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Fixing South Africa's Electricity Crisis

Ensuring that the light at the end of the tunnel is on.

Connie Mulder

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Executive Summary

South Africa now is in its 15th year of load shedding. Electricity supply has been subject to frequent interruptions since 2007. The consequences for the economy simply are devastating. South Africa's GDP per capita in USD terms has declined from 2011 up to 2022. Unemployment has risen from 24% to more than 34%, using the narrow definition.

While this crisis is raging, the South African government has announced at best poorly formulated plans that would never be implemented, and at worst Eskom has been ransacked by state capturers.

Energy security is absolutely critical for economic growth and job security for every single South African citizen. Without energy security, all our members' jobs are being threatened as investments dwindle and businesses have to resort to retrenchment in order to keep going. Any institution that is serious about jobs should urgently intervene in the energy sector, not only to maintain jobs in that sector but also to protect and hopefully expand job creation throughout the entire economy.

Unfortunately, prospects for energy security in South Africa are extremely dim. Eskom currently has an installed generation capacity of 51 115 MW, with a nominal capacity of 46 466 MW. Yet, peak demand of 34 155 MW cannot be met at present owing to on-going unplanned failures of generating units. The continuing failures may be ascribed to the fact that the average age of Eskom's fleet of coal-fired power stations (excluding Medupi and Kusile) is 41 years at present. Most coal-fired power stations are designed for a useful life of 50 years, which implies that our coal-fired fleet is nearing the end of their useful life. Consequently, Eskom's planning is to demolish 22 000 MW of coal-fired generating capacity before 2035 owing to the end of their useful life being reached.

To address this energy crisis, the Integrated Resource Plan (IRP) was developed by the Department of Mineral Resources and Energy, in line with the Minister's responsibilities. This plan is supposed to be the leading document to describe and inform South Africa's energy future. Unfortunately, South Africa's IRP2019, the most recent version, is totally inadequate. The plan foresees a total generating capacity of 81 984 MW by 2030, provided that everything runs without a hitch. At the same time, the CSIR's estimates foresee an increase in electricity demand of approximately 40% by 2030. The government's plan relies heavily on solar and wind power to provide the new generating capacity. Because the sun does not shine all the time and at times there is no wind, solar and wind power generation is erratic, with capacity factors ranging between 30% and 40%. Therefore, the government's plan may be adequate only if everything is executed perfectly and the sun shines 24 hours per day in South Africa and the wind is blowing all the time. In short – this is totally impossible. The South African labour market therefore is facing the reality of permanent load shedding if we rely on the government alone to head off the energy crisis.

Although the imminent crisis is enormous, it is not insurmountable. A similar international example is that of Vietnam. In 2007 Vietnam also experienced an enormous energy crisis with regular power failures. The Communist Party of Vietnam, after a long struggle, eventually broke with their Marxist ideals in order to face the energy crisis. In 2017 the Communist Party of Vietnam announced a special supply tariff for companies and individuals who could generate solar power and feed it into the power grid before 2018. The results were remarkable: within a year, Vietnam added 4 500 MW of generating capacity to the system. A new tariff aimed specifically at individuals generating power with solar panels on the roofs of their homes and feeding it into the power grid, was announced and this resulted in the addition of another 9 000 MW of generating capacity by January 2021. Of this 9 000 MW, 6 000 MW was constructed in December 2020 alone. Stage 6 load shedding is a shortage of 6 000 MW.

Everything that is required to copy Vietnam's success is already in place in South Africa. NERSA launched a supply tariff way back in 2007 but has never used it. Furthermore, private generation of up to 100 MW is possible merely on the strength of a permit issued by NERSA. At present, the bottleneck simply is lack of political will to solve the energy crisis.

This lack of political will must be addressed urgently. It simply is not acceptable merely to assume that existing solutions are going to work. Therefore, it is critically important to encourage discussions at the highest political levels regarding solutions rather than analyses of problems. A parliamentary debate on supply tariffs and other possible policy options is needed so as to move and stimulate the discourse.

It is estimated that the cost of load shedding to the South African economy is R500 million per stage per day. Mike Schüssler calculated that more than a million jobs had been lost by 2021 owing to load shedding. If regard is had to Eskom's capacity and operational capability, as well as the government's history and best planning, it is clear that without radical intervention by community institutions and the private sector, load shedding simply is going to escalate.

Introduction

In the late months of 2007, South Africa experienced its first rolling blackouts of what would progressively become the largest energy crisis ever to be experienced. Although euphemistically called loadshedding, practically it has meant 15 years of massive energy uncertainty with an ever-escalating crisis.

Unfortunately, government has taken the lead in trying to solve the energy crisis to disastrous effect. This has led to 15 years of wasted opportunities whilst decisionmakers were bogged down in either incompetence, corruption, or ideology.

The net-effect is astonishing – South Africa is one of the few industrialised economies that cannot guarantee energy stability to investors and business owners. Unsurprisingly divestment happened which led to record-levels of unemployment in global terms as well as anaemic economic growth. Ultimately culminating in real GDP being lower in US Dollars in 2022 than it was in 2011. In short, the lack of electricity is making South African citizens poorer and leaving South Africa as a whole uninvestable.

It is no exaggeration when stating that energy is the number one obstacle standing in the way of economic growth and subsequently lower unemployment rates, yet government's response has been to do nothing for 15 years. Once again, government is part of the problem rather than the solution. If South Africa is to solve its energy crisis, the burden will fall on its citizenry to take active steps to pressure energy regulators and ultimately gain energy independence from a corrupt and overbearing government.

