

Electricity and load shedding

20 January 2023

Antonio Gramsci had it right: 'The crisis consists precisely in the fact that the old is dying and the new cannot be born; in this interregnum a great variety of *morbid symptoms* appear.'

Gramsci was referring to politics in Italy in the 1930s, but the quote also describes Eskom and load-shedding in South Africa in the 2020s. Load-shedding brings with it the morbid destruction of many small businesses and the merciless disruption of peoples' lives. Eskom is dying and cannot be saved in its current condition. Electricity provision, however, is not dying. It is important to distinguish between those two, lest we are overwhelmed by morbid symptoms.

Load-shedding

We have load-shedding because South Africa does not generate enough power. The capacity gap is estimated at between 4 000 MW and 6 000 MW. As recently as November, Eskom put the capacity gap at 4 000 MW. Let's assume the gap is the higher number of 6 000 MW. That is 6 000 MW of base load (ie energy that is available continuously for 24 hours of the day). To produce that from renewables (solar and wind) we need about 18 000 MW of renewable-energy capacity with a mix of storage and gas. That is the first of the new that must be born.

Currently there is about 12 000 MW of solar and wind power in the pipeline – 9 000 MW is being driven by private companies for their own and clients' use (embedded power) and about 3 000 MW through the official procurement processes run by government (including local government, but the latter is miniscule).

Add 2 000 MW that is being procured through Eskom's repurposing of land around coal-fired power stations for renewables. The first 6 000 ha of land has been leased out to producers. Another 30 000 ha are available, and the next parcels to be released are at Kusile, Kendal and Newcastle. These sites are already connected to the grid. This initiative became possible after the president raised the level for which a licence is not needed from 1 MW to 100 MW (June 2021) and then abolished it altogether (July 2022).

A further 1 000 MW can be bought from existing independent producers and the Southern African Power Pool under Eskom's Standard Offer of Purchase. (Although Bloomberg reports that 2 000 MW can be bought under this scheme, let's tread cautiously and use only half that number.) The standard offer allows Eskom to buy power from existing producers at a predetermined price, approved by the National Energy Regulator of South Africa (NERSA).

All this adds up to 15 000 MW of the 18 000 MW needed to beat load-shedding. There is enough transmission capacity to connect all 15 000 MW to the grid, but the grid will then be 'full'. (See 'Transmission capacity' below.)

How long?

How long before these 15 000 MW are connected to the grid and produce electricity?

The time from when proposal is initiated by a developer to final connection is about three years. But many of the MWs referred to above have already progressed beyond the initial stages. In fact, construction has commenced on three projects and six have reached financial closure. (Bloomberg quotes a presidency report that 2 800 MW is ready for construction.) The construction time for a wind farm is typically eight to 14 months and for a solar farm from six to 12 months. Most of the 15 000 MW should be connected by the end of 2024 or beginning of 2025.

So, to plug the load-shedding gap we still need an additional 3 000 MW renewables, or about 1 000 MW baseload.

For that we turn to ...

Medupi

Yes, yes ... I can hear the howls of protest, snorting of disgust and derisory laughs! But let's just look coldly at the data we have.

Medupi has six units, of which three are in full operation. For the last year they have run above 85% EAF (electricity availability factor). One in fact ran above 92%. The manager there is a 21-year Eskom veteran, Mr Zweli Witbooi. The notion that Medupi can never produce is simply not correct. Flaws can and are being corrected – of course at huge costs (R19 billion in the case of Medupi).

Two units at Medupi are being modified to deal with carbon emissions and are currently running at partial capacity only. Eskom was denied an emission exemption for Medupi and the modifications must be made. Medupi unit 4 was damaged in an explosion in 2021. The two employees who were investigated for the incident have been dismissed. The unit will be operational by September 2024 and will add 800 MW of base power to the grid. Then we only need 200 MW baseload to plug load-shedding, or about 600 MW of renewables.

... but not Kusile

Kusile also has six units, four of which had been brought into operation by June 2022. Three months later in September an 'explosion' took one of the four out of action. In October an 'accident' took two more out. Currently only one unit is running. Unit 5 is scheduled to come into operation by December 2023 and unit 6 by the middle of 2024. Some are sceptical that these dates can be met, so it's better to tread cautiously and exclude any MW numbers from there. If we exclude Kusile, where are we going to find the 600 renewables MWs we still need?

