GOLD STACKERS AUSTRALIA

PLATINUM

The Impact of South Africa's energy crisis on PGM mine supply

Research by:
Dr David Davis
PhD. MSc. MBL. CEng. CChem. FIMMM. FSAIMM. FRIC.

August 2021

INDEX

Introduction — 3 – 4

Setting The PGM Scene — 5
South African PGM Supply Risk — 6 – 7
Setting The Energy Crisis Scene — 8 – 9
Eskom — 10 – 12
The Roots of Eskom's Demise — 13 – 16
Load Shedding: The Looming Energy Gap — 17 – 18
The Relationship Between EAF and Coal-Fired Plants — 19
The Relationship Between EAF and Load Shedding — 20 – 21
Coal Generation Comparison at A Glance — 22 – 24
Fixing The Energy Gap at A Glance IRP2019 — 25 – 28
The Power Ship Saga — 29
IRP2019: Some Risk Considerations — 30
Will Pivotal Key Factors Be Met? — 30 – 31
Summary of Load Shedding Stages by 2025 — 32 – 33
Eskom Supply To The PGM Mining Industry — 34
The Frequency and Level of Load Shedding Stages — 35
The Impact of Increasing Load Shedding Stages at Higher Frequencies on PGM Supply — 36 – 40
Reducing The Impact of Load Shedding In The PGM Industry — 41 – 42

About Dr David Davis *PhD. MSc. MBL. CEng. CChem. FIMMM. FSAIMM. FRIC.* — 43
Important Notice - General Disclosures, Disclaimers and Warnings — 44

INTRODUCTION

This review provides an insight into the "potential" impact of a diminishing and intermittent electricity supply from South Africa's power utility (Eskom) on the future of South African Platinum Group Metal (PGM) mine supply.

Since 2007, South Africa has faced ongoing periods of widespread rolling blackouts (load shedding) as supply continues to fall behind demand, threatening to destabilise the national grid. The situation, some 14 years later, has reached "crisis level".

In the worst-case scenario, the effect of this "energy crisis" is likely to be "overwhelming" and will undoubtedly have a "crippling" effect on South Africa's economy. Manufacturing, agricultural, industrial, mining, transport and domestic users will not go untouched if the electricity supply shortage is not urgently addressed and reversed by replacement and additional new capacity from coal, gas, wind, storage and solar.

The government and Eskom do not have a good record of completing projects on time and therefore there is a high probability that the new-build of electricity capacity will be late, thereby exacerbating the energy crisis.

The objective of this review is to provide evidence and timing to support this scenario. The outcome will determine the degree and level of load shedding and its impact on PGM supply from South Africa.

It is important to recognise that load shedding is a controlled way and legal requirement to make sure that the national grid remains stable in the case of major incidents. Load shedding is done to avoid a total countrywide blackout. There are 8 stages of load shedding. Eskom decides on the load shedding stage depending on the number of megawatts (MW) required to be saved to balance the grid.

For the investor in precious metals, the degree and level of load shedding and the impact on PGM supply from South Africa will likely support the price of PGMs. The PGM industry can cope with load shedding Stages 1, 2, 3 and 4, albeit at Stage 4, and at higher frequencies, throughput may have to be adjusted downwards. At Stage 6 and above operations would cease.

I am of the view that it is "imperative" for investors to gain an understanding of those factors that have led to the demise of Eskom, which in turn, has led to a decline in electricity supply (negative electricity supply gap) and will, in my view, continue to do so. Much of this review describes the demise of Eskom. In this regard, I have used a number of graphics to illustrate the conversation.

My research indicates that it is most likely that the energy gap will widen significantly over the next 5 years, caused mainly by a low energy availability factor (EAF) of the coal-fired plants, a "slippage" in the new build programme (3 to 4 years) and capital constraints. This, together with political interference and vacillation with respect to the recovery plan, will likely cause a rise in PGM supply losses. In this regard, the PGM supply from South Africa will probably start to decline within the next 2 to 3 years when higher levels and frequency of load shedding persist, including Stage 6 and above ceteris paribus. (Noting, Stage 6 and higher would cause mine operations to cease).

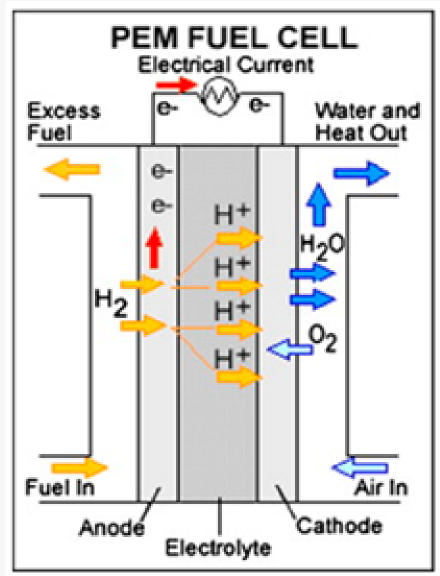
Setting The PGM Scene

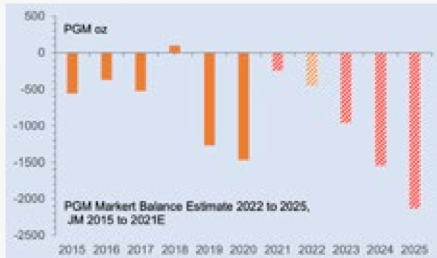
Demand for PGMs is all about climate change and the drive for net zero emissions by 2050.

In this regard, the auto industry has introduced new types of drivetrains for vehicles, with a move from ICE to BEVs, HEVs and FCEVs to meet new emission standards. These new standards mean higher autocatalyst PGM loadings. The new emission standards also mean accelerated demand for FCEVs that contain platinum (mainly heavy-duty vehicles). Furthermore, PEMs' electrolysers, which also contain platinum, are currently seen as the most cost-efficient way to produce green hydrogen from renewable power as they are able to withstand the intermittency of renewable generation.

The progressive tightening of environmental regulations and technology innovation surrounding the production of green hydrogen has led to an increase in PGM demand. My calculations imply that global PGM demand will likely grow at a rate of around 3.5% CAGR (2027). In this regard, my estimates are not too dissimilar from GlobalData's estimates. Global PGM mine supply will most likely remain roughly constant with an average PGM of c.13moz, with a recognisable downward trend starting around 2031. Under these circumstances, I am of the view that PGM demand will increasingly outstrip PGM supply.

This scenario is already playing out. The market balance for palladium has been in deficit for at least nine years, rhodium has been in deficit over the past two years (JM). In both cases, the supply imbalance has been the main driver of the sky-rocketing price of these metals. Platinum has a positive outlook due mainly to substitution in petrol autocatalysts and an increase in catalyst loadings together with a global decline in platinum supply. **I expect platinum to move into deficit in 2022.**





South African PGM Supply Risk

The continuity of South African PGM supply is not secure. The South African PGM mining industry has faced numerous challenges in the past caused mainly by the combined effects of electricity shortages (load shedding), prolonged industrial action, political upheaval, increasing costs and a significant reduction in capital expenditure. **The PGM mining industry has been starved** of expansion and ore reserve replacement capital for a number of years.

South Africa has experienced 14 years (from 2007) of intermittent load shedding stages between 2 and 6. Currently, Eskom is implementing load shedding. Furthermore, Eskom has recently warned that it expects load shedding (Stage 4) to increase towards the end of 2021, as it is facing a 5GW shortfall, which is expected to continue for at least another 5 years. The higher the load shedding stage, the more frequent load shedding becomes. In this regard, the impact on PGM production will likely become more severe.

At this stage of the conversation, it is important to put into perspective the potential impact of this looming "energy crisis" on some of South Africa's strategic mining exports such as PGMs, manganese, chrome and coal.

- South Africa produces 72%, 36%, 82%, 81% and 87% of platinum, palladium, rhodium, ruthenium and iridium respectively (JM), (SFA Oxford).
- South Africa is the number one global exporter of manganese, producing 5.2mt in 2020, some 37% more than the runner-up, Australia, at 3.3mt. China was the fifth largest producer of manganese in 2020, recording output of 1.3mt. It should be noted, however, that a number of manganese mines have their own generators which supply them with electricity.

- South Africa produced 16mt of chromium in 2020, beating the rest of the world's chromium producers by a wide margin (58%): Kazakhstan came in at number two, producing 6.7mt of chromium.

- Based on the latest available data, South Africa's coal exports increased in 2020. In a recent report, shipbroker Banchero Costa said that South Africa is the fourth largest exporter of coal in the world, after Australia, Indonesia and Russia.

I note that global mine supply of platinum has grown by c.1.7% CAGR between 1990 and 2020. In 2019, global mine supply was some 6.1moz (JM). Global platinum mine supply depends heavily on the South African PGM mining industry, which supplies about 72% of global platinum. Russia, North America and Zimbabwe supply around 12%, 6% and 7% respectively (JM 2019). Global platinum mine supply between 2006 and 2019 declined by c.-1.0% CAGR. South African platinum mine supply declined by c.-1.4% CAGR. The gradual decline in the supply of platinum is mainly attributed to the historical evolution of the mining mix ratio of the PGM reefs in South Africa and to the lack of capital investment.