Future of energy in South Africa

Status Quo

Before one can look at possible scenarios as to how energy will be supplied in South Africa in the future, you have to get a proper grip on the current situation.

Quite frankly, the situation is extremely dire. South Africa plunged into loadshedding Stage 6 in 2022 for the second time in the history of loadshedding. The shortage in generation capacity has only worsened. Where Stage 4 loadshedding was considered anomalous in 2014 it has now become normal in 2022 with Stage 6 being extreme. If the current trend continues, Stage 6 will become the normal in the next five years with more extreme stages becoming the extreme.

Energy Limiting Growth

To illustrate the extent to which electricity generation is not keeping up to pace with demand, we used data on annual gigawatt/hours (GWh) sent out by Eskom compared to the expected annual GWh demand as seen in the CSIR's Forecast Document.

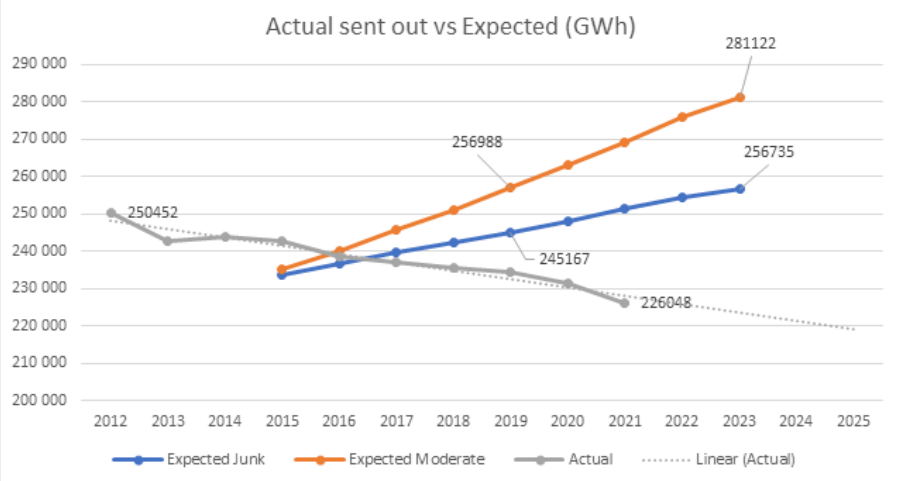


Figure 1 - Actual GWh vs Expected GWh
Source: https://www.eskom.co.za/wp-content/uploads/2021/08/2021IntegratedReport.pdf
http://www.energy.gov.za/IRP/irp-update-draft-report2018/CSIR-annual-elec-demand-forecasts-IRP-2015.pdf

As seen in the graph above, actual electricitavailable for distribution has steadily decreased from 2012, with electricity available for distribution in 2021 being 9,7% lower than in 2012. During the same period, the 8 million people [1]. Quite frankly energy demand has rapidly outstripped energy supply with the gap increasing evermore. In short, South Africa is generating less electricity per annum than in 2012 with more people and a bigger economy in Rand-terms. The impact of the energy shortage can clearly be seen in the GDP per capita PPP that has basically stalled since 2008.

"South African population has increased by

8 million people"

GDP Per Capita PPP (USD)

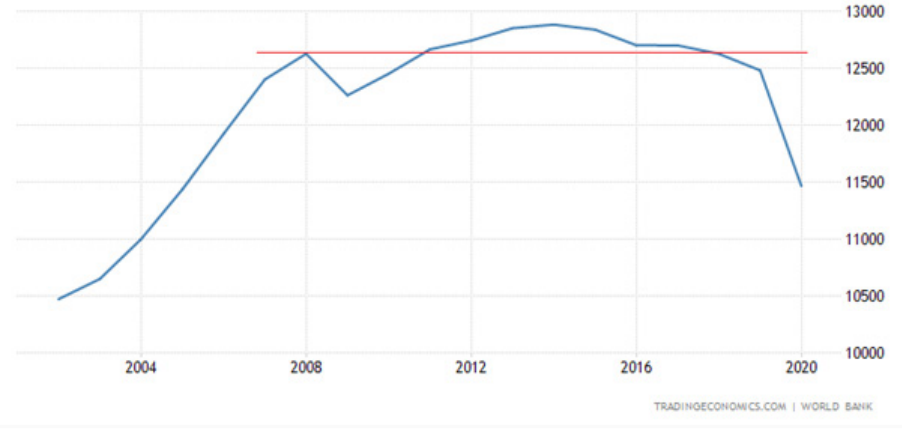


Figure 2 - GDP per capita PPP (USD)

Source: Tradingeconomics.com

Eskom's Capacity

According to the 2021 Integrated Report, Eskom has 51 115 MW of generating capacity installed, with a nominal capacity of 46 466 MW.[2] On the surface it would seem to be more than enough to handle a peak power demand of 34 155 MW, however the energy availability factor has been steadily dropping. The energy availability factor is the difference between the maximum availability and all unavailabilities – planned and unplanned.

The massive reduction is largely due to the average age of Eskom plants (Medupi and Kusile excluded) being 41 years .[3] Inevitably older plants lead to more breakdowns which lead to bigger and more frequent power outages. There is very little evidence that the energy availability factor will increase in the coming decade. In fact, all indications are that it will worsen as plants get even older whilst no new capacity is being added.