Homeowners to the rescue

Across the country more and more rooftop installations are appearing, which reduce demand on the grid and generate *surplus* energy that can be fed into the national or a local grid. Industry insiders reckon there is about 3 600 MW of solar rooftop installed in South Africa, with another 1 000 MW being added every year. We are talking more MWs than Kusile's current production. No doubt that 1 000 MW extra per year is rising. Homeowners can overtake Medupi in a few years.

On the lovely sunny days here in Johannesburg one can use all the electricity one needs and from about noon the batteries are fully charged (ready for load-shedding!). The power generated when the batteries are fully charged simply goes to waste.

A precondition for using that wasted power is a feed-in tariff at which Eskom and municipalities buy from producers. The current state of play is neatly summarised by *Engineering News*. 'Eskom already has net-billing tariffs being used by agriculture, commercial and industrial customers (called Gen-Offset). These tariffs provide a credit for energy exported at the same energy rate that the customer pays for consumption. NERSA still needs to approve the **residential tariff** Homeflex (my emphasis), which will then allow Eskom to offer net-billing to residential customers as well.'

All this is okay for customers directly linked to Eskom, but similar arrangements would have to be made for customers getting their power from local municipalities. Municipalities are not keen to lose a source of income and have in fact launched a court case to declare that only they can distribute power in a municipal area. Municipalities will have to develop a new business model: use their local grid as a resource that can be rented out to power providers – much like a fibre company rents its fibre line out to internet service providers.

At municipalities too, the old is dying and the new is not yet born. The country needs a dedicated energy champion that can drive these issues and push the birth of the new.

In the context of load-shedding there is clearly considerable capacity available on rooftops to help plug the gap.

It can be done

It is clear from adding the above numbers that, between renewables currently in process, the return of units at Medupi and existing solar power on rooftops, the capacity gap of 6 000 MW base load (or 18 000 MW renewables) can be filled, and load-shedding alleviated, albeit only in two years' time. Equally clear is that if we do not add the additional capacity, load-shedding will persist beyond the two years.

Is there any short-term solution?

All the above adds up to relief by the end of 2024. But what can be done immediately to alleviate load-shedding? **The answer is not much.**

One option would be to go the dreaded Karpowership route. Dreaded because it involves 20-year contracts, very little permanent infrastructure, and undesirable environmental impact. Emergency power can provide 2 000 MW, equal to two stages of load-shedding. Word on the street is that NERSA has not approved a fee for the Karpowership deal, so let's see what comes out of the wash in the next while.

The other alternative is diesel, which is dreadfully expensive. For example, R1,1 billion can prevent two levels of load-shedding for 79 hours.

Under both alternatives there will still be load-shedding. **There are no quick fixes.**

Last year I wrote that load-shedding would be with us for two years until the end of 2024. This is where we are now. I do not see a quick way out.

The mirage in the desert

There is, however, a school that argues that load-shedding is not about the lack of capacity, and that Eskom has more than 44 000 MW of installed capacity. If only the place is properly maintained and managed, all the country's needs could be met. This school wilfully ignores the EAF (energy availability factor) history of Eskom.

During the last financial year (to March 2022) Eskom ran at an EAF of 58,6%. For the coal fleet, the EAF was a mere 55,5%. In the current financial year, measured to October 2022, the coal fleet's EAF fell to 53,9%. Only two of Eskom's 14 power stations run above a 70% EAF. I will write that again. Only two of 14 stations run above 70%.

To say Eskom can be fixed in six to 12 months is simply wrong.

Eskom's power stations ran at an EAF level above the global average, as measured by VGB in Germany, until 2011. (VGB is an international [association](#) of companies from the [electricity](#) and heat supply industry.) Remember, in the early 2000s Eskom was voted the best utility in the world. Since 2011, now eleven years ago, the Eskom EAF decoupled from the global average. The latter is now running at 75% while Eskom is at 53,9%. It is a big gap and speaks to the fact that a lot of the 44 000 installed capacity at Eskom is old and decrepit. Exclude Medupi and Kusile and the average age of the Eskom stations is more than 40 years – past their sell-by date. Add poor maintenance since about 2008 and the result is what we now have: highly unpredictable plant performance; continuous multiple failures; a low EAF and load-shedding. Eskom has been in decline for 11 years; it is not going to be fixed in 11 months. Those proclaiming this are chasing a mirage in the desert.

The new is still to be born

The age of the Eskom plants combined with poor maintenance mean that many will be closed in the near future. Komati was the first to go last year. Hendrina, Camden and Grootvlei will follow over the next four years. Four more stations will follow thereafter. In total, eight of Eskom's 14 stations will close down over the next decade. Add adherence to minimum emission requirements and more plants may close quicker.