It is clear from the above list of strategic exports that an "additional" decline in PGM supply from South Africa, due to a continuous decline in power supply, will likely become more sensitive as PGMs are inextricably linked to climate change. **Furthermore, the PGM market balance will inevitably move into a continuous and declining deficit, which will put upward pressure on the price, in particular the price of platinum.**

It is important to note that the relationship between a decline in power supply and its impact on PGM supply cannot be measured directly because of the complexities surrounding this calculation. The frequency and level of load shedding stages can, however, be measured. This leaves us with a series of probabilities as to the likely impact on PGM supply. The frequency and level of load shedding stages are entirely in the hands of Eskom.

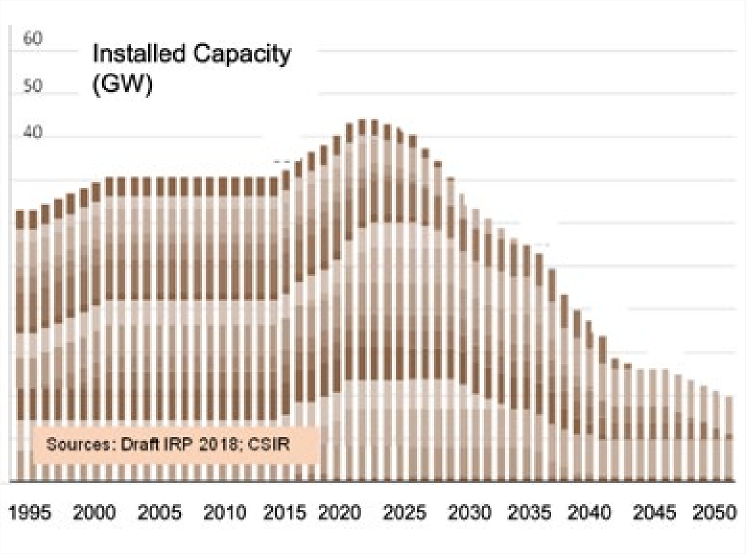
This conversation therefore focuses on Eskom and its ability to achieve its new build plan.

Setting The Energy Crisis Scene

This section sets the scene as the energy crisis unfolds. The government has set out a plan (IRP2019) designed to neutralise the electricity supply gap by reducing the existing dependence on fossil fuels to a mix of renewable energy sources. In this regard, apart from the availability of capital, there are two pivotal key factors that will drive the successful accomplishment of this exercise. These are: the energy availability factor (EAF) of the coal-fired plants must increase from 67% to 75.5% and above by 2024, and the new plan must be executed between 2021 and 2030. If one or both of these pivotal key factors are not achieved the plan will fail, and Eskom will be forced to increase the frequency of load shedding until the energy gap is neutralised.

An Integrated Resource Plan (IRP) for electricity is a rational, mechanistic, techno-economic planning process that determines the optimal mix of generation technologies and capacities, with the least cost to the economy, necessary to meet the projected demand for electricity in the years ahead, with defined reliability and security of supply (Eskom).

There is, however, an overarching factor which will have an impact on the execution of this plan; many of Eskom's coal-fired plants are old and reaching their end of life. In this regard, five out of fifteen coal-fired power stations are expected to be decommissioned by 2025.



The decommissioning of these power stations will remove around -3.8GW from the grid between 2020 and 2025 and -9.1GW between 2020 and 2030. The decline between 2020 and 2030, and on to 2050 is relatively steep.

This means that it is imperative to replace the loss in capacity timeously, as per the new-build plan. Any slippage, as indicated above, will mean prolonged periods of load shedding.

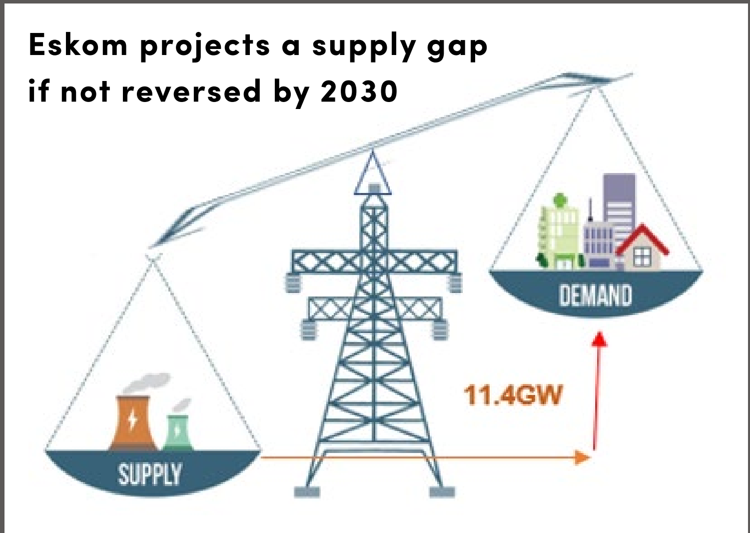
Energy expert Ted Blom has indicated (MyBroadband) that "he would not be surprised if between now and the end of winter 2021, we will experience Stage 6 load shedding, pretty much for certain, and even Stage 8 or above that is a possibility''.

In a surprise move, South Africa's President Cyril Ramaphosa announced on 10 June, that the licence-exemption cap on self- or distributed-generation plants would be raised from 1MW to 100MW. The increase in the threshold will enable mining companies and other entities to build power generation units of up to 100MW without applying for a licence through the National Energy Regulator of South Africa (Nersa). This action was introduced to help address the country's electricity crisis, which has been weighing down economic growth and confidence for more than a decade. This move was welcomed by the industry.

In this conversation thus far, I have alluded to the pivotal key factors which must be met in order to neutralise the energy gap. Unfortunately, Eskom and the government do not have a good track record in meeting project deadlines. Therefore, the energy gap is likely to widen instead of being neutralised.

The objective of this review is to provide evidence and timing to support the scenario that the two pivotal key factors will or will not be achieved in a timely manner. The outcome will determine the degree and level of load shedding and the impact on PGM supply from South Africa.

In this section of the conversation, I focus on the demise of Eskom. This subject is extremely complex and, in this regard, this review draws mainly from experts in this field: Eskom, the CSIR and government publications and presentations, the Minerals Council South Africa, Energy Intensive Users Group and the collective writings of energy experts and news publications. It should be noted that the Minerals Council and other interested parties engage extensively with government and Eskom. This review also uses a number of graphics drawn mainly from Eskom and the CSIR in order to aid the understanding of the conversation and to provide evidence and timing to support the objective outlined above.



In this regard, I have also alluded to the track records of the government and Eskom concerning the delivery of power to South Africa. The country has already experienced 14 years (from 2007) of intermittent load shedding at stages between 2 and 6. The higher the load shedding stage the more frequent load shedding becomes.

The subject matter concerning Eskom and its future is not new. The impact of a diminishing and intermittent electricity supply is the result of a number of downgrading factors, which are attributed to a "cauldron" of political ideology, political interference, state capture, mismanagement, lack of skills, poor maintenance, unscheduled breakdowns, crime and corruption.

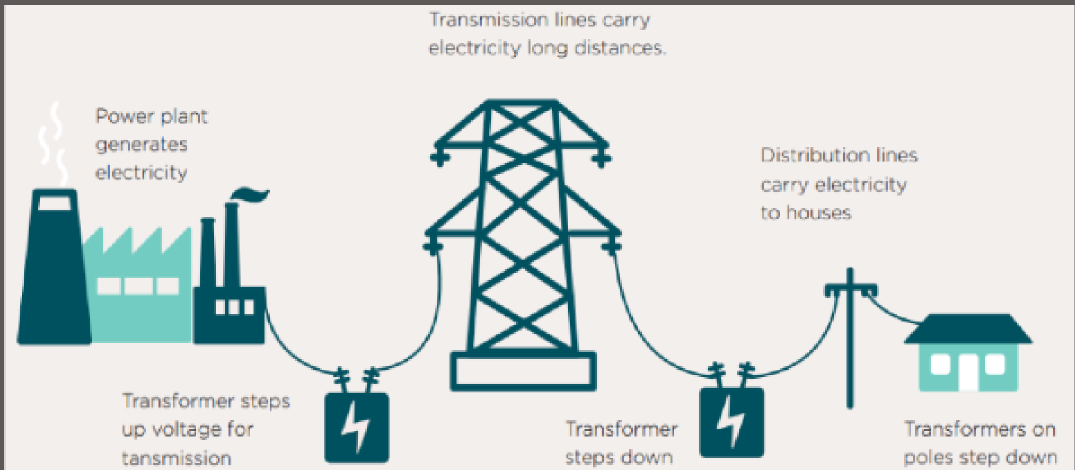
It should be noted that Eskom has an ageing fleet of coal-fired power stations. Historically, the EAF of these power stations was above 80% (2000). Over the past decade, the EAF has declined to around 67% and lower, which has further constrained power supply resulting in load shedding.

