve this goal. The paper then shows how claims to the contrary – using as an example the highly-publicized work from Jacobson et al. in PNAS in 2015 - are unsupported by reliable evidence.

“There is no more urgent task than achieving a near-zero-emission energy system as soon as possible to combat climate change,” said Clack, lead author with expertise in energy modeling of decarbonized grids. “While wind, solar, and hydroelectric should play a central role in future American energy systems, we concluded that a much broader array of energy technologies is necessary to complete the transition to a zero-emissions future as quickly and seamlessly as possible.”

“Previous research, by myself and others, indicates that there are numerous low-cost pathways that can rely on a substantial share of our energy needs coming from wind, solar and hydroelectric generation. After that point, more nuance is required to transition remaining energy needs to low-emission sources because of wind, solar and hydroelectric inter- and intra- annual variability. It can be achieved cost-effectively with a combination of complex operational research, smarter market design, energy efficiency, synthetic fuel production, and dispatchable near-zero-emission generation,” said lead author Clack. “If we use all the available tools, then we have a good chance to do this at an affordable cost. But success is much less likely if we arbitrarily throw half those tools away at the outset,” Clack added.

# VIBRANT CLEAN ENERGY, LLC



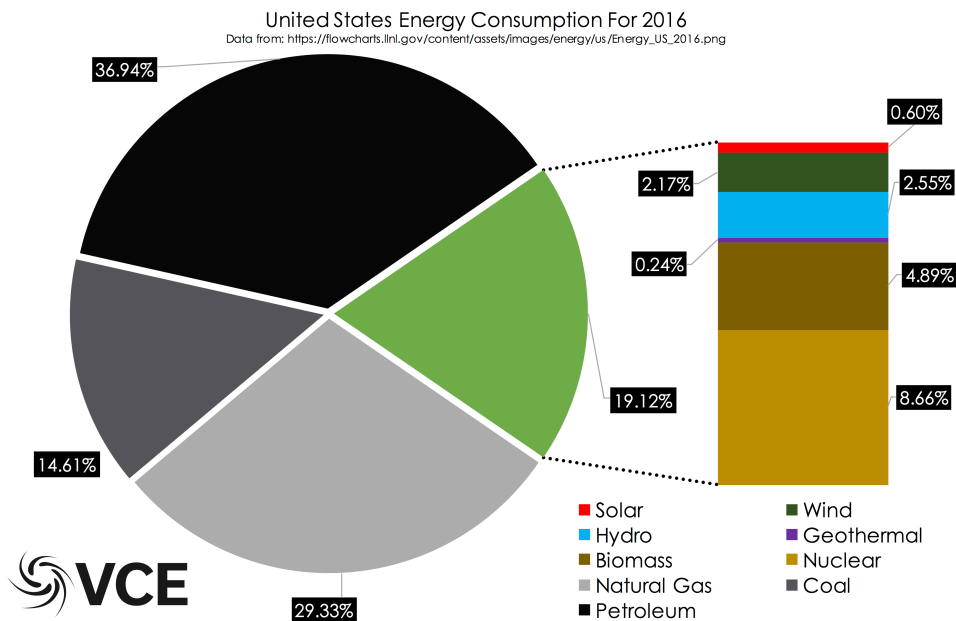
**Caption:** *This map shows the resource potential of wind across the contiguous United States. The research says that since weather-driven resources are variable, a diverse portfolio of technologies and approaches are needed to meet the 100% greenhouse gas emission reduction needed to combat climate change.*

The authors concede that there is likely to be some practical upper limit to the use of renewables on the grid due to the variability of sun and wind and the built-in inflexibility for some of our energy needs. The authors note that is why the majority of peer-reviewed studies and international expert bodies, including the Intergovernmental Panel on Climate Change, and the recent mid-century climate strategy from the Obama Administration, conclude that achieving a much lower carbon energy system will require a wide variety of low carbon energy options.

Professor Tynan in the Department of Mechanical and Aerospace Engineering at the Jacobs School and a member of the UC San Diego Center for Energy Research stated that “Getting to 80 percent reduction in carbon emission rates is going to be tough, and decarbonizing beyond 80 percent will be even more challenging. That’s why it’s important to be as rigorous as possible in laying out a pathway to this goal”.

“Any serious proposal for near-zero-emission energy must address the fact that carbon-emitting fossil fuels today supply 80 percent of the energy for our transport systems, industrial base and electrical grids. Replacing all of that energy with no emissions in just a few decades reliably and affordably is a Herculean task that we must not underestimate,” said Dr Clack. “Renewables like wind and sun can carry a big part of that load, but anyone who claims they can do it all or nearly all needs to supply rock-solid evidence – which we have yet to see. In the meantime, a policy prescription that over-promises on the benefits of relying on a narrower portfolio of technologies options could be counterproductive, seriously impeding the move to a cost effective decarbonized energy system.”

# VIBRANT CLEAN ENERGY, LLC



**Caption:** The current energy mix in the US is 81% fossil-fuel based and 19% near-zero-emission based. The entire energy system needs to transition to near-zero-emission by 2050 to avoid dramatic climate change consequences.

Vibrant Clean Energy LLC (VCE) ([vibrantcleanenergy.com](http://vibrantcleanenergy.com)) is a private, for profit organization headquartered in Colorado. VCE creates, and licenses, computer software to cost-effectively configure pathways for energy systems under various political, regulatory, economic and emission controlled futures. It also performs detailed studies using its software for clients looking at reliability, cost-effectiveness, performance of variable renewables, and zero-emission grids. In addition, VCE computes forecasts for wind and solar power producers at high resolution to help with operations of existing facility within markets. The mission of VCE is to help facilitate universal, sustainable and cheap energy for everyone.