Electricity: why can't our authorities see the light?

I am a critic of the government's Integrated Resource Plan for Electricity ("the IRP"). Like others, I have concerns around the nuclear stuff in there. That does not mean I am anti-nuclear per sè, I just don't agree with most of the assumptions on which nuclear is provided for in the IRP. My main gripe around the IRP is the way renewable energy, and more specifically solar energy, has been handled to date. Many other authors have criticised the IRP due to the fact that a seemingly arbitrary limit has been placed on renewable energy. My main criticism is totally different: I believe the paradigm around which government is approaching renewable energy is completely wrong. And that is leading to major problems. Nearly two years ago, I expressed this concern in an article on this forum (The key trick government is missing). I will repeat the gist of my concern here. Recently, I have followed with interest, the developments in South Australia. There, when they actually suffered a collapse of the electricity supply system, the government of South Australia stepped in to take decisive remedial action to stabilise their grid. Now, they have just announced a new renewable energy initiative that is exactly the right way to go and will add to the stability of their grid! I find it absolutely despairing that the Aussies can figure this out, but our own authorities seem to be blind.

Let's start at the beginning. Why do I say the paradigm of government around solar energy, in the IRP is wrong? The IRP (correctly) identifies two types of solar installations. The 1st of these are the relatively large-scale solar plants that we have seen cropping up all over the country. Construction of these plants has been facilitated by the very successful program of the Department of Energy ("DoE") to establish a renewable energy footprint in this country. The 2nd type is referred to as Rooftop solar installations. This refers to the typical situation where a household or business installs solar panels on its roof to generate (a portion of) its daily electricity requirements. The IRP simply takes the view that this will happen all over the country at some pace and that it might have some impact on electricity demand. Nothing serious though. And that is just the problem!

Let's get some clarity on these so-called Rooftop solar installations. There are two main design philosophies for rooftop solar installations ~

Grid tied systems: these systems consist of solar panels (normally installed on the roof of the building as the name implies) and an inverter. The inverter is a clever piece of electronic hardware. Firstly, it converts the direct current from the solar panels to alternating current and it matches this alternating current to the municipal

electricity feed to the building. Secondly, the inverter measures the current electricity consumption in the building and blends-in just enough electricity from the municipal supply with the solar electricity to ensure the electricity supply to the building exactly matches the current demand. If more solar electricity is generated than what is needed by the building, the inverter feeds this surplus electricity back into the municipal grid and the owner gets credited or paid for this electricity at the applicable promulgated tariff of the municipality. Likewise, if less electricity is generated by the solar panels, the owner pays for the municipal electricity used at the applicable promulgated tariff of the municipality. The occupants of the house are oblivious to the actual source of the electricity.

Off grid systems: Like grid tied systems these systems contain solar panels and an inverter. The third critical part of these systems is a battery bank that is charged through the solar panels. During the day, the solar panels typically produce more energy than required – this surplus is used to charge the batteries. At night, the battery bank supplies the electricity requirements. The battery bank is a critical and expensive part of the system.

The obvious and key difference between grid tied – and off grid systems is that the former is still fully reliant on municipal supply whereas the latter tries to be independent of the municipal supply. In the evenings or on cloudy days, a well designed off grid system is still fully functional and reliable. Under the same conditions a grid tied system will fail if the municipal supply fails or is interrupted.

There is one final note I would like to make about these two types of system. In practice, no system is likely to be purely grid tied or off grid as described here and hybrid systems are common. Thus, most grid tied systems do feature some (even if limited) battery back up. On the other hand, it is not necessarily cost effective to design a system to be truly 100% off grid – in most instances the design would target 99%, 95% or even a lower level of independence from the municipal supply.

Now we can return to the real problem. The problem with large-scale solar plants as well as grid tied rooftop installations is this: they only generate electricity during day-time hours when electricity demand is relatively low. Due to this, they typically cause a surplus of electricity supply onto the grid. This is a big problem for the grid operator - Eskom in our case. Such a surplus, if not addressed rapidly will lead to instability of the grid. In dealing with such a surplus the grid operator can take two actions: (i) reduce supply onto the grid by shutting down some generation capacity and (ii) increase demand to the point where it matches the supply. Both of these are

easier said than done and it is this fact (amongst others) that has lead to a standoff between Eskom and the DoE about the impact of the renewable energy program. Note for this situation the converse also holds true – when demand exceeds supply (even for relatively short periods of time) the network can rapidly become unstable, leading to deterioration in the quality of supply and then widespread load shedding.