Eskom is currently struggling to meet electricity demand and has already started load shedding. Notwithstanding, Eskom is scheduled to remove around 3.5GW from the national grid by decommissioning five coal-fired stations, which will have reached the end of their 50-year lifespan between 2021 and 2025. Eskom estimates that without additional capacity, there will be an electricity supply shortfall of around 5GW over the next four years (2025).

Plans to install alternative renewable energy to neutralise and bolster the diminishing electrical supply "slipped" mainly because of a failure to implement policy between 2015 and 2018, which led to a breakdown in procurement. It has taken, in all, around two years, until April 2021, of effectively doing nothing about the looming energy crisis. The government has hastily restarted utility scale procurement processes for renewables according to the government's upgraded IRP2019, which sets out the transition from the existing dependence on fossil fuels to a mix of renewable electricity energy sources to replace this widening energy gap. The IRP2019 also calls for the restructuring of Eskom into Eskom Holdings with three new subsidiaries: Generation, Transmission and Distribution to improve the effectiveness of Eskom.

The key question in this regard:
Will the planned transition of the ageing coal-fired plants to a mix of renewable electricity energy sources be timeously implemented? Or will there be continuous bouts of project "slippage" with Eskom having to continuously play "catch up", thereby having to implement higher stages of load shedding.

To cap it all, Eskom is not generating enough cash to fund its operations and service its R401bn (US$27bn) debt (Eskom annual report 2021). So where will the money come from? Among others, a significant increase in tariffs is expected to fund, in part, the new build programme.



Source: Power Futures Lab at the University of Cape Town's Graduate School of Business. October 2019. Design by: Design for Development (www.d4d.co.za)

As indicated, the subject matter concerning Eskom and its future is not new. A number of well-known leading engineering and energy experts, CEOs of large industrial and mining organisations, the Minerals Council South Africa, the CSIR, South African Independent Power Producers Association (SAIPPA) and many other associated organisations have been raising "alarm bells" surrounding the progressive demise of Eskom since 1994.

Currently, these "alarm bells" are at full volume!

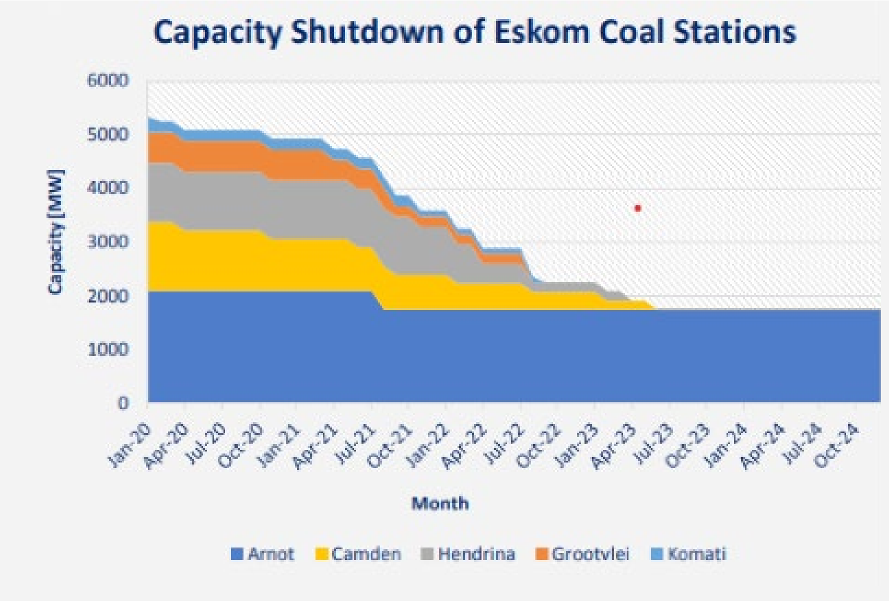
THE ROOTS OF ESKOM'S DEMISE

The objective of this section is to "set the scene" surrounding the major factors that have led to the decline in Eskom's electricity supply.

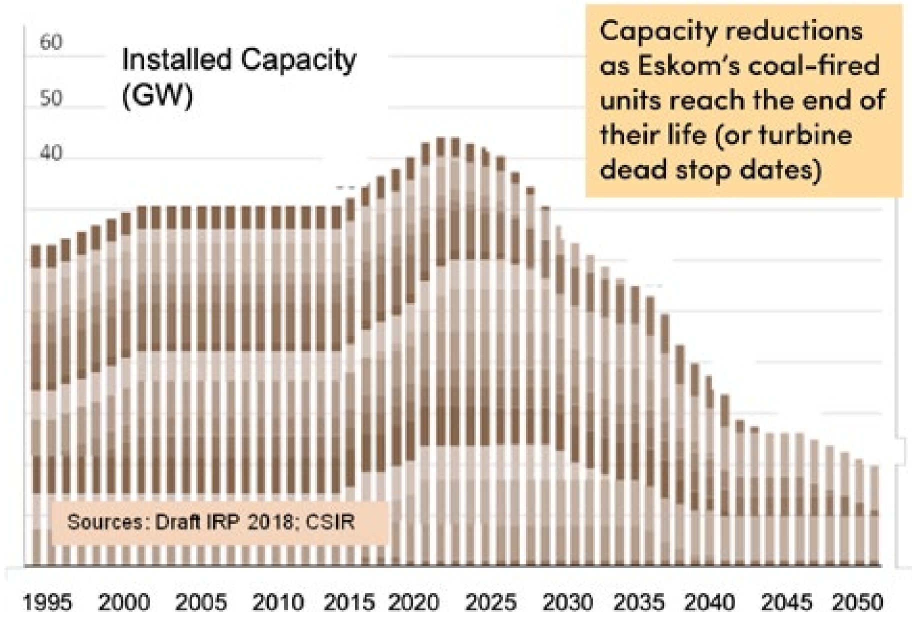
The roots of Eskom's decline date back to 1994, some 27 years ago, when the ANC government took power. The demise of Eskom has been attributed to numerous "crippling factors", which have been well documented and reported on. As indicated, much of these downgrading factors are attributed to political ideology, political interference and meddling, state capture, mismanagement, lack of skills, poor maintenance, unscheduled breakdowns, crime and corruption. In a paper published in @ Liberty2015, the policy bulletin of the IRR, engineer and energy expert, Andrew Kenny said "that from a well-run state organ, Eskom's politically appointed new managers appear to have little interest in ensuring future electricity supply.

''Accountants replaced engineers at senior levels, and those accountants lost sight of Eskom's fundamental purpose, which is simply to provide electricity and cover its costs, not make a big profit or a high rate of return".

Experts also blame Eskom for not building more power stations. Many of Eskom's coal-fired plants are old and reaching their end of life. It is noted that 60%, or 22.5GW, of Eskom's nominal capacity of 37.4GW is generated by plants that are between 35 and 59 years old.



Five of Eskom's coal-fired power stations are expected to be decommissioned by 2025: Komati, Camden, Grootvlei, Hendrina and Arnot, which are now 59, 54, 52, 51 and 50 years old respectively. It is noted that among others, the EAF from the coal-fired fleet has declined from over 80% in 2000 to around 67% over the past decade, which has contributed to a continuous decline in power supply resulting in load shedding.



The relationship between the EAF and power supply will be discussed further in the load shedding section of this review.

The graphic (CSIR) on the left illustrates the scheduled decommissioning of the ageing coal-fired plants. It is important to note that the shutdown of the ageing coal-fired plants declines steeply from 2022 through to 2050, which amounts to a coal-fired energy gap of around 30GW.

Eskom expects decommissioning of approximately 24.1GW of coal-fired power plants in the period beyond 2030 to 2050. As indicated, the government's IRP2019 sets out the transition from the existing dependence on fossil fuels to a mix of renewable energy sources to fill this energy gap.

Eskom indicates that despite decommissioning of old power plants and preference for renewables and gas, coal remains dominant in the energy mix for the planning period up to 2030.

It should be noted that Eskom does not have a good track record with regards to EAF, caused mainly by mismanagement, cost constraints, the lack of skills and unscheduled breakdowns of the ageing coal-fired plants. In this regard, the projected rate of decline of its coal-fired plants may well be "optimistic".

The steep decline in the scheduled shutdown of ageing coal-fired plants after 2022 through to 2050 illustrates just how precarious South Africa's energy crisis is, affecting in particular South Africa's PGM supply.

On this subject, Ted Blom noted that Eskom was facing what the Fossil Fuel Foundation called a 'coal cliff'.

Clearly, the degree of slippage surrounding new capacity will progressively impact PGM supply. In this regard, Eskom and the government do not have a good track record of completing projects on time.