Decommissioning

Compounding the already large gap between

1 https://www.statssa.gov.za/publications/P0302/P03022021.pdf
2 https://www.eskom.co.za/wp-content/uploads/2021/08/2021IntegratedReport.pdf
3 https://mobile.twitter.com/eskom_sa/status/1427653720783925249

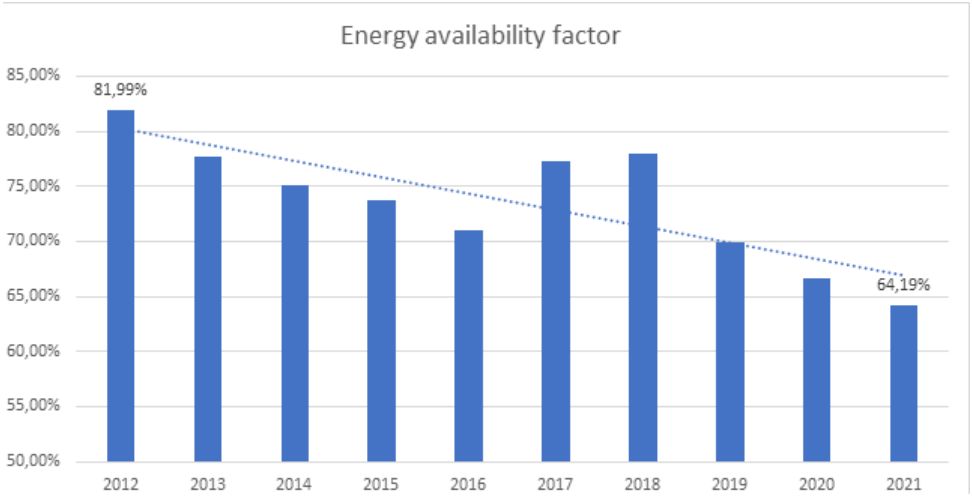


Figure 3 - Energy Availability factor
Source: https://www.eskom.co.za/wp-content/uploads/2021/08/2021IntegratedReport.pdf

supply and demand for electricity in South Africa, is the fact that Eskom is planning to decommission 22 000 MW of generating capacity before 2035 while, with the exception of a few units at Medupi and Kusile coming online, installing no new generation capacity.

The necessity of decommissioning old plants in the middle of an energy crisis has been overlooked, with Eskom under increasing pressure to run plants past their designed life of 50 years. To summarise, Eskom is struggling to generate enough electricity for South Africa with their current infrastructure and they must reduce generation capacity significantly in the next decade due to the decommissioning of old plants.

"Eskom is struggling to generate

enough electricity

for South Africa"

Decommissioning

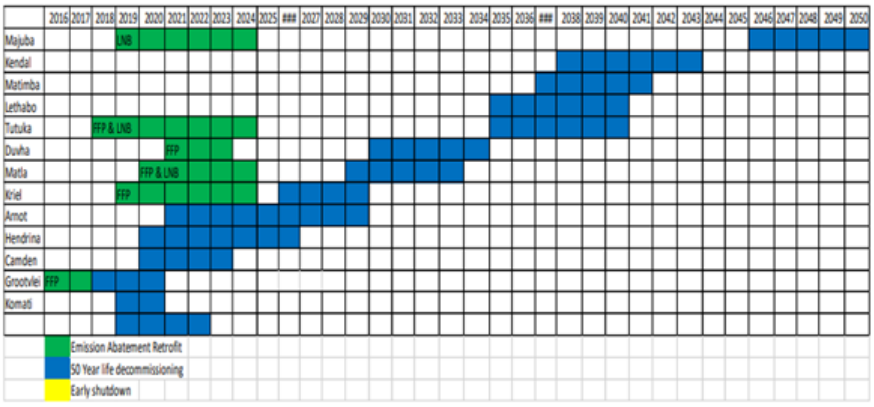


Table 1 - Decommission Schedule IRP-2019

Source: http://www.energy.gov.za/IRP/2019/IRP-2019.pdf

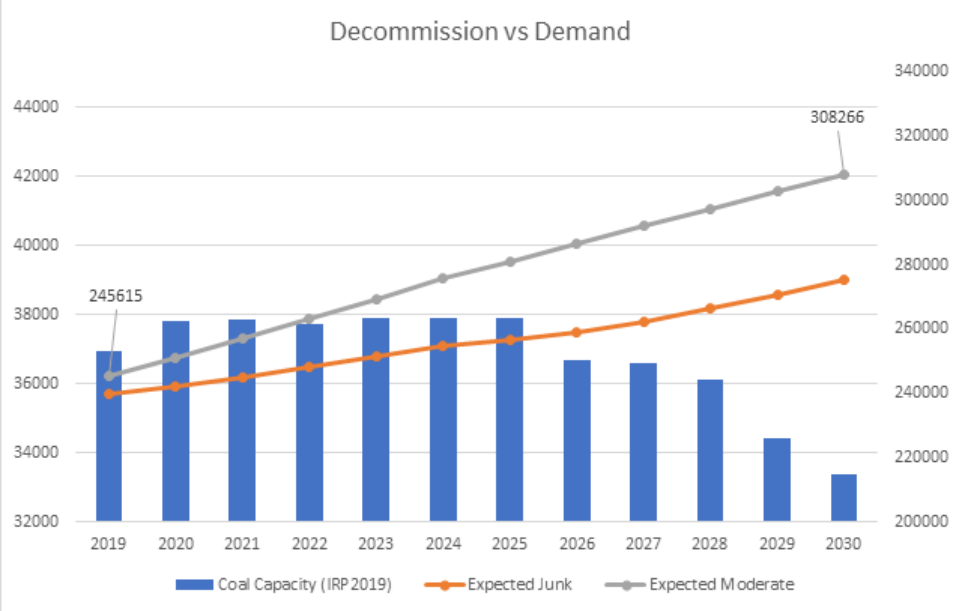


Figure 4 - Decommission vs Demand

Source: http://www.energy.gov.za/IRP/irp-update-draft-report2018/CSIR-annual-elec-demand-forecasts-IRP-2015.pdf

