Vanadium – Help Yourself

A spin-off from the surge in green energy solutions in recent years (particularly wind and solar) is that the world is now awash in electricity that is not generated when it is wanted or needed but rather when the sun shines and the wind blows. This is not exactly the best way to run a grid management system. The missing part of this equation is storage devices to stash away this power for, quite literally, a rainy day.

Some bizarre suggestions for "do it yourself" story have emanated from Tesla but as with everything from that source it's more a case of form over content. What is needed is a realistic means by which either the power generator (in some cases households) or the grid operator can store up the energy for when it's really needed and thus flatten the peak load problem that has bedeviled electricity distributors since the dawn of the modern age.

The solution, many knowledgeable observers believe, may very well lie in the Vanadium Redox Battery (VRB).

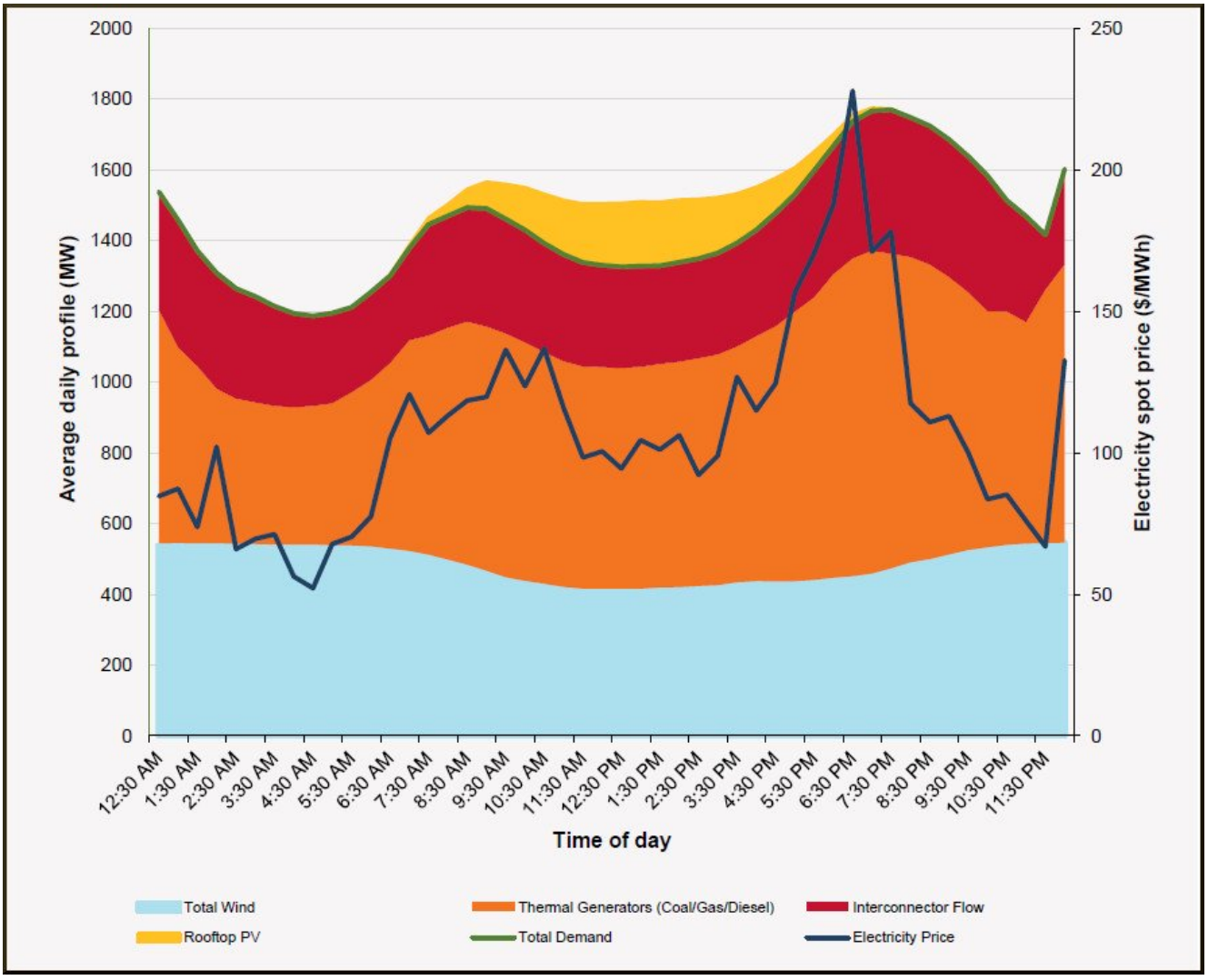
The South Australian Experience

The Australian state of South Australia is not exactly a place that is seen as being very innovative. If the rest of the world knows about it then it's primarily for its wine production. What the state does have in abundance is sunshine and this led to high levels of uptake of solar panels. However to put this in perspective the southern part of the state (where the bulk of the people live in the city of Adelaide) has nowhere near as many cloudless days as say, Nevada or Arizona.