For example, two mega coal-fired plants with an output of 4.8GW each were commissioned to be built in 2007. Eskom said at that time Medupi and Kusile will be completed by 2015 and will play an important role in solving South Africa's energy challenges. The construction of these plants was plagued by a multitude of delays, spiralling costs and corruption scandals.
Current forecasts indicate that Medupi's completion date has been extended to 2021, with Kusile expected to be completed in 2025. It is noted that Medupi and Kusile have been de-rated at below name-plate rating, meaning that these plants are unable to provide the full complement of energy for their rating. It should be noted that this energy shortage occurs despite the already-committed capacity from renewable energy projects and the commissioning of the remaining units at Medupi and Kusile.

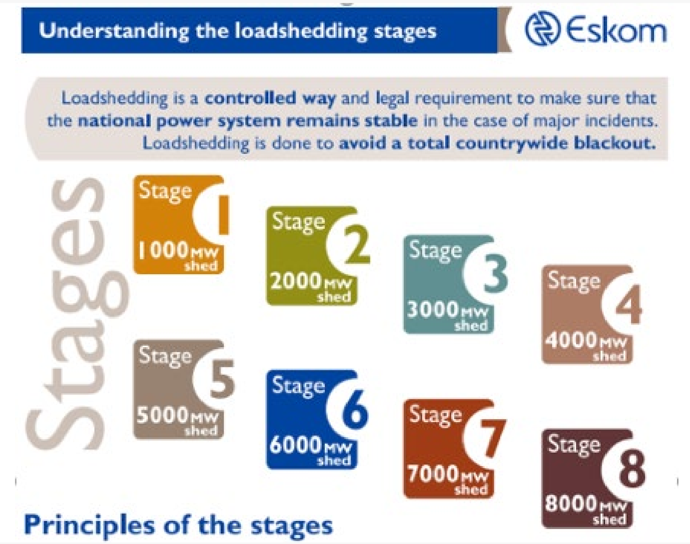
It is interesting to note that the government published a White Paper on energy policy in 1998, which was full of sensible suggestions, according to energy experts. This White Paper proposed restructuring Eskom's generation, distribution and transmission operations, which has finally been adopted in IRP2019, some 22 years later. The White Paper also proposed the option of renewable energy systems and opening electricity generation to independent power producers, as well as competition for Eskom in power supply. Politically, the notion of privatisation did not sit well with the ANC's Marxist doctrine. In this regard, the government banned Eskom from building new power stations. It should be pointed out that in 1998 Eskom had surplus capacity but expected demand to outstrip supply in 2007 if nothing was done to replace its ageing coal-fired power stations.

Load Shedding: The Looming Energy Gap

Eskom is currently struggling to meet electricity demand and has started load shedding. Notwithstanding, and as indicated, Eskom is scheduled to remove around 9.1 GW from the national grid between 2021 and 2030. Eskom estimates that without additional capacity, there will be an electricity supply shortfall of 5GW over the next four years (2025).

In this regard, South Africa's power utility will be forced to increase the frequency of load shedding in stages until the energy gap is neutralised.

The higher the load-shedding stage the more frequent load shedding becomes. For example, Stage 4 load shedding means: load shedding 12 times over a 4-day period for 2 hours at a time, or 12 times over an 8-day period for 4 hours at a time. Load shedding in Stage 8 will result in its customers having electricity for approximately 50% of the day.



The **higher** the **loadshedding stage**, the **more frequently** you will experience loadshedding.

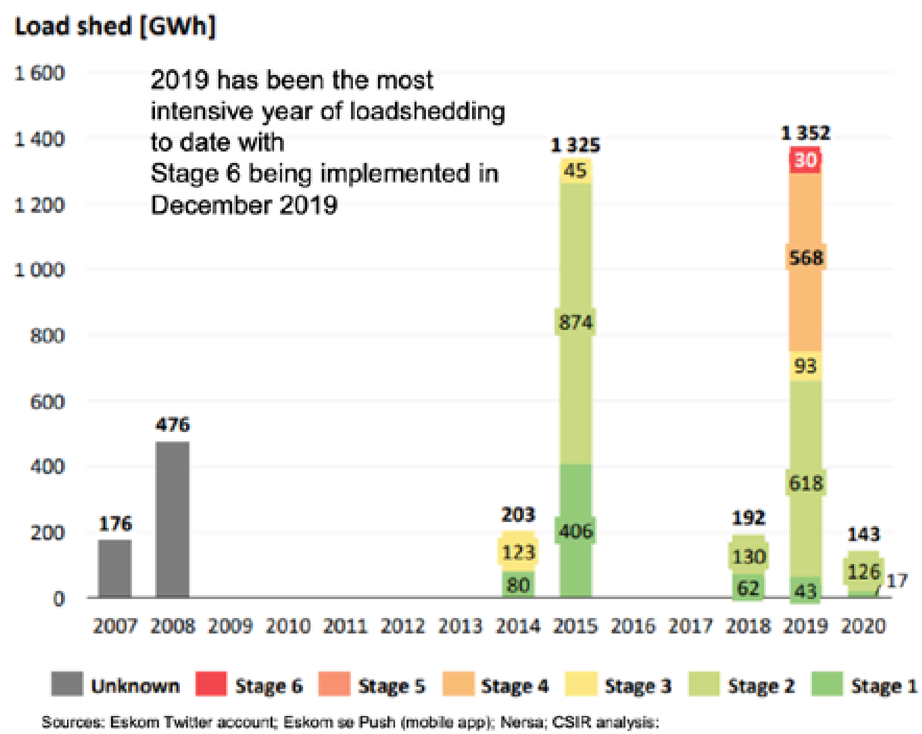
The **higher** the **stage**, the **greater** the **number** of **customers** who will be affected across the country

Generally loadshedding in stage 8 will result in customers being on and off through the day for a total of about 12 hours.

HOW DOES IT WORK?

1. Eskom decides on the loadshedding stage depending on the number of megawatts needed to **balance** the power grid.
2. Eskom and the municipalities then implement loadshedding on a **rotational basis**, based on the schedules developed.
3. Loadshedding is done for **2-4 hours depending on the schedule for your area** (+30 minutes restoration time)

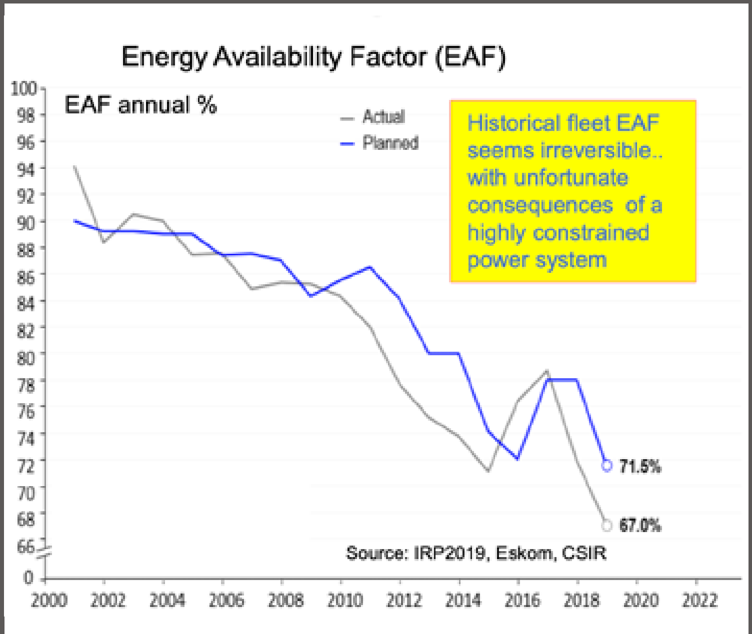
The graphic on the right illustrates the load shedding events since 2007 together with energy shed and the estimated economic impact. Presentation CSIR, J Wright, and J Calitz, January 2020 (abbreviated to CSIR, W and C).



Year	Duration of outages (hours)	Energy shed (GWh)
2007	-	176
2008	-	476
....	....	....
2014	121	203
2015	852	1325
2016	-	-
2017	-	-
2018	127	192
2019	530	1352
2020 (YTD)	80	143

It is important to note that it is assumed that load shedding takes place for the full hours in which it was implemented. Practically, however, load shedding and the stage may occasionally change during a particular hour. The graphic also illustrates how complex it is to forecast load shedding. For example, in 2019, load shedding Stages 2, 3, 4, 5 and 6 were implemented, with most load shedding falling in Stages 2 and 4. It stands to reason that the longer load shedding remains at higher stages (4 to 8) and at higher frequencies, the greater the impact on PGM mine supply. It should be noted that the mining companies' load shedding protocols are somewhat different from the national protocol. The definition of stages of load shedding does not change.

Energy expert Ted Blom has indicated (MyBroadband) that he would not be surprised if between now and the end of winter we experience Stage 6 load shedding, and even Stage 8 or above, which is a possibility. Ted Blom also indicated that **based on Eskom's own forecasts, 2021 is going to be the worst year of load shedding on record.** The relationship between the load shedding stage and the impact on PGM supply is discussed later in this review.