http://www.energy.gov.za/IRP/2019/IRP-2019.pdf

Integrated Resource Plan

The Integrated Resource Plan (IRP) is South Africa's roadmap to the future of energy. Initially meant to be updated every two years[4] , the plan has only been published twice since 2011, with the most recent iteration promulgated in 2019.

The IRP 2019 has several shortcomings and has clearly been unduly influenced by political interests instead of presenting a least-costly route to energy generation as was the intention.[5] [6]

As it stands, the current iteration of the IRP was out of date by the time it was published due to protracted talks and negotiations. Ultimately the emerging long-term plan from the different scenarios modelled in the IRP led to the proposal of the following energy mix until 2030 .

"Influenced by political interests"

Table 2 - IRP 2019 Long-term plan

	Coal	Coal (Decommissioning)	Nuclear	Hydro	Storage	PV	Wind	CSP	Gas & Diesel	Other (Distributed Generation, CoGen, Biomass, Landfill)
Current Base	37 149		1 860	2 100	2 912	1 474	1 980	300	3 830	499
2019	2 155	-2373					244	300		Allocation to the extent of the short term capacity and energy gap.
2020	1 433	-557				114	300			
2021	1 433	-1403				300	818			
2022	711	-844			513	400 1000	1600			
2023	750	-555				1000	1600			500
2024			1860				1600		1000	500
2025						1000	1600			500
2026		-1219					1600			500
2027	750	-847					1 600		2000	500
2028		-475				1000	1 600			500
2029		-1664			1575	1000	1 600			500
2030		-1050		2 500		1 000	1 600			500
TOTAL INSTALLED CAPACITY by 2030 (MW)	33364		1860	4600	5000	8288	17742	600	6380	
% Total Installed Capacity (% of MW)	43		2.36	5.84	6.35	10.52	22.53	0.76	8.1	
% Annual Energy Contribution (% of MWh)	58.8		4.5	8.4	1.2*	6.3	17.8	0.6	1.3	

Installed Capacity
Committed / Already Contracted Capacity
Capacity Decommissioned
New Additional Capacity
Extension of Koeberg Plant Design Life
Includes Distributed Generation Capacity for own use

Several absurdities exist in this plan, but most notably is the inclusion of 2 500 MW of Hydro Power by 2030 from the Grand Inga Treaty South Africa signed with the DRC in 2013. There is no indication that this large-scale hydro project will be completed on time and it would be folly to bargain on the project being up and running, and able to export electricity in 2030. [7]

The simulation results for the least-costly option of the IRP 2019 was shown to be quite simply removing the build limits on renewables. Unfortunately, the IRP 2019 as promulgated made a policy decision to impose build limits on renewables per bid window of 2 600 MW.

As seen in the table, the IRP 2019 also caps solar energy at 1 000 MW per year and wind at 1 600 MW.

The reasons provided for simply not reverting to removing the build limit and continuing to allow unlimited renewable construction in the IRP is as follows:

4 https://www.dffe.gov.za/sites/default/files/docs/irp2010_2030.pdf

5 https://www.news24.com/fin24/economy/more-gas-faster-nuclear-mantashe-cites-compelling-reasons-to-update-energy-plan-20220207

6 https://www.dailymaverick.co.za/article/2021-11-08-the-real-deal-with-renewable-energy-in-south-africa-unpacking-the-suite-of-options/

7 https://18.198.47.39/german-investors-interested-in-funding-drcs-inga-iii-dam/

- Committed REIPPP (including the 27 signed projects) and Eskom capacity rollout ending with the last unit of Kusile in 2022 will provide more than sufficient capacity to cover the projected demand and decommissioning of plants up to around 2025.
- The installed capacity and energy mix for scenarios tested for the period up to 2030 does not differ materially. This is driven mainly by the decommissioning of about 12GW of Eskom coal plants.
- Imposing annual build limits on RE will not affect the total cumulative installed capacity and the energy mix for the period up to 2030. See Table 7 and Table 8 for details.
- Imposing carbon budget as a strategy for carbon dioxide emission reduction or maintaining the PPD approach used in 2010 will not alter the energy mix by 2030.
- The projected unit cost of electricity by 2030 is similar for all scenarios, except for market-linked gas prices where market-linked increases in gas prices were assumed rather than inflation-based increases.
- The scenario without RE annual build limits provides the least-cost option by 2030.

