



Utility Savings & Refund, LLC

Energy Storage for Renewable Energy and Grid Stability

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Toward Perpetual Wind Power: How VRB™ Energy Storage Lowers Energy Bills and Improves Project Economics

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Summary

The rapid deployment of renewable energy in the United States has led to a growing concern about the intermittency of these energy sources and their effect on the stability of the power grid. Wind energy in particular is creating major challenges for power dispatchers. According to the US Department of Energy, for every one gigawatt of new wind capacity brought on-line, another 17 megawatts of spinning reserve – the extra generating capacity that can be delivered without delay – must be purchased to protect against increased variability in power supply.

Wind developers are typically worried that the extra costs of adding utility-scale energy storage systems will hurt their project economics. But US&R has proven – in the development of actual wind installations – how Prudent Energy's VRB™ Energy Storage Systems (VRB-ESS™) is an attractive, affordable *solution*. For example, a VRB-ESS™ installed on-site, "behind the meter", alongside megawatt-size wind turbines, creates a practical means of monetizing savings for commercial and industrial end-users through the avoidance of high tariffs and demand charges. In short, wind power, combined with the high performance and low operating cost of Prudent's VRB-ESS™, creates the highest value proposition for the renewable energy customer.

Background

US&R noticed during one discussion with a leading US wind developer that he was not including demand reduction in the project's energy savings calculation. His reasoning was that, with monthly electricity demand based on the peak kilowatt per month (based on 15 minutes of metered data), wind output was too intermittent to have any appreciable impact on utility bill demand charges for his industrial customer. In addition, it seemed potentially to make sense to switch to a special utility tariff – a time-of-use tariff with a new option (call it "Energy Only Option R") that reduced demand charges and increased energy charges. There were no time-dependent demand charges and roughly half of the facilities-related demand.

Before switching to this special tariff, we asked the wind developer to analyze his time series data of wind turbine production and usage. One trade-off in particular appeared key to the savings analysis – the amount of energy the wind project would produce during the summer peak period, versus the amount of wind energy customers actually used during those summer on-peak hours.

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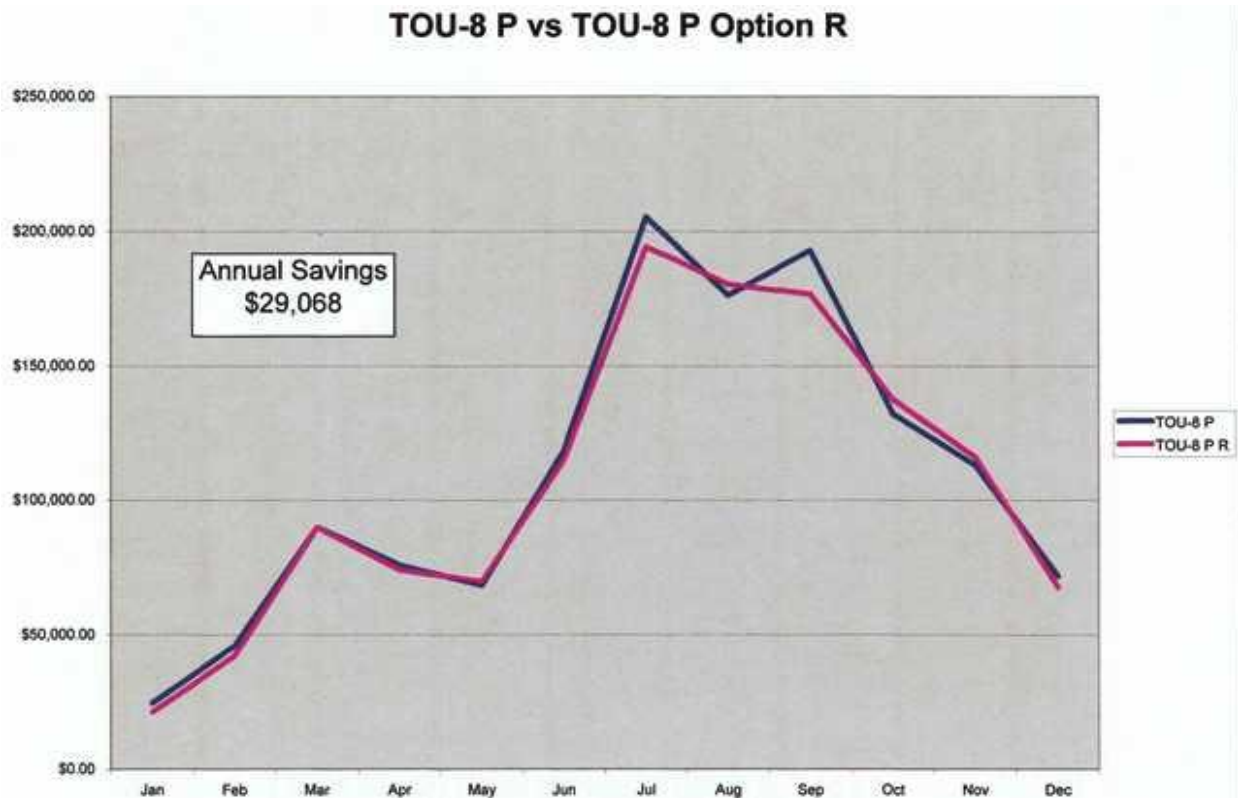
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This supply-demand ratio in effect was the risk of switching to the Energy Only Option R tariff. By accounting for diurnal wind patterns and 'weighting' the output by the number of hours, the production ratio was well over 100% for the summer. With consistent summer afternoon winds at the site, usage was estimated at 85-95%. The summer on-peak rate was very high. Demand charges for industrial customers in this project exceeded 40% of their total electricity costs. Therefore, those demand charges would *presumably* be captured by switching to the new "green friendly" tariff.