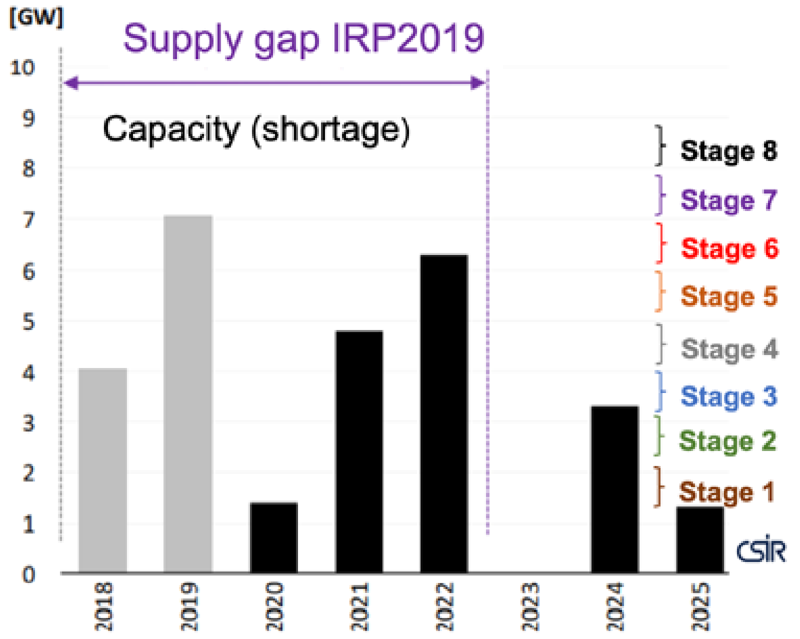
The Relationship Between EAF and Coal-Fired Plants

The EAF from the coal-fired fleet has declined from above 80% in 2000 to around 67% over the past decade. This situation has contributed to a continuous decline in power supply, which has an impact on increasing load shedding. It is interesting to note that Eskom's EAF was assumed to be 75.5% in the updated IRP2019, 2010 - 2030 plan. The graphic on the left, illustrates the rate of decline of the EAF between 2000 and 2019. The CSIR comments that the "historical fleet EAF decline seems irreversible... IRP2018 EAF did not materialise, risk of IRP2019 EAF not materialising is high".

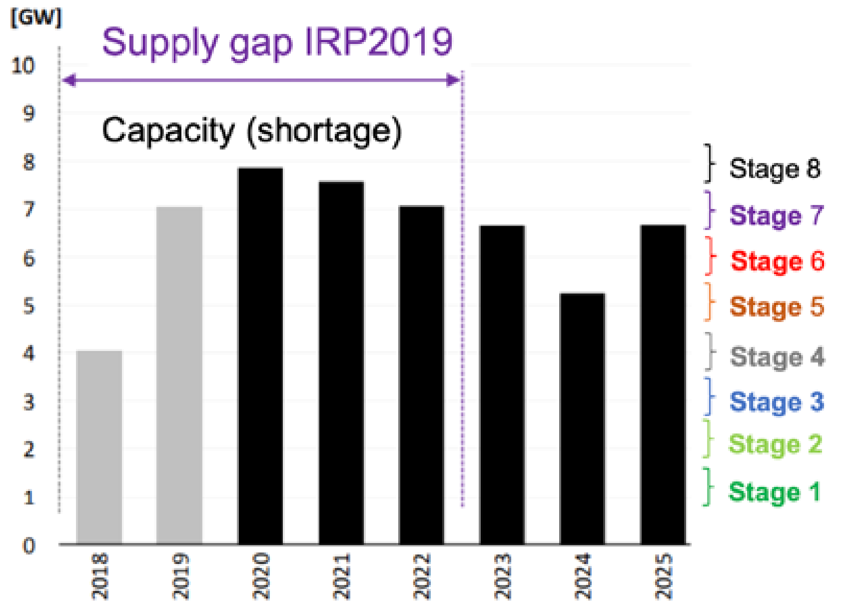
This situation is likely to be heightened as five of Eskom's coal-fired power stations are expected to be decommissioned by 2025.

The Relationship Between EAF and Load Shedding

The graphics (CSIR, W and C) below, illustrate the relationship of the weighted average EAF of the coal fired plants and load shedding.



IRP 2019 EAF & IRP 2019 demand forecast. EAF recovery from ≈67% in 2019 to 75.5% by 2024



Updated EAF & demand forecast indicates further shortage relative to IRP 2019 requiring capacity and significantly more energy EAF from ≈67% in 2019 to ≈64% by 2024 .

The two graphics compare: IRP2019 EAF and IRP2019 planned demand forecast and the planned EAF recovery forecast, from ≈67% in 2019 to 75.5% by 2024 with an updated EAF and updated demand forecast, EAF from ≈67% in 2019 to ≈64% by 2024.

Note, these graphics are simulated. The first graphic implies a capacity shortage from the IRP2019 despite an increasing EAF to meet the plan of 75.5% by 2024 (IRP2019). The power system is, however, less constrained, but still exhibits a dominant short-term capacity gap and small energy gap until planned new-build capacity comes online. This graphic also implies the likelihood of load shedding Stages 2 to 4 during 2021, and the possibility of load shedding Stages 2 to 6 during 2022. According to the CSIR and W and C, this scenario is unlikely to materialise.

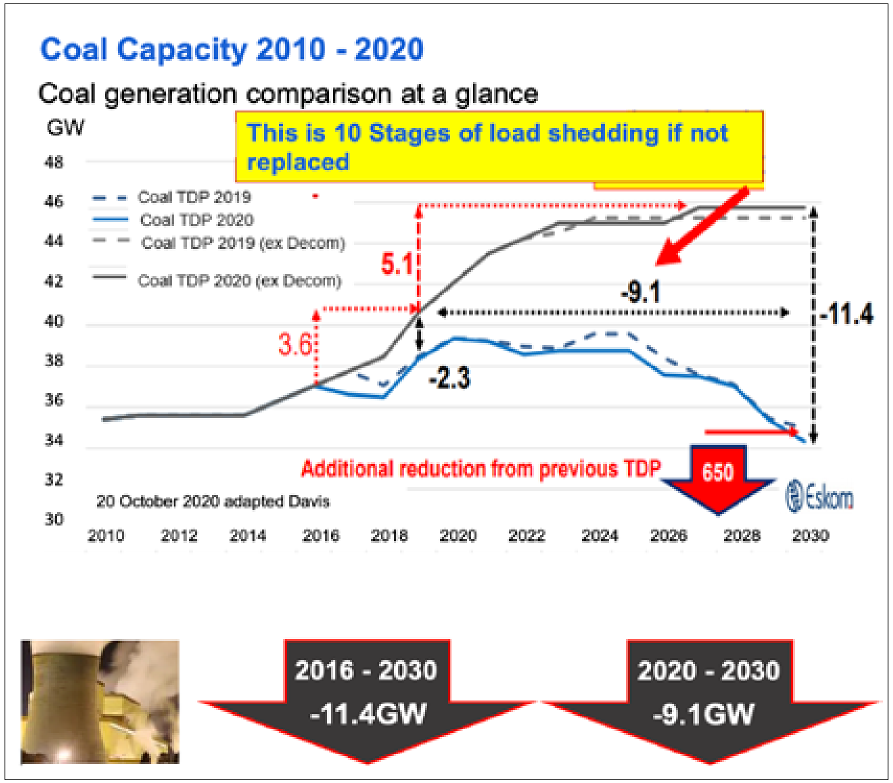
The second graphic is an updated demand and EAF forecast from ≈67% in 2019 to ≈64% by 2024. This graphic is used for comparative purposes against the EAF IRP2019. Essentially, the EAF used in this graphic represents the actual average achieved in 2019, which remains more or less constant to 2024. This scenario implies further additional capacity and energy shortages relative to the IRP2019.

The second graphic also implies the likelihood of Stages 2 to 7 load shedding through to 2025. The updated EAF and updated demand forecast is the most likely scenario. This means the EAF IRP2019 will probably not materialise (CSIR, W and C).

In summary:
Clearly, the improvement in the EAF is one of the pivotal factors surrounding the success of IRP2019. In this regard, risk is to the upside, which implies the likelihood of Stages 2 to 7 load shedding through to 2025 (CSIR, W and C) and beyond.

COAL GENERATION COMPARISON AT A GLANCE

Thus far, this study has focused on the complexity of forecasting load shedding and the impact of EAF on load shedding. This section of the conversation uses Eskom's data to illustrate the ballooning energy gap if the new-build capacity does not come online as planned.



The graphic on the left, illustrates a diminishing electricity supply as Eskom's ageing coal-fired plants are decommissioned through to 2030. The graphic also illustrates, for comparative purposes, the equivalent coal-fired capacity transition development plan (TDP) for 2019 and 2020, required between 2020 and 2030 to neutralise the expanding energy gap, which reaches a deficit of around -9.1GW, if not replaced. (Eskom TDP 20 October 2021 to 2030). As indicated, Eskom has recently warned that it expects load shedding (Stage 4) to increase towards the end of 2021, as it is facing shortfalls that are expected to continue for at least another five years.