Source: http://www.energy.gov.za/IRP/2019/IRP-2019.pdf

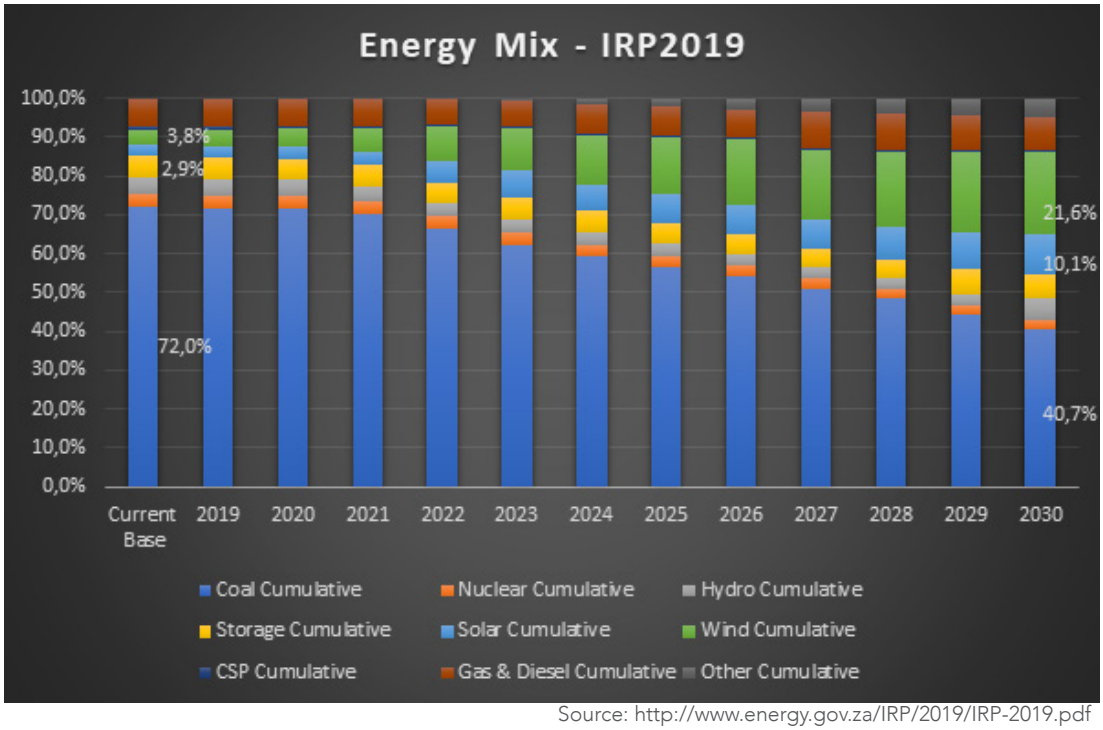
"continuous rolling blackouts"

Despite renewable energy without build limits providing the least-costly option, the IRP focuses heavily on limiting the scope of renewables and expanding energy sources such as coal, gas, and nuclear power. Assumptions from the state that there is sufficient capacity to cover the projected demand in the interim is quite obviously false, given the current continuous rolling blackouts South Africa is experiencing.

Most worrying, however, is that even with perfect execution of the IRP 2019, South Africa will only have installed generation capacity of 77 834 MW by 2030, indicating a 48% increase in installed generation capacity. The CSIR's projections for electricity demand by 2030 on a moderate expectation is 308 266 GWh[8] annually; a 40% increase on the actual electricity available for distribution in 2021.

Since wind and solar energy are variable, they typically have capacity factors of 30% to 40%.[9] [10] Quite simply, the sun doesn't always shine, and the wind doesn't always blow. Since wind and solar make up 26 030 MW of the proposed installed 81 984 MW it is quite simply not possible for the perfect execution of the IRP 2019 to meet South Africa's energy needs by 2030.

Figure 5 - Energy Mix IRP2019



Source: http://www.energy.gov.za/IRP/2019/IRP-2019.pdf

When factoring in the capacity factors of wind and solar to calculate the actual nominal capacity by 2030 according to the IRP2019, the flaws in the IRP2019 become much more readily apparent.

8 http://www.energy.gov.za/IRP/irp-update-draft-report2018/CSIR-annual-elec-demand-fore-casts-IRP-2015.pdf

9 https://www.e3s-conferences.org/articles/e3sconf/pdf/2020/41/e3sconf_icsree2020_02004.pdf

10 https://css.umich.edu/publications/factsheets/energy/wind-energy-factsheet

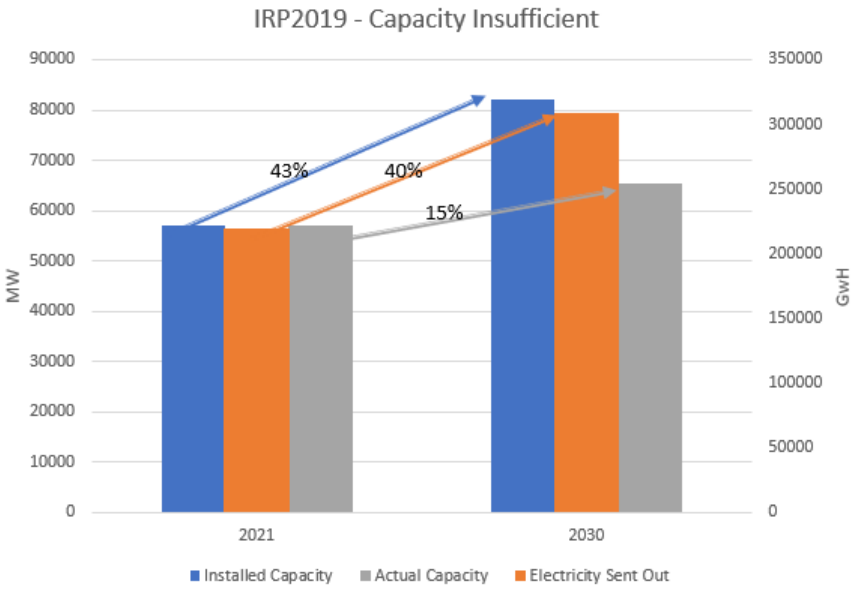


Figure 6 - IRP2019 Insufficient Capacity

Given South Africa's track record of energy projects that are prone to exceptional delays and cost overruns, there is almost no chance that a perfect implementation of the IRP 2019 will take place.