The VRB-ESS™ Solution

US&R modeled the trade-offs inherent in Option R versus the standard time-of-use tariff, and found some interesting dynamics. First, when switching to Option R, the *facility* charge was indeed reduced by half. However, the *energy* charge was *increased*. Deciding which tariff to use had everything to do with load factor.

With the significant increase in energy charge (more than \$0.04 - \$.30 per kilowatt-hour), US&R determined that a customer with a *low* load factor, say of less than 50%, would probably come out better with Option R. This type of customer would have occasional spikes in demand, setting the demand charge high relative to the actual usage. Switching to Option R would remove the demand charge from the billing, offsetting the higher energy charges. But the load factor would have to *remain* extremely low over time to achieve significant savings. To prove the point, US&R conducted an analysis on one of its customers with a spiky load profile, and the savings were minimal (see graph below).



Our results showed that the project's customers would be better served if the standard time-of-use tariff were used – with its low energy cost – while reducing spikes in demand using the VRB-ESS™. For example, a 1 MW VRB-ESS™ can reduce the monthly demand by 1 MW as follows:

- The VRB™ effect on facilities demand charges (which in many states can exceed \$10/kW) over 12 months equates to savings of \$120,000 or more.
- For the 4-month summer mid-peak charge, a 1 MW monthly reduction in demand achieves \$20-25,000 in savings.
- For the 4-month summer on-peak charge – which can reach above \$20/kW – the savings are \$75-90,000.
- Total savings in demand charges alone as a result of a 1 MW VRB-ESS™ installation can therefore exceed \$250,000 in states with high tariffs.

Lowest Cost of Installation and Operation

Integrating an energy storage system such as the VRB-ESS™ may increase costs compared to installing a wind turbine alone. However, when the proper financing and incentives exist, the VRB™ system, associated with the wind turbine, allows for greatly increased financial benefits to the end-user. Not only does a wind / VRB™ combination provide greater savings to the customer, it also creates additional value streams like emergency power, UPS, curtailment avoidance, demand response, ancillary services, reduced greenhouse gases, increased power quality, reduced line losses, deferred transmission costs, black start capabilities, and more.

Based on this analysis, we advocate evaluating the benefits of a VRB™ Energy Storage System at the outset of a wind power project, rather than waiting until after the wind turbine is installed.

Charles R. Toca and his company, Utility Savings & Refund, LLC, have been saving money on natural gas and electric costs for large energy users for more than 15 years. Charles and US&R have achieved this through creative projects, collaborative efforts, large group energy purchase, and fee based energy procurement services. For example, he was a founding board member of the California Energy Users Cooperative in 1999, representing large agricultural cooperatives like Sunkist and Land O'Lakes, purchasing 50 MW of electric demand. He is located in Southern California and is the USA sales affiliate for the VRB™ flow battery of Prudent Energy Corporation, a Delaware corporation headquartered in Bethesda, Maryland. Charles has promoted the VRB™ energy storage system since he first learned of the technology in 2006. He believes that bulk energy storage systems, like the VRB-ESS™, can offer multiple economic benefits to energy users, utilities and the grid operator - in a single installation.