The graphic, however, implies that the energy gap is ballooning and will likely advance much more rapidly through load shedding stages of around 2 to 9 between 2022 and 2025 if additional capacity is not implemented timeously. The acceleration of the energy gap shortfall has been attributed in part to a failure to implement policy between 2015 and 2018, which led to a breakdown in procurement until April 2021.

This graphic confirms the urgency of the implementation of the TDP from the existing dependence on fossil fuels to a mix of renewable electricity energy sources to neutralise this energy gap if not expedited rapidly. The graphic also implies that the TDP upgrade is of vital importance and should go hand-in-hand with the alternative renewable energy and gas-coal installations.

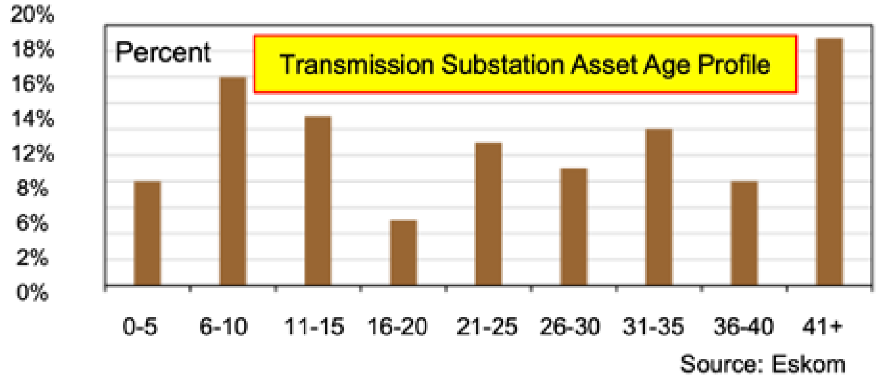
It is important and disturbing to note that according to Eskom's graphic, should there be any further slippage in the installation of renewable energy sources and the completion of the transition development plan (TDP) the supply gap will balloon to -9.1GW by 2030. This, according to Eskom, represents 10 stages of load shedding! This level would be disastrous for South Africa and the mining industry.

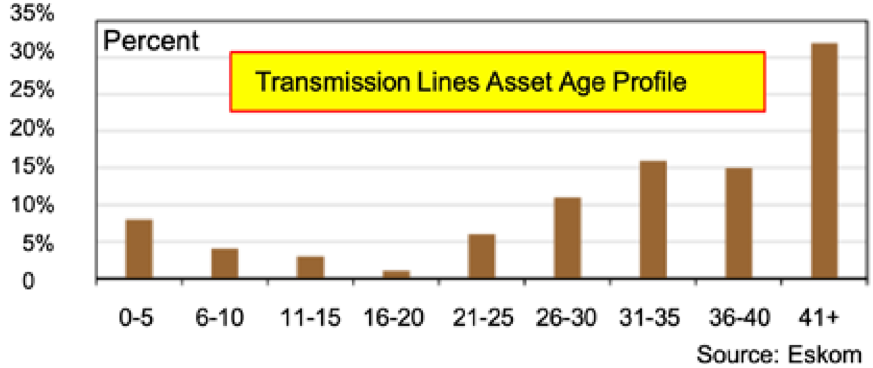
Eskom has numerous sub-stations and transformers, with approximately 33,000km of transmission lines and has a national footprint in South Africa. Eskom indicates that the overall transmission network performance, has deteriorated over the past 5 years, and requires capital for replacement.

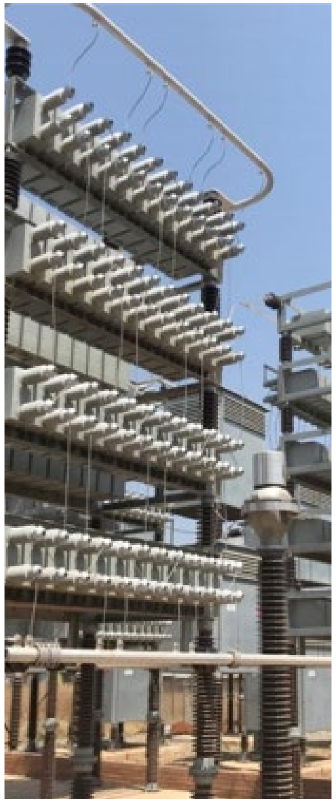
Eskom has a 10-year transmission refurbishment plan in place based on asset condition assessments, asset criticality and network risks. (See graphics on the right).

Quote from Eskom's TDP 2021 to 2030 presentation 29 October 2019:

"Existing generation fleet replacement with both new energy (wind and solar) and new capacity (back up gas, batteries, etc.) is required irrespective of load growth. Transmission expansions are critical to create access for these new energy sources and capacity location. Load growth plays a significantly lower role but is still important."

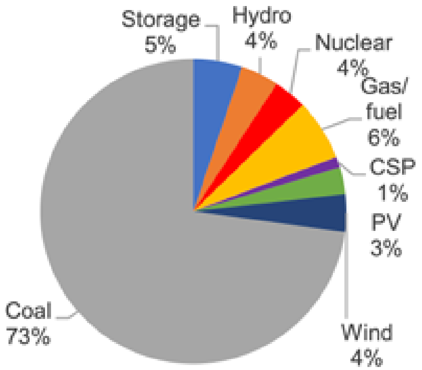




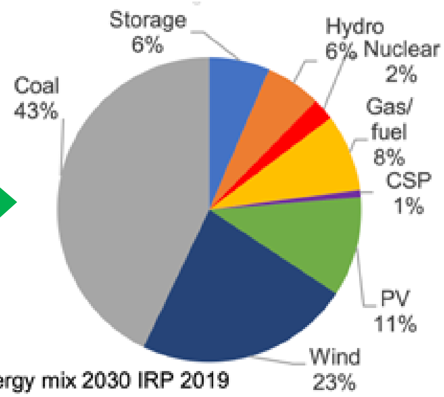


FIXING THE ENERGY GAP AT A GLANCE IRP2019

WWW.GOLDSTACKERS.COM.AU



Current energy mix IRP 2019



Energy mix 2030 IRP 2019

Recommended Plan IRP 2019	Coal		Nuclear	Hydro	Storage	PV		Wind	CSP	Gas & Diesel	Other*
Current Base	37149		1860	2100	2912		1474	1980	300	3830	499
2019	2155	-2373						244	300		•••
2020	1433	-557					114	300			
2021	1433	-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						1600		2000	500
2028		-475					1000	1600			500
2029		-1694			1575		1000	1600			500
2030		-1050		2500			1000	1600			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	

Grey	Installed Capacity
Yellow	Committed/ Already Contracted Capacity
Red	Capacity Decommissioned
Green	New Additional Capacity
Blue	Extension of Koeberg Plant life
Orange	Distributed Generation Capacity for own use

* Distributed Generation, CoGen, Biomass, Landfil

Source: DMRE

This section focuses on the new-build plan as laid out in the government's IRP2019.

The Eskom graphics on the left, Illustrate the electrical energy build-up mix of: wind, PV, gas/fuel and storage to be achieved by 2030. It is important to note that the electrical energy produced by coal-fired plants reduces from 73% to 43%, while wind and PV energy increases from 4% and 3% to 23% and 11% respectively.

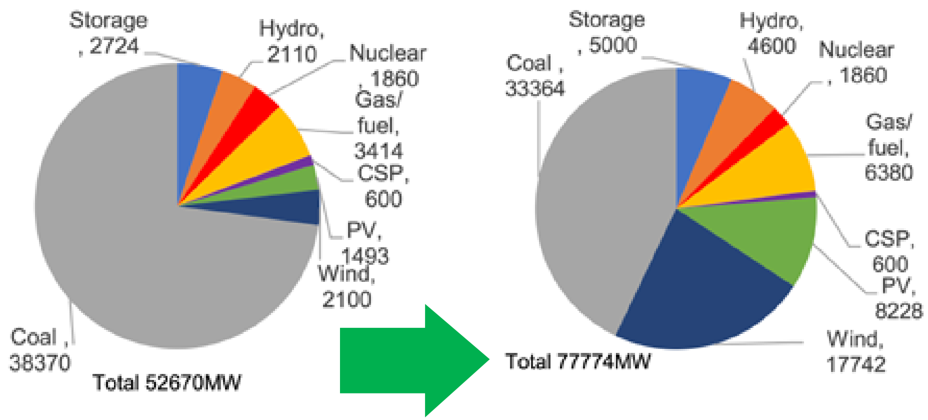
Renewable energy increases from 8% to 35% (wind and PV). The Eskom table on the left, illustrates the timetable for the electrical build-up mix of the new-build plan as laid out in the government's IRP2019.

It should be noted that this schedule has already "slipped" by two years. This timetable colour codes the installation sequence of the energy mix.

According to the colour codes, the timetable implies that the first new builds (green) should be commissioned by 2022, which in my view, seems "optimistic".

