Testimony at the Vermont House Energy and Technology Committee

Paul Hines, Ph.D.
CEO, Packetized Energy and Professor of Electrical Engineering, University of Vermont

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Hello. My name is Paul Hines. I'm co-founder and CEO of Packetized Energy, a Vermont based clean energy startup. I'm also a professor at the University of Vermont.

My passion is to solve problems associated with our transition to clean, affordable and resilient energy systems, something that I have been doing for the last 20 years. After earning BS and MS degrees in electrical engineering, I earned my Ph.D. at Carnegie Mellon University in Engineering and Public Policy in 2007 through a program focused on developing interdisciplinary solutions for the electricity industry. I have previously worked at the US Federal Energy Regulatory Commission on problems associated with nuclear power plants and grid reliability; at a US National Laboratory developing algorithms for smart grid systems; at a large US engineering firm designing power substations; and at Alstom Grid, designing software to predict changes in load. For the last 12 years, in addition to serving as a commissioner for the Burlington Electric Department, I have been a professor at the University of Vermont leading a team of innovative graduate students and post-doctoral scholars working on solutions for emerging challenges in the electricity industry. Our work has been funded by the National Science Foundation, PJM (the mid Atlantic grid operator), VELCO, and the Department of Energy. Our research has been featured in Scientific American, Science Magazine and NPR.

About 8 years ago, as a part of my work at the University of Vermont a fellow Professor, Jeff Frolik, and I discovered a way to adapt an algorithm that Jeff had previously used to manage the communications among wireless sensors, to the problem of too many electric vehicles charging on the grid at the same time. The problem is this. If all of a sudden everyone goes out and buys EVs and they all plug their cars into the grid at 6pm, the grid will break. It is not designed to handle that kind of sudden increase in demand. The algorithm that we discovered enabled EVs to all get the charge that they needed without overloading the grid. The implications are that we can

make the transition to clean electric transportation, without massive new investments in grid infrastructure, which is great.

About 5 years back, Prof. Mads Almassalkhi joined us at the University of Vermont. We began talking about our algorithm for EV charging and he helped us to see that we could adapt the algorithms further to manage water heaters, building heating and cooling systems, pool pumps, batteries and many other types of devices. We then wrote a proposal to the Department of Energy's Advanced Research Projects Agency (ARPA-E) and they awarded us a $2 million project to develop systems for managing millions of distributed energy devices to solve problems in the grid. We were one of 12 teams originally selected to solve the problem of managing the future of distributed energy systems. Other teams were from Stanford, GE, and some of our top national laboratories. After 3 years of work, our Vermont-based team was selected as one of two most successful teams in the cohort and was awarded funding for another 2 years of work.

Early on in the project, we realized that our solutions had the potential to solve some of the biggest problems facing the global electricity industry. And so, we launched Packetized Energy in 2016 to start transforming research ideas into practical solutions that could solve real problems in the electricity industry.

Which brings me to the two biggest challenges and opportunities facing the global electricity industry. First, wind and solar are the fastest growth sources of energy worldwide. This is very good news for the climate but presents serious challenges for the grid. We are already seeing here in Vermont how wind farms in the Northeast Kingdom are curtailed due to grid infrastructure that can't handle the growth in variable supply, and solar is creating huge uncertainty because the effective need for imported electricity changes by 30% or more depending on whether it's a cloudy day or not. Vermont is a leader in energy efficiency. But energy efficiency cannot solve this problem. We need something smarter than energy efficiency.

The second challenge is this: the electric grid is our best hope for decarbonizing energy. The hydrogen economy is a long way off. Biofuels face a number of difficult barriers. As a result, we

need to move almost all energy usages to grid electricity 10-20 year. If we don't manage this transition well, this new load will break our already aging grid.

Which brings me back to our work at Packetized Energy. At Packetized Energy we are transforming everyday energy devices like water heaters, heat pumps, EV charging stations, and batteries into resources that solve problems in the grid. We started our work with electric hot water heaters, building a device that we call the Mello, a smart thermostat that transforms a fleet of ordinary water heaters into valuable "virtual batteries" that can balance supply and demand in the grid, saving rate payers a lot of money.

We are supporting an innovative pilot program at Burlington Electric, in which BED is providing its customers with half price electric energy for their EV, so long as they use our device which only charges cars when electricity is cheap.

And we are soon to launch a new product that will enable Cold Climate Heat Pumps that are rapidly being adopted by Vermonters who want to transition to high efficiency, low carbon energy, to participate in our grid optimization programs.

Even though we are a small company of only about 12 people, Packetized Energy is increasingly recognized as an emerging leader in grid optimization technology. We now have 7 pilot projects with utilities; 4 here in Vermont, 1 in California, 1 in South Carolina and 1 in Canada.

However, the problem is this. The regulated electric utility industry is a cautious industry and runs on very tight margins. Selling new pilot projects to electric utilities can take years. And moving from pilot project phase to full scale can take even longer. It takes a long time for companies like ours, who depend on revenue from electric utilities, to build up the revenue needed to attract the external investment needed to hire the business development and technology teams that we need to grow.

This is where I believe that the proposed Clean Grid Optimization Proposal can help. Take, for example, the heat pump pilot proposal. As I understand it, this element would provide some

additional state support to launch Vermont into the lead in the transition from fuel oil to clean electric heating systems. But in order to make this transition work without adding enormous new costs we need to manage these loads so that we primarily use electricity when it is cheap and clean and in ways that will not break the grid. Packetized Energy has the core technology needed to do this. However, we will need some seed funds to demonstrate the potential and to build the business cases needed to obtain commercial funding for larger scale projects. I believe that the proposed Clean Grid Optimization Proposal can help tremendously in moving clean energy companies like ours from pilot phase into larger projects that will have a significant impact on the global transition to clean energy.

My vision is to leverage the innovative technology and business models that Packetized Energy will develop and demonstrate here in Vermont to accelerate the transition to clean energy sources for water and space heating, first here, and then to reproduce that model all across the world. By doing so I believe that we can build one of the most valuable energy companies in the world, while also creating hundreds of great jobs right here in Vermont.

Zooming out for a minute, Vermont has been and can continue to be a leader in the global transition to clean energy. Our electric utilities are doing great things for Vermont as they purchase renewable power and adopt smart grid technology. However, the real opportunity for Vermont is to become a leader not only in the energy that it provides to its citizens, but also a leader that exports that same innovative technology to the rest of the world. Doing so would be tremendously valuable for the Vermont economy and could contribute to solving the global climate crisis.

In light of this I strongly support the Clean Grid Optimization Incentive Package that is included in H. 678 and encourage the committee to pass this package through to the house for a vote and adoption.