The key trick government is missing around our future electricity supply

In an article last week (read it here) I argued that we should elevate the debate around our future electricity supply to the strategic issues as outlined and identified in government's Integrated Resource Plan for Electricity ("IRP"). I also indicated that I would comment on some of my own concerns around the strategy outlined in the updated IRP of 2013. My first concern is how rooftop solar installations are handled in the IRP. It is not that the IRP is silent on rooftop solar installations, but I believe the strategy is not correct and that some further key strategic spin-offs are being missed. I can refine my concern even further to this: the IRP reflects a specific paradigm when it comes to solar electricity. While that paradigm may be correct (given current technology) for large solar farms, it is not the correct paradigm when it comes to rooftop solar installations.

Firstly, what is meant by rooftop solar installations? It is literally as the name indicates: solar panels installed on the roof of a home, office, factory or any other building for the purpose of generating solar electricity. But, a solar installation is a solar installation right? Wrong – not when it comes to rooftop solar installations. Let me explain further. There are two possible 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. Any shortage of electricity is supplemented from the batteries. 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. In South Africa, with our history of load shedding, the increased cost of off grid systems over grid tied systems has traditionally been justified through the reliability of supply that is gained. More recently, with the ever-increasing electricity price, off grid systems have become fully financially feasible although the capital investment required remains daunting for most households.

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 IRP and government's strategy around rooftop solar systems. When the IRP discusses rooftop solar installations, it is clear that the paradigm is for grid tied systems. Although the benefit of distributed (or local) generation is recognised, the IRP (rightly) does not differentiate between the impact of these rooftop solar systems and large solar farms. Both of these are intermittent sources of electricity and impacts on the national grid in the same way. I don't want to go too deeply into any technical analysis here so let us simply state that because they do not supply power at night (when the night time electricity peak demand occurs) or in early morning (when the morning peak demand occurs) the peak demand still has to be satisfied through other sources of electricity. There is thus a limit to how much we can depend on this form of electricity in our overall supply. This limit is quantified in the IRP. From the perspective of the IRP it is immaterial whether this is supplied through large-scale solar farms or grid tied rooftop solar installations.

Can this limit be changed or even eliminated completely? Yes it can – through suitable, large-scale, mechanisms to store electricity. One way to store electrical power (on a large scale) is through pump-storage-schemes. There are a number of such schemes operating in the country and it is due to these schemes that we can

already derive some benefit from solar and wind electricity generation. But the ideal way to change or even eliminate this limit is through large-scale battery systems that can store electricity cheaply, efficiently and reliably. This is the technology the world is waiting for – more about this in the next article.

But let us return to rooftop solar systems. The most fundamental difference between grid tied systems and off grid systems is that the latter is not wholly dependent on grid supply. Off grid systems do not contribute intermittent supply to the grid. In fact, off grid systems should not even be counted as part of the overall electricity supply system – they actually form part of the demand, but this demand is of a very occasional nature and when it occurs it is usually not during the peak times. In the overall equation of things, off grid systems are highly beneficial from a number of perspectives ~

- They reduce demand for electricity. This means government needs to invest less in new generation capacity. Is this really significant? Well, a very simple calculation shows that between 100 000 and 300 000 off grid rooftop solar systems will reduce peak demand by between 3 500MW and 5 000MW – that is one less power station the size of Medupi or Kulisile. I think that is significant.
- They can be installed in a fraction of the time needed to build a new power station. Any national effort to promote such systems will rapidly show results through the declining electricity demand. I think that is significant.
- They reduce pressure on the grid. As these systems will be spread across the country they will reduce the need to transport electricity from the power stations to these buildings. That reduces losses in the transmission system and it defers capital expenditure to extend or upgrade the grid. I think that is significant.
- They promote small and micro enterprises ("SMEs"). These systems are typically designed, installed and maintained by SMEs. Installation of the number of systems indicated above represents direct benefits (i.e. excluding cost of equipment installed) of between R2 000 million and R20 000 million for these SMEs over the relevant period of time.
- They start to pave the way towards "smart, localised grids". This is a 'technical hot potato' and I am going to try and address it in a future article. Suffice to say here that the way electricity is distributed in 30 to 50 years' time will look vastly different to what we have today. The new way is called "smart, localised grids" and it is essential that as a country we start

preparing to move that way. The first step in this direction is through promoting off grid solar installations.

I started this article by stating that my key concern around the IRP is that it reflects the wrong paradigm when it comes to rooftop solar installations. Government needs a paradigm shift! With rooftop solar installations the paradigm must be off grid systems rather than grid tied systems as is currently the case. I hope the discussion above clearly demonstrates this. Moreover, off grid, rooftop solar systems are not dependent on any new technology. The technology is in place and the systems are financially feasible.

If this paradigm shift occurs, what are the strategic choices I would like to see in terms of the IRP? Firstly, I would like to see a strategy that actively pursues and promotes off grid rooftop solar systems as opposed to grid tied systems. Such a strategy should recognise that although these systems are financially feasible they represent a significant investment for the relevant property owner. A suitable, government-backed, financing scheme would be one way to promote such systems. Further strategic spin-offs that are not necessarily in the domain of the IRP but which must be addressed by government elsewhere include the publication of norms and standards, promotion of local manufacture of certain equipment, training and SME development.