- Wind, 1.6 GW is scheduled for commissioning in 2022
- PV, 1.0 GW is scheduled for commissioning in 2022
- Storage 0.5 GW is scheduled for commissioning in 2022
- Coal, 0.75 GW is scheduled for commissioning in 2023
- Gas/Fuel,1.0 GW is scheduled for commissioning in 2023

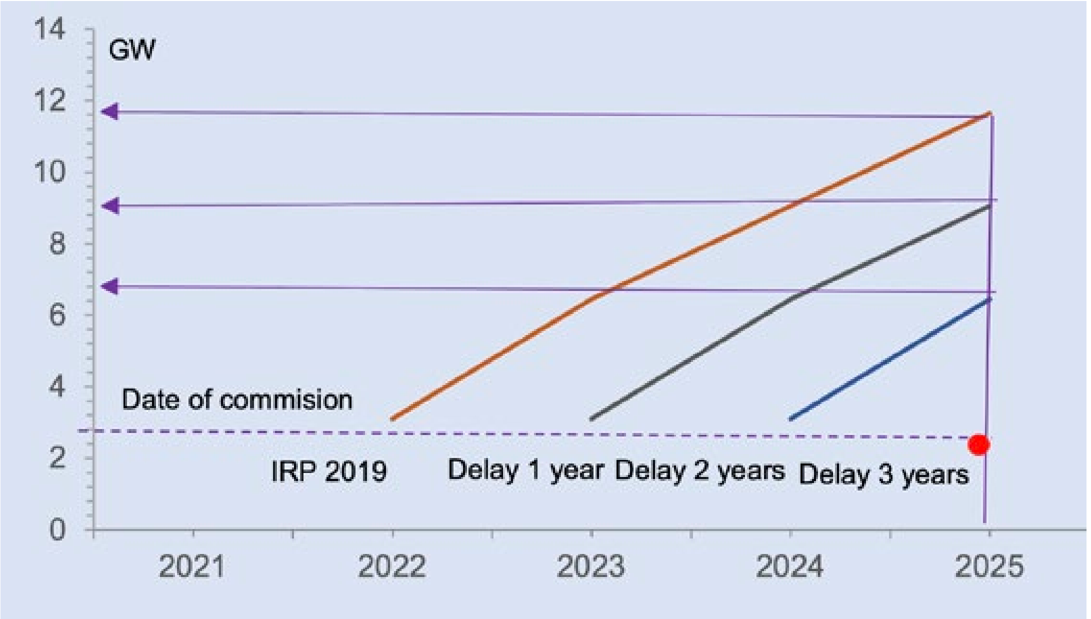
According to the IRP2019, by 2025 the additional wind, PV, storage, coal and gas/fuel should add 6.4GW, 3GW, 0.5GW, 1.5GW, and 0.75GW respectively: In all amounting to an additional 12.2GW to the grid (cumulative).



Procurement of some of the major installations are only now being implemented. Under these circumstances, it's not unreasonable to assume at least a 3 to 4 slippage (from 2021) in this plan ceteris paribus. A 3 to 4 year (2024 to 2025) slippage in the new build programme will mean that new-build capacity of 77.7GW will not likely be met by 2030, from 52.6GW in 2019.

A slippage of three years from IRP2019 commissioning date of the new build programme would likely result in a new-build production level of around 5.5GW, instead of the expected IRP2019 production level of around 12.2GW by 2025. Or a 45% completion rate. What does this mean? Given that the decommissioning of coal-fired plants will remove around 3.5GW from the grid, a slippage delay amounting to some 6.7GW coupled with a low EAF (67% to 64%) implies that by 2025 the energy gap will likely widen to approximately 9GW to 10GW. This quantum will equate to load shedding of around Stage 9 and above.

Roger Baxter, CEO, Minerals Council of South Africa, in a speech to EE Business Intelligence said: "Our view is that in the short term and medium term, given the fact that we are going to see such a significant phase-out of the older generation power stations, and given the fact that we are going to need to bring on a lot more capacity, our perspective is that capacity needs to come on stream pretty quickly''. This statement has been quantified in this review. It should be noted that this "assumed slippage" is not set in stone; the government has a number of alternative options to fast track



Roger Baxter, CEO, Minerals Council of South Africa

© Creamer Media

the new-build programme at any time. As indicated above, the White Paper also proposed the option of renewable energy systems and opening electricity generation to independent power producers, as well as competition for Eskom in power supply. Delaying the decommissioning schedule of the ageing coal-fired plants would be another option. Furthermore, as described above, the government's recent licence exemption cap on self- or distributed-generation plants has been raised from 1MW to 100MW to try to mitigate the energy shortfall.

Apart from the likely delays in implementing the new build programme, further delays surrounding growing opposition and legal challenges are beginning to arise against new gas/fuel, coal and "power ship'' installations.

Clearly, the energy plan IRP2019, does not have the slack to pick up any shortfall. In this regard, the government's licence exemption cap on self- or distributed-generation plants should be opened to being privatised and raised to at least 1,000MW sooner rather than later.

The Power Ship Saga

Recently, the Mineral Resources and Energy Minister, Gwede Mantashe, proposed the leasing of three Turkish-built ''power ships" as part of the risk mitigation programme. Each ship is set to produce 1,220MW of power, using liquefied natural gas to alleviate SA's power constraints in the shortest possible time. These ships are set to be docked across three ports: Richards Bay, Ngqura and Saldanha for a period of 20 years at an estimated cost of R218bn (US$14.7bn).

The leasing of the power ships has been met with a raft of controversy by experts criticising the value of the scheme and method of procurement. Aside from environmental concerns, the ships emit greenhouse gases and are known to endanger marine life. There have also been allegations of corruption around the bidding process.

In the latest turn of events, the Department of Forestry, Fisheries and the Environment has rejected the environmental impact assessments submitted by Turkish majority held company Karpowership SA for all three of the ports.

As an aside, Koeberg nuclear power station appears on the plan; however, this plant will likely be shut down in 2024 in line with its 40-year life-of-plant design. In this regard, 1,860MW will come off the grid, worsening the power generation situation.

IRP2019: Some Risk Considerations

In this section, I draw attention to a few risk considerations highlighted in the IRP2019:

1. **Variable capacity:** Renewable sources impacting system security and stability.
   There is an inherent risk associated with the intermittency of renewable technologies such as wind and PV as requirements to balance the system increases (energy and ancillary services).

2. **Coal:** There is risk of 900MW of procured coal not materialising due to financing and legal challenges. There is also the likelihood of future coal-to-power capacity not being realised due to financing challenges.

3. **Gas:** The availability of gas in the short to medium term is a risk as South Africa does not currently have gas resources. This project may also face legal challenges There is also a supply and foreign exchange risk associated with a likely increase in gas volumes depending on the energy mix adopted after 2030 when a large number of coal-fired power stations are decommissioned.

One would have expected all the nuts and bolts needed to complete the IRP2019 would be in place before starting the new build plan. However, as indicated above, and among others, there are basic risks associated with the plan that point to many "ifs and buts", which are likely to lead to failure, even before the plan gets off the ground. There are many aspects to the Eskom puzzle which do not provide much comfort, including the possibility that coal and gas projects don't materialise due to financing and legal challenges.

Will pivotal key factors be met?

At the beginning of this review, I indicated that the government has set out a plan (IRP2019) designed to neutralise the electricity supply gap by reducing the existing dependence on fossil fuels to a mix of renewable energy sources.

In this regard, I indicated that there are two key factors that will drive the successful accomplishment of this exercise: the i) the low EAF of the coal-fired plants must increase to 75.5% and ii) the plan must be timely executed between 2021 and 2030. If one or both factors are not achieved the plan will fail and Eskom will be forced to increase the frequency of load shedding until the energy gap is neutralised.

The objective of this review is to provide evidence and timing to support the scenario that the two key factors will or will not be achieved timeously. The outcome will determine the degree and level of load shedding and the impact on PGM supply from South Africa.

After analysing reports and presentations from Eskom, the CSIR and government publications and presentations, the Minerals Council South Africa, Energy Intensive Users Group and the collective writings of energy experts and news publications, I am of the view that:

Key factor 1

According to the CSIR, W and C, the planned EAF IRP2019 scenario is "highly unlikely to materialise".

In this regard, there is a likelihood of load shedding Stages 2 to 4. during 2021 and load shedding Stages 2 to 6 during 2022 (CSIR, W and C).

If the EAF does not change but dips marginally from the 2019 figure of ≈67% then, according to CSIR W and C, this EAF forecast is "the most likely scenario".

This scenario implies the likelihood of Stages 2 to 7 load shedding until 2025 and beyond (CSIR, W and C).

Key factor 2

Plans to install alternative renewable energy to neutralise and bolster the diminishing electricity supply have "slipped" because of a failure in part to implement policy between 2015 and 2018, which led to a breakdown in procurement.

It has taken around two years of effectively doing nothing about the looming energy crisis. I am of the view that further slippage of at least three to four years (from 2021) will occur as procurement for the new-build programme has only just begun. This is despite the likelihood of capital constraints and legal challenges, which are also likely to hinder this programme.