It is critical to understand there is limited ability to rapidly shut down portions of the current supply. With coal-fired and nuclear power stations it is out of the question. With gas-fired turbine generators, hydropower and solar power installations it is easy. There is such limited capacity of gas-fired turbine generators and hydropower active during day hours that their impact is negligible. Shutting down (some of the) solar power plants is problematic, as Eskom have to pay for the electricity whether they use it or not. Can you start seeing the problem?

Likewise, there is very little the grid operator can do to increase electricity demand as and when there is a surplus on the grid. Switching on some of the pump storage schemes is virtually the only mechanism available.

It is for this reason that solar power is often blamed for causing instability of the grid. It is for the same reason that the argument is made that there is a limit to the amount of solar power that the country can utilise. Luckily there are solutions to this problem – it just seems that our authorities are very slow or lax to address the situation. To illustrate this, let us discuss the recent experiences in South Australia.

Wikipedia presents interesting information on a number of large-scale blackouts that were experienced in South Australia in recent years. Most of these were caused by storms that damaged pylons and transmission lines. But, in February 2017, in the midst of a major heat wave, over 90 000 households lost power. This was due to the instability of the grid caused by demand exceeding supply. The grid operator was not able to rapidly bring additional supply on-line with the resultant crash of the system. The wide-spread commentary and political fall-out of this incident led South African born CEO of Tesla, Elon Musk, to comment that the incident could have been completely avoided if South Australia had a 100 Mega Watt battery supplied by Tesla installed to stabilise the grid. Musk went further and offered to install and commission such a battery within 100 days, failing which there would be no charge.

In South Africa, our authorities would probably drag their feet for a couple of years to consider such a proposal. In South Australia, after considering the technical merits of the proposal and a short (emergency) procurement process the contract was signed.

And Tesla did it! The battery system was up and running within the 100 days period. Within the first three months of its operation, there have been a number of incidents (including failure of a coal-fired power plant), where the action of this battery system was decisive in stabilising the grid and preventing any blackouts. Success then.

But now for the crunch part. Having experienced the taste of success and the benefits brought by this battery system, the South Australia Government and Tesla is stepping up to the next level. They have just announced an initiative where 50 000 houses in South Australia will be fitted with 5 Kilo Watts of solar panels as well as a Tesla Powerwall battery system – all completely free of charge to the house owner. Yes, you have read correctly, it is free of charge! How can they do this? The answer is quite simple.

Firstly, these 50 000 installations represent generation capacity of around 250 Mega Watts – the size of a small power plant. Instead of paying for a new power station to supply the rising demand in South Australia, the government is simply providing that supply through these solar panels.

Secondly, with the Tesla batteries included in the deal, these are basically off-grid installations. These 50 000 batteries represent in total another 100 Mega Watt battery storage capacity – combined they are viewed as a single virtual battery. This battery comes with a double whammy benefit. In the first instance, it takes 50 000 households off the grid at the peak hours – a massive boost for the stability of the overall system. In the second instance, as a household will use only a fraction of the battery capacity at any instance, it provides another 100 Mega Watt battery that can feed electricity into the grid immediately, should at shortage arise. This effectively doubles the stabilising effect of the first battery installed. The South Australian government has indicated that the value of the electricity that would be sold, from this battery, into the grid at peak times, will effectively pay for this initiative over a relatively short period of time.

Want my prediction? In a number of years this deal will be replicated a few times. The economic and other benefits to South Australia will be significant. South Australia will start to assist neighbouring states to stabilise their networks – at a price of course.

There are many other benefits to this deal – I am sure you the reader can knock off a few of them without even thinking about it. This is the benefit of off-grid domestic solar installations. This is the trick that our government (and who else?) have been

missing and are still missing. A coordinated program, like the one the South Australia Government and Tesla are implementing should have been incorporated into our IRP and should have been implemented as the main drive of the DoE. It is just sò straightforward and simple! Why can't they see the light?