This puts South Africa in the unique situation where the best intended plans of government will not solve the problem even with perfect execution, which inevitably means that other key players will have to step forward if the energy crisis is to be solved.

Current CEO of Eskom, André de Ruyter, estimates that 68 000 MW of renewable energy needs to be added by 2035 to replace the 22 000 MW of coal-powered electricity that Eskom will be decommissioning by then.[1]

At IRP 2019 rates that would require 27 bid windows of 2 600 MW at a time.

RMIPPPP

The Risk Mitigation Independent Power Producer Purchase Program (RMIPPPP) was launched as a result of the IRP 2019, determining that a 2 000 MW generation shortfall exists in the short-term between 2019 and 2022.

The goal of the programme is to address the immediate electricity supply problems by procuring 2 000 MW of electricity from projects that are near completion or already completed.

According to the official website of the RMIPPPP the criteria used is as follows:

In response to the shortfall, 2 000 MW of new generation/supply capacity will be procured from a range of energy technologies and are based on the following criteria:

- It will be technology agnostic;
- based on the plant's performance needs from the electricity system operator;
- it will procure dispatchable flexible generation that should be able to provide energy, capacity and ancillary services;
- should be able to operate between 5:00 to 21:30;
- it must have an AGC load following ability, flexible capacity factor and must be "scalable" with changing capacity requirements; and
- must be able to connect power to the grid by June 2022.[2]

The programme was launched in July 2020 with the goal of adding 2 000 MW of additional emergency generation capacity to the power grid before June 2022. Ultimately the programme was a complete failure beset by delays in the bidding process as well as repeated extensions of the deadline for financial close of the preferred bidders.[3] [4]

1 https://www.engineeringnews.co.za/article/south-africas-electricity-plan-underestimating-new-generation-needs-former-eskom-ceo-warns-2022-03-25

2 https://www.ipp-rm.co.za/

3 https://www.businesslive.co.za/bd/national/2022-04-25-fifth-delay-in-emergency-power-procurement-plan/

4 https://www.engineeringnews.co.za/article/mantashe-confirms-some-rmipppp-projects-wont-close-outlines-six-monthly-renewables-procurement-tempo-2022-02-15/rep_id:4136

Karpowership

An additional complication to the RMIPPPP was the controversial bids by Karpowership for three Powerships (floating power plants) that would be moored in South African ports and supply 1 220 MW of emergency electricity to South Africa.[11]

Since the beginning, the bid to Karpowership was beset by irregularities, with Karpowership's competition alleging that the bidding process was rigged to favour the Turkish Powerships.[12] [13]

Ultimately the High Court held that the bid awarded to Karpowership could continue in January 2022. [14]

11 https://www.ipp-rm.co.za/
12 https://amabhungane.org/stories/210428-powerships-losing-bidder-claims-blatant-corruption-fingers-mantashe-associate/
13 https://amabhungane.org/stories/210514-powerships-how-the-multi-billion-rand-tender-was-legally-rigged/
14 https://www.news24.com/fin24/companies/industrial/karpowership-rival-loses-court-bid-to-halt-deal-it-claimed-was-corrupt-20220131

Vietnam as case study

Background

Vietnam is a relatively good comparative case study for a possible path out of South Africa's current energy woes. Vietnam had a similar energy landscape as South Africa with Vietnam Electricity (EVN) being a state-owned monopoly that limited private sector participation in the electricity generation space. EVN was established in 1994 as a state-owned company with the goal of generating electricity. Vietnam has experienced unprecedented economic growth, resulting in electricity generation not being able to keep up with the growing demand for energy due to the growing economy.

Ultimately the crisis came to a head in 2007 with Vietnam experiencing severe power shortages. With an estimated 14 blackouts per day in the first 7 months of 2008.[15] Vietnam is a single-party communist state with the Vietnam communist party being the only legal party, yet in spite of the Marxist underpinnings of their ideology the energy crisis mobilised a move towards liberalisation and competition in the electricity generation market.

After persistent blackouts and electricity shortages, Vietnam decided to break up the monopoly that EVN has on generation to allow competition into the market and increase generation capacity in 2011. [16]

Although this led to the establishment of a wholesale market for the generation of electricity, it still failed in satisfying the energy demands of Vietnam's growing economy.[17] [18]

Facing the prospects of increasing blackouts, Vietnam decided on a radical policy shift in 2017 to address the energy crisis.

Feed-in tariffs in Vietnam

In 2017 the government of Vietnam implemented a feed-in tariff scheme for solar power installations. The scheme entailed that EVN is obligated under law to buy electricity generated via grid-connected solar power plants or roof-mounted solar panels at a fixed tariff. Commercial solar plants could sell electricity at a fixed rate, whilst rooftop solar from individuals would get reimbursed annually if the electricity generated was more than the electricity consumed.[19] This created certainty for commercial investors regarding the return on investment a solar power plant would deliver. It also incentivised individuals to reduce their nett energy use by installing rooftop solar as far as possible. The initial feed-in tariff was only applicable to plants that reached operation before June 2019, which created a frenzy of construction in a very short time as investors and homeowners scrambled to install solar capacity to generate electricity.