In this regard, I am of the view that a slippage of this magnitude will complement the likelihood of higher levels of load shedding, Stages 2 to 8, through to 2025 and beyond.

Summary of load shedding stages by 2025

In this section, I have applied my view together with the collective views of experts as outlined above, and have concluded that:

My research indicates that it is most likely the energy gap will widen significantly over the next five years, caused mainly by the low energy availability factor (EAF) of the coal-fired plants, a "slippage" in the new build programme (three to four years) and capital constraints. Together with political interference, meddling and vacillation with respect to the recovery plan, this will likely cause a rise in PGM supply losses. In this regard, PGM supply from South Africa will probably start to decline within the next two to three years if the frequency and higher stages of load shedding persist ceteris paribus. (Note, Stage 6 and higher would stop mining operations.)

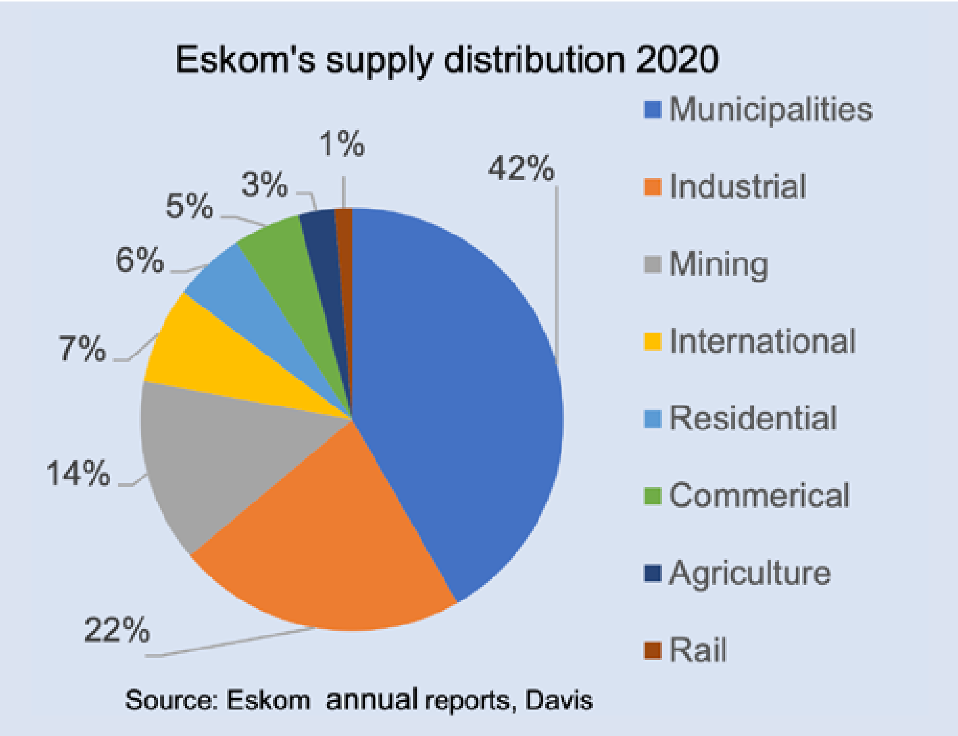
1. If EAF remains constantly low (65%): Stages 2 to 7 at least.

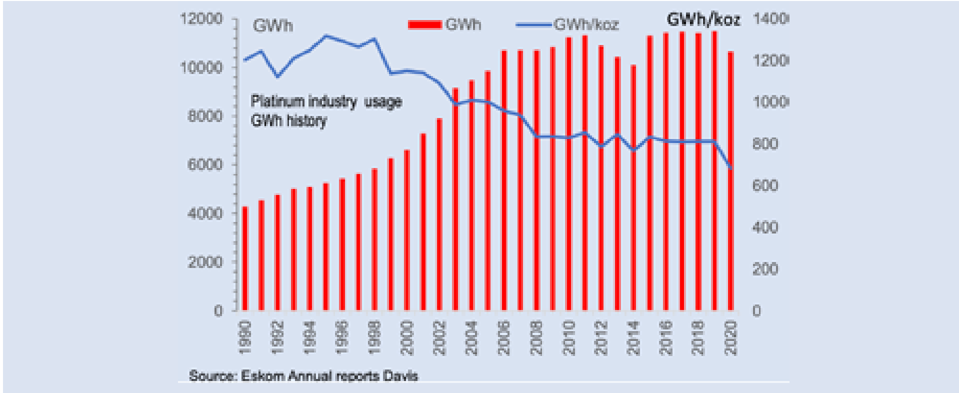
2. Decommissioning coal-fired plants plus three-year slippage of the new build: load shedding Stages 2 to 8 to 2025 and beyond.

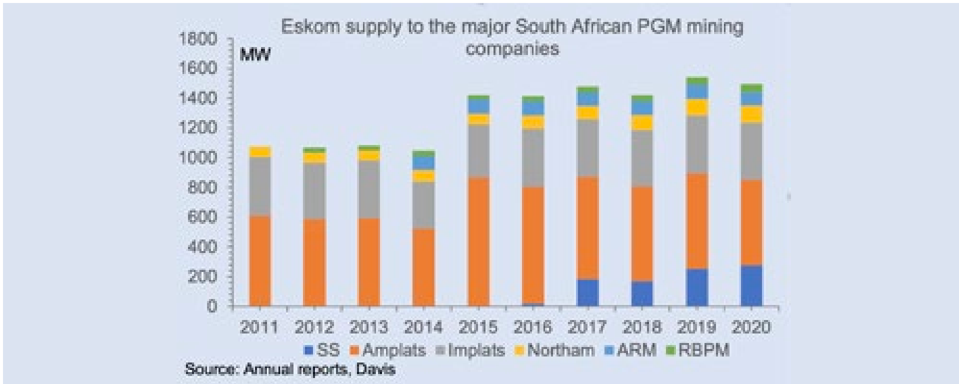
ESKOM SUPPLY TO THE PGM MINING INDUSTRY

Eskom supplies some 14% of its total supply to the mining industry (3,284MW) of which around 40% (1,314MW) is to the platinum mining industry (Eskom annual report 2020).

The graphics below illustrate the PGM mining industry's annual consumption in GWh/koz produced together with the individual usage of five of the major PGM mining companies: Sibanye-Stillwater, Amplats, Impala Northam, ARM and RBPM are rated around 276MW, 557MW, 381MW, 91MW and 53MW respectively. Note, there are small differences between Eskom and annual reports. The decline in GWh/koz over the period 1990 to 2020 implies in part that the PGM industry has become more energy efficient over time.







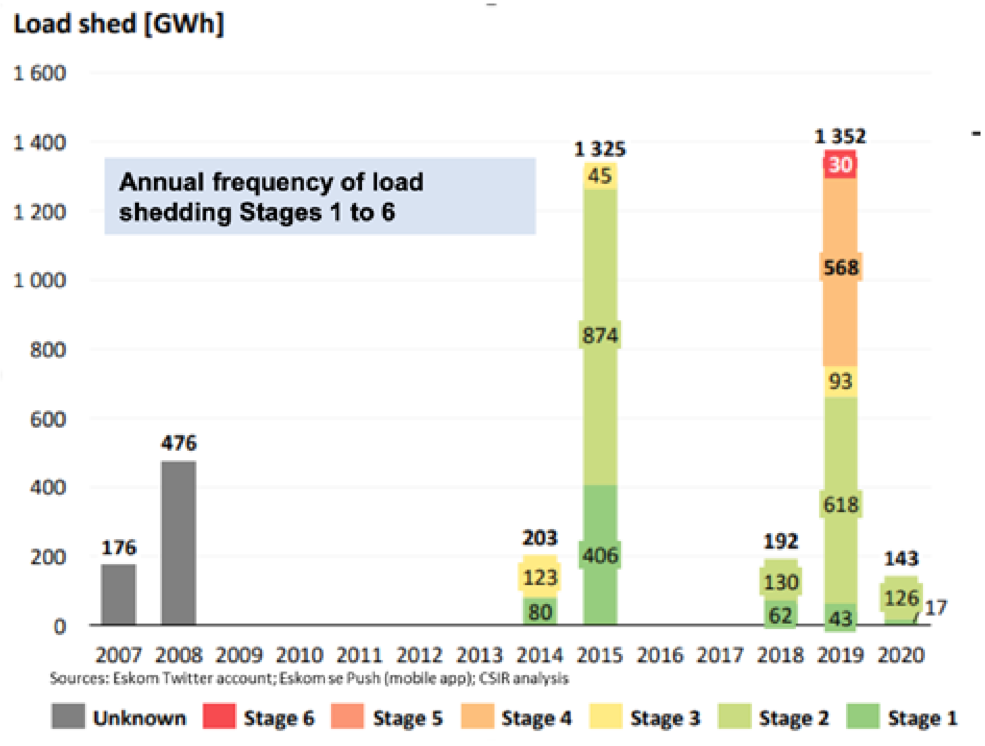
The Frequency and Level of Load Shedding Stages