There are solar panels everywhere these days (though not as many as there might be) and yet few places have come up with as comprehensive a policy as to exploit them as South Australia has. As a result the state is already being hailed

for its leadership on renewable energy technology. Its efforts have been styled as “a consumer-powered grid”.

A report from the Australian Energy Market Operator highlights that 9.2% of the electricity generated in the state over the last financial year came from small-scale (sub 100kW) solar PV on the rooftops of households and businesses in the state. The graphic below shows the sourcing of energy an average day in South Australia over the last year.



This new style of electricity sourcing is called “distributed generation”.

The level of rooftop solar penetration in South Australia is a record for any major grid in the world, and the contribution of rooftop solar is likely to have been well over 10% in the last year (when larger rooftop solar installations of more

than 100kW are included).

According to AEMO forecasts, the total will likely at least double over the next 10 years to more than 20%, at which time rooftop solar will be pushing “minimum demand” from the grid to zero on occasions.

As can be noted from the graphic the solar component is, unsurprisingly, during the core daylight hours yet the peak of demand for power (and peak in pricing) is just after the solar ceases to be a factor. Indeed one might even interpret that the absence of solar at that point prompts the price spike, but that is a chicken-and-egg debate.

It is here that VRB’s can potentially play a part. The ability to store power from the low usage periods and then spill it back into the grid at peak demand periods would be a major advantage. This prompts another thought. With grid operators paying peanuts to solar “vendors” then it is not really in the public’s interest to invest in storage devices to stash the power, but seemingly the grid operators are not doing so either. One or the other needs to make this investment. For the grid to do so would require massive “battery farms” with VRBs spreading in all directions. For the householders to do it would require a small VRB at each solar producer’s home. The latter raises the interesting possibility that the householder might then be able to use in the evening the power they produced during the day and lessen their own dependency on the grid. This might ironically result in more householders going *off-grid* for longer periods in the day. They would thus avoid the generators’ peak usage fees. The lesson in all this is “Embrace the VRB, it will set you free”.

China Embraces the VRB

Aficionados of VRBs have long wondered what the trigger might be for mass adoption of the technology and the answer is to look to the country that specializes in “mass adoption” and

that is China. Recent news has shown the process is moving rapidly now. In late September 2017, the China National Development and Reform Commission (NDRC) released Document 1701, “Guidance on the Promotion of Energy Storage Technology and Industry Development” aimed at accelerating the deployment of energy storage. The policy calls for the launch of pilot projects, including deployment of multiple 100MW-scale vanadium flow batteries, by the end of 2020, with the aim of large-scale deployment over the ensuing five years.

Not one to be backward in coming forward, Robert Friedland has now jumped on the Vanadium bandwagon in China, hence his many and various allusions to the metal at the presentation he made at the London Stock Exchange a few months back. His play in the space is a private Chinese company called Pu Neng, which styles itself as “the leading provider of vanadium flow battery technology in the world” with more than 800,000 hours of demonstrated performance. The claimed USP of Pu Neng is its combination of proprietary low-cost ion-exchange membrane, long-life electrolyte formulation and innovative flow cell design.

In early November, Pu Neng announced that it had been awarded a contract for a 3 MW – 12 MWh VRB as Phase 1 of the Hubei Zaoyang 10MW 40MWh Storage Integration Demonstration Project. This first phase will be installed in Zaoyang, Hubei to integrate a large solar photovoltaic system into the grid. Following this 10MW 40MWh project, there will be a larger 100MW 500MWh energy storage project that will be the cornerstone of a new smart energy grid in Hubei Province. This large project will serve as a critical peak power plant, delivering reliability and emissions reductions.

The project will be located in Zaoyang, and installation of the VRB system will commence in November 2017. When Phase 1 is completed in early 2018, Pu Neng’s VRB will be the largest flow battery installed in China. As part of the initial agreement, Pu Neng and Hubei Vanadium will jointly develop a

vanadium electrolyte supply from local vanadium sources. This however is easier said than done. Vanadium mines do not “grow on trees” and its sources as a by-product of petroleum refining are relatively inelastic to the Vanadium price. If Vanadium is the New Lithium, then China is not that well-positioned (yet again) but then again who is?

Conclusion

It would seem that the need for mass storage has come upon those areas with significant alternative energy efforts as somewhat of a surprise. Power is quite literally being wasted and residential “producers” are not maximizing their revenue from what they generate due to lack of a means of storage.

Thus a focus on solar and wind generation does not reward the producers thereof if it’s at the wrong time (or day) and place. For example, the low levels of grid demand on both Sunday and Saturday in South Australia pushed prices firmly into negative territory. Prices were as low as minus $1,000/MWh on some occasions and averaged minus $120/MWh for two hours on a Saturday. It also created record low demand on the grid.

VRB technology would seem to hold the solution to this problem. If the householder owns the VRB then they get the whiphand. If the grid operator owns it then they can “buy low and sell high” leaving the householder (i.e. generator) with mere scrapings. The first party that is able to make the “not too big, not too small but just right” VRB for domestic storage should be able to clean up.