Impact of the policy

The impact of Decision 11 to enable feed-in tariffs for solar power was nothing short of spectacular. In 2017 Vietnam had negligible solar capacity, which exploded to 16 660MW of solar generating capacity in 2020.

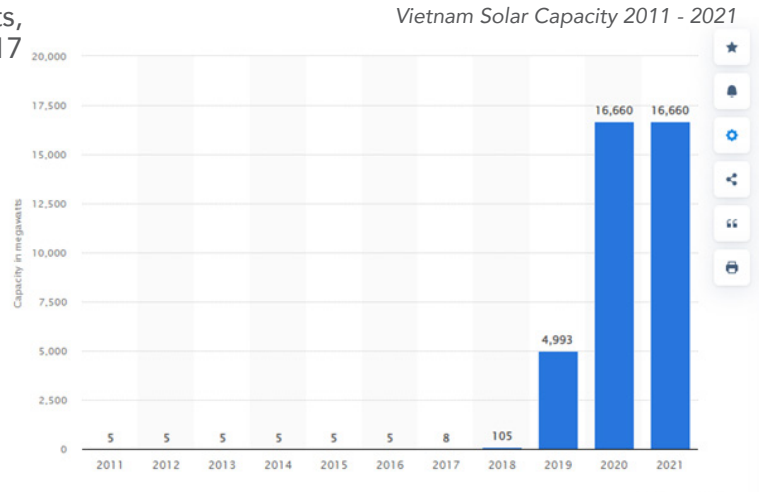


Figure 7 - Vietnam Solar Capacity

Source: https://www.statista.com/statistics/1006138/vietnam-total-solar-energy-capacity/

15 https://ash.harvard.edu/files/vietnams_infrastructure_constraints.pdf
16 https://www.reuters.com/article/vietnam-power-idUSL3E7I10FI20110701
17 https://www.linkedin.com/pulse/evn-chairman-power-cuts-south-2017-worse-come-2018-2019-gavin-smith
18 https://www.economist.com/asia/2013/08/31/a-heavy-load

19 https://policy.asiapacificenergy.org/sites/default/files/Decision%20No.11-2017-QD-TTg%20of%20the%20Prime%20Minister%20on%20the%20mechanism%20for%20encouragement%20of%20the%20development%20of%20solar%20power%20projects%20in%20Vietnam%20%282017%29%20EN.pdf

Compared to its peers, Vietnam now completely dominates renewable energy in the South-East Asian economy.

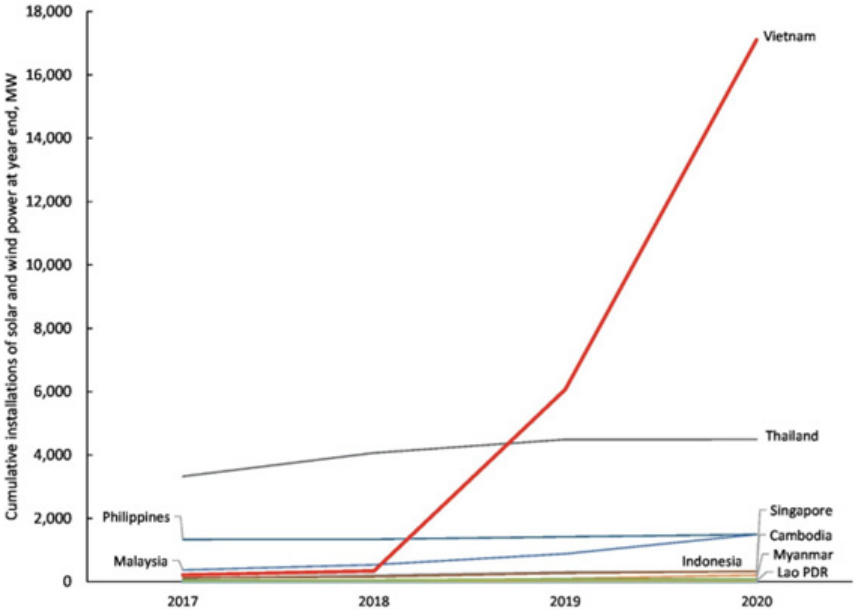


Figure 8 - ASEAN total solar plus wind power capacity, 2017–2020.

Source: https://www.sciencedirect.com/science/article/pii/S097308262100096X

It is important to note the massive expansion in rooftop solar in 2020 after the Vietnamese government announced a special feed-in tariff for rooftop solar. At the end of December 2020 Vietnam had connected 101 029 rooftop solar power projects to the power grid with a total installed capacity of 9 296 MW.

The policy was too successful with infrastructure being overloaded due to too much generation being added to take advantage of the feed-in tariff. [20]

Ultimately Vietnam has been forced to curtail electricity generation in several sectors due to pressure being placed on electricity infrastructure due to congestion of the power grid.

Looking at many reviews, one simple factor stands apart as the defining measure of success for Vietnam's energy success story and that is their political will to solve this crisis. [21] [22] [23] [24]

"Renewable energy"

20 https://www.aljazeera.com/economy/2022/5/18/after-renewables-push-vietnam-has-too-much-energy-to-handle
21 https://www.sciencedirect.com/science/article/pii/S097308262100096X
22 https://news.mongabay.com/2020/08/analysis-vietnams-leadership-flex-shows-how-to-drive-electricity-reform/
23 https://www.iseas.edu.sg/articles-commentaries/iseas-perspective/2021-28-vietnams-solar-power-boom-policy-implications-for-other-asean-member-states-by-thang-nam-do-and-paul-j-burke/
24 https://www.nbr.org/publication/vietnams-renewable-energy-policies-and-opportunities-for-the-private-sector/

Conclusion

Several factors are at play in South Africa's energy landscape to form and sustain the current crisis.

