The impact of new technology on our future electricity supply

Last week I discussed my first concern around government's strategy for our future electricity supply as outlined in the Integrated Resource Plan for Electricity ("IRP"). That discussion revolved around rooftop solar installations (read it here). In this article I would like to discuss my next concern and it revolves around the (future) impact of new technology. Of course, new technology can impact at any time and on any element in the overall electricity value chain. It would be difficult to plan for each and every potential new technology. My concern however is around new technology that will dramatically change the nature of the game. Something akin to what the Model T Ford did to the transport industry, or the PC did to the computing industry or even more recently what the iPhone did to Nokia (remember them?). Let us also be very clear that one of the prime reasons why any business does strategic planning is to at least attempt to identify and prepare for any such game changers. The same applies to government. In fact, in government's case it might be even more critical because the nature of infrastructure is such that the consequences of any investment decision will stay with us for the next 40 to 60 years. So, when I read government's strategy for our future electricity supply I get concerned that it does not adequately identify and plan for the impact of new technology.

What is the new technology I am concerned about? It has nothing to do with new generation - or transmission technology or any thing of that kind. The new technology that will be a complete game changer is: batteries. Yes, new technology that will (dramatically) reduce the cost to store electrical energy and will also (dramatically) scale-up the ability to store electrical energy will be a real game changer. Why is that?

Firstly, a large-scale and cheap storage mechanism is the one thing that will set solar energy free. With that, all the debates of coal versus nuclear versus oil and gas will be over, once and for all. From then on, it will mostly be solar electricity supplemented by some wind generation. The reason for this is because such a storage mechanism will change solar electricity from an intermittent source to a stable source. This dramatic shift will not be driven by environmental concerns but through pure economics. There will simply be nothing that could beat the price of solar electricity. In fact, my view is that the price of electricity will continue to decline to the point where it becomes virtually free. Think of the world and society with free electricity? That is how big the impact of this game changer will be.

Secondly, a large-scale and cheap storage mechanism will eliminate the need to transport electricity over long distances from source to consumer. Electricity will mostly be generated at the location (or in the near vicinity) of where it is needed. Elimination of the significant capital investment needed to operate, maintain and upgrade the vast national distribution network (or the grid as it is called) and to fund its losses will contribute to the decline in the price of electricity. Localised, smart grids will operate independently and fairly autonomously. Each house or building will generate its own electricity. Surplus electricity will be made available to neighbours and shortfalls will be supplemented from the neighbours. These localised, smart grids will virtually eliminate the risk of large-scale supply interruptions caused by natural phenomena or even sabotage.

It is difficult to imagine any part of our society and our day-to-day lives that will not be impacted by this cheap electricity revolution as I like to call it. How does government plan for this revolution? Is it realistic at all? Realistic to the point where it is anticipated, and planned for, in the actual strategy? Let me first deal with how real and how close this new technology is.

Batteries as a way to store electrical power have been around for more than a century. During this time an enormous amount of research and development has been conducted to refine existing technology and explore new technology. From time to time new commercial opportunities have spurted research and development that yielded quantum leaps of improvement in both the cost and effectiveness of the technology. The popularity of golf carts and the need for electrically driven vehicles (such as forklifts) on shop floors and in underground mining applications have driven significant improvements of the standard lead acid battery found in every car. The invention of laptop computers has accelerated the improvement of alternative battery technology such as nickel cadmium batteries. The introduction of the cell phone followed by smart phones and tablets have accelerated this process even further and lead to the development of the lithium ion battery.

Lithium ion battery technology is now entering an accelerated production phase of its life cycle. As its production worldwide increases, prices will fall – the only question is: how far will prices fall? From a strategic planning perspective we can rephrase this question slightly: will lithium ion battery prices fall far enough to render stable, solar electricity supply cost competitive with all other forms of electricity supply? In my view the answer to this question is undoubtedly: yes. Why do I say so? For the simple reason that the commercial incentive for the global economy to achieve this is so massive. Does it mean that there is no more uncertainty around this?