Closing all those plants means many thousands of MWs will be retired. Not only will this be replaced, but a lot more will be added. Some 53 000 MW of renewables is to be built over the next 10 years, together with some gas and probably some nuclear. It will involve many billions in investment, creating an investment boon for South Africa (See [Green is the new gold of August last year.](#)) That is the upside to all this mess. The old system of electricity is dying and the new is still to be born. We are caught in the interregnum.

Transmission capacity

In December it became very clear that the current South African grid has reached the end of its tether and cannot accommodate more renewable producers. Only 860 MW of the 4 200 MW in Bid Window 6 could be accepted. (That 860 MW is part of the 15 000 discussed above.) There were 56 bidders in the round (indicating how keen people are to invest) and only six were eventually accepted (indicating the wasted opportunity). It was a big disappointment – in fact a fiasco, which reflects poorly on all the official energy players. The dirigiste nature of our energy system is often justified with the argument that it allows for coordination. So where was the coordination to prevent this mishap?

How did this happen?

Essentially companies in the private sector who built generation plants outside the bid windows snapped up the available grid space before Bid Window 6 was concluded.

Currently South Africa is running two energy procurement systems simultaneously. The one is an official process by the Department of Energy involving bid windows; the other is a private process where companies or investors go ahead and build plants for their own and others' use. This creates a problem because players under both systems use the same grid. Eskom is bound by its transmission licence to provide non-discriminatory access to the grid. It looks like Eskom used a 'first come, first served' basis. Clearly what is needed is a queueing system that can balance bid windows, private developers, shovel-ready and environmentally friendly projects.

In fairness, this is new territory for everybody. The official procurement system is slow, bureaucratic, and very dirigiste. Alongside this, a market in electricity is developing with fleet-footed private players. (Private companies have 9 000 MW in the pipeline and Bid Window 6 had 4 200 MW). These two systems must be integrated and managed as one. It is part of the interregnum we find ourselves in: the old system is dying, the new one has not been fully born yet.

How to get out?

The only way out is to throw money at the problem, ie a serious investment in grid capacity. Eskom's Transmission Development Plan for 2023 to 2032 (released in October) shows that over the next five years 12 100 MW of additional grid capacity can be unlocked from 23 transmission projects in the north-eastern part of the country (Mpumalanga, Limpopo, the Free State, North West and Gauteng). A total of 4 500 MW can be unlocked through 13 projects across the Eastern, Western and Northern Cape provinces. These projects will involve 2 890 km of high-voltage lines and 60 transformers, requiring a capital investment of R72,2 billion by 2027.

In short, R72 billion of transmission investment can unlock 16 600 MW of grid capacity. In the Just Economic

Transition Investment Plan (JET IP) R131 billion is budgeted for grid upgrades (see December's [COP 27 and South Africa](#)). President Ramaphosa has emphasised that the first money from the JET IP will indeed go to grid upgrades.

As announced by the president in 2019, Transmission is being set up as a company distinct from Eskom. It has been registered as the National Transmission Company (NTC), and a binding agreement with suspensive conditions has been signed to transfer the assets and liabilities from Eskom to the NTC. Eskom's creditors must give their consent for this transaction and that is still outstanding. If all the substantive conditions are met, the NTC can start operating independently by April 2023 (the new financial year). Last year Transmission (still a division of Eskom) made a net profit of R1,6 billion. It had assets of R80 billion and liabilities of R19,5 billion. With an injection of climate change funds, it can expand its activities considerably.

Upgrading the grid and building a stronger transmission company is part of the new that must be born.

So what?

- Since April 2018, when the then new Ramaphosa government reinstated the renewables contracts cancelled by Brian Molefe, government has introduced several changes to energy policy and practice, but it never got on the front foot. Load-shedding kept getting worse and government remained on the backfoot. The reality on the ground is running faster than government.
- Load-shedding will be with us for two years (as I wrote last year already) and there are no quick fixes. However many marches and court applications there are.
- It is imperative that the projects in the pipeline are concluded and not delayed, whether they are under a bid window, from private developers or under the Eskom repurposing and standard offer schemes. A delay in any of these will perpetuate load-shedding beyond two years.
- It is equally imperative that a feed-in tariff be agreed and announced, and that climate change funds are used to expand and upgrade the grid. We cannot take our eye off the ball that 50 000 MW more capacity is needed to position South Africa for the future.
- To drive these changes the country needs the right political leadership regarding energy. We do not have it now.