It is blatantly obvious that Eskom does not have the capacity to meet the country's current energy needs and will most definitely not be able to meet the future energy needs. Eskom itself will be decommissioning most of its coal fleet in the coming decades, with 22 000 MW set to be decommissioned by 2035. This implies that South Africa desperately needs to create private generation simply to ensure that generation capacity does not deteriorate. To increase generation capacity and ensure electricity stability a massive increase in private generation capacity is required.

Even with absolute perfect execution of the government's proposed Integrated Resource Plan (IRP), South Africa will continue to experience loadshedding in 2030. The IRP is irrational in its deviation from the modelling results for ideological and political reasons. Without a proper basis of evidence, the IRP proposes keeping build limits in place on renewables, even though South Africa is currently experiencing escalating electricity shortages. The IRP itself admits that there would be a 2 000 MW shortfall, by the time the IRP was finally promulgated. In the meantime, the shortfall increased to 4 000 MW and currently it is sitting at 6 000 MW. In the light of Eskom's generation capacity rapidly deteriorating due to breakdowns at aging plants and decommissioning, the shortfall will only increase. Government's complete and utter failure to address a 2 000 MW shortfall in more than 2 years using emergency measures, points to a complete lack of political will to solve the electricity crisis. The irregularities with the RMIPPPP bidding process, the sabotage at power stations and the lack of action to protect the essential service of generating electricity during illegal and violent strike action in June suggests that political will is lacking due to several of the connected elite benefitting financially from the energy crisis. Unfortunately, this suggestion is supported by the Zondo-report that touches on the endemic corruption rampant in state-owned enterprises such as Eskom.

Although Vietnam's energy crisis was a result of unprecedented economic growth, and South Africa's is a result of mismanagement and lack of planning, several lessons can be learnt from Vietnam on how to solve the energy crisis and mobilise private capital to create excess capacity. Both countries entered an energy crisis in 2007; South Africa, however, has loadshedding in 2022 whilst Vietnam has too much electricity. South Africa does not require centralised generation projects, planned and controlled by government, but much rather a radical, decentralised approach to electricity generation. New technologies in renewable energy have made economies of scale attainable for the small-scale generator. Vietnam managed to solve its energy crisis with rooftop solar in a country that has a GDP per capita less than half of South Africa. This implies that the resources already exist in South Africa.

Feed-in tariffs have been used in more than 100 countries to accelerate the transition to renewable energy. The most well-known of these have been the feed-in tariff schemes of Germany, China, and Vietnam. One drawback of a generous feed-in tariff like the one implemented in Vietnam is that it can be quite an expensive option. Given South Africa's limited fiscal space this might be a difficult policy to fund. Considering the alternative of unceasing rolling blackouts, the cost of a generous feed-in tariff could potentially be offset by the immediate positive impact on economic growth a stable electricity supply would have.

Ultimately, South Africa will not be able to move out of the energy crisis without radical intervention and a radical restructuring of the electricity generation landscape.

Recommendations

1. Decentralise generation as quickly as possible

Quite simply put – everyone who is able to, should apply for a permit to generate and sell electricity to the grid. Currently the process to get a permit is quite onerous and aimed at commercial generation, but it should be forced to permit rooftop generation as well. Ultimately South Africa will benefit from rooftop solar generating power on the roofs of malls, schools, parking lots and homes. We need to build this capacity since government quite simply cannot do it. Civil society needs to take a leading role and force this issue.

2. Abandon the build limits on REIPPP's and scrap the RMIPPPP programme in its entirety. Also scrap all unnecessary regulation that keep investors out of this market (BEE requirements, procurement requirements, etc.)

The build limits on REIPPP are irrational with the government's own modelling indicating that they increase cost to the average citizen and do nothing to increase capacity at the rate needed to ensure energy stability. Having different bid windows for limited build capacity should be changed to simply have bid windows for anyone who wants to generate electricity commercially. Additionally, the unnecessary regulation that deters investors like BEE-requirements for IPP's should be scrapped. South Africa needs urgent solutions for the energy crisis. We should welcome all investments and stop attaching unnecessary conditions that do not serve to get electricity into the grid faster.

3. Ramp up training in renewable energy and battery storage technology

In the coming decade South Africa will require massive amounts of skilled technicians and engineers specifically in the renewable energy space. We will need millions of skilled people to design, install and maintain renewable energy and storage solutions. At this stage there is a massive dearth of skills in this sector. Training should be ramped up to enable South Africa to move out of the energy crisis with its own labour and skills.

4. Implement a generous feed-in tariff scheme to address immediate supply concerns

Government should incentivize decentralised generation by implementing a feed-in tariff scheme for solar and wind generation that can be online within a year. This policy intervention is already possible due to NERSA's REFIT regulation published on 26 March 2009. Rather than spending billions of rands on bigger commercial installations through the REIPPP and RMIPPPP schemes, we should spend the money on enabling small-scale generation and self-sustainability through generous feed-in tariff schemes. Given Vietnam's experience, and the regulatory leeway of being able to generate up to 100 MW without a license, we can solve the short-term energy crisis in less than a year with the right policy interventions.