Unfortunately not - the uncertainty that remains is around timing. When will storage costs decline to the point where stable, solar electricity supply is cost competitive with all other forms of electricity supply? Of course we cannot tell exactly, but we can do the projections and we can start following the trends.

From the discussion above my view is clear: we are not dealing with some hypothetical future event; we are dealing with reality. When I read the IRP, I get the impression that government's view is that this reality is only post 2030. I believe that view is seriously flawed. How should we be planning for this given the timing uncertainty? This is a classical case where one deals with the timing uncertainty by deferring a final investment decision (for as long as possible) in the hope that the timing uncertainty will reduce sufficiently or even disappear completely. Of course, when dealing with something as important as the country's future electricity supply there is a limit to how long one can defer the final investment decision – that is one lesson that government has hopefully learnt during the debacle of recent years. But there is a way in which one can stretch the deferment period: by investing in an interim (short-term) solution. From an all-in cost point of view such interim solution may be fairly expensive but that cost will be recouped hundred fold (or more) if through the longer deferment, the correct final investment decision is made.

The cost of the interim solution is sometimes called an option fee: in financial terms one is literally buying an option to make your decision at a later point in time. In South Africa, there is such an interim solution and it is correctly identified in the IRP update of 2013. This interim solution is to invest capital in all our old, coal-fired power stations to stretch their collective lives for a few more years. I believe this is the perfect interim solution but it may not be enough. Under certain demand projections the IRP indicates that we will have to install additional generation capacity and that decision must be made soon. Or must it? There is an alternative to installing additional generation capacity and that is to reduce demand. The appropriate way to reduce demand is certainly not how it has been done to date: (i) load shedding or (ii) paying large-scale consumers not to use electricity. The appropriate way to reduce demand is to stimulate and incentivise off grid, rooftop solar installations as discussed in my previous article.

But that is not the end of my strategic concerns. Allow me one more slight digression to explain. Lithium ion technology just happens to be a battery technology with a specific mix of features that renders it suitable for small-scale applications (devices such as phones and tablets), but also for larger applications (such as electrical vehicles) and even very large applications (such as large-scale storage of solar

electricity). While its initial development and commercialisation were driven by the small-scale applications, the world can readily benefit from its large-scale application. There are other battery technologies that are fairly well established but have lacked the commercialisation impetus due to the fact that they are not suitable for phones, tablets or electrical vehicles. One such technology is called flow batteries. Flow batteries have the potential to offer mega-scale storage at a fraction of the cost of lithium ion technology. To my mind flow batteries is where the attention should be focussed. Why is this relevant to our strategy? Let us return to the timing uncertainty discussed above. There are two ways in which one can handle such an uncertainty. The one way is to sit tight and wait for it to disappear (as also discussed above). The other way is to go out there and to make it disappear. By investing in the commercialisation and production of flow batteries, this country can make a meaningful contribution to mature the technology and accelerate its price decline.

Why should we as a country make such an investment? Firstly, Africa as a whole will probably benefit more than any other continent from the cheap electricity revolution. Secondly, one of the popular configurations of flow batteries uses solutions of vanadium metal as its electrolytes. South Africa, as one of the top producers of vanadium metal in the world, stands to benefit significantly if this configuration becomes the de facto world standard. Just look at what is happening to the price of lithium to illustrate this benefit. This would present significant new investment and economic development opportunities in this country.

To conclude, I definitely support the current strategy as outlined in the IRP to invest capital in the existing coal-fired power stations to extend their economic life. (Just two weeks ago Eskom announced that it is embarking on the pre-feasibility study of this strategy). My concern is government arrived at this preferred strategy through other considerations (such as reducing short-term financing requirements) rather than the impact of new technology as discussed above. The result is that other key strategic elements such as investment in certain new storage technology and active promotion of off grid, roof top, solar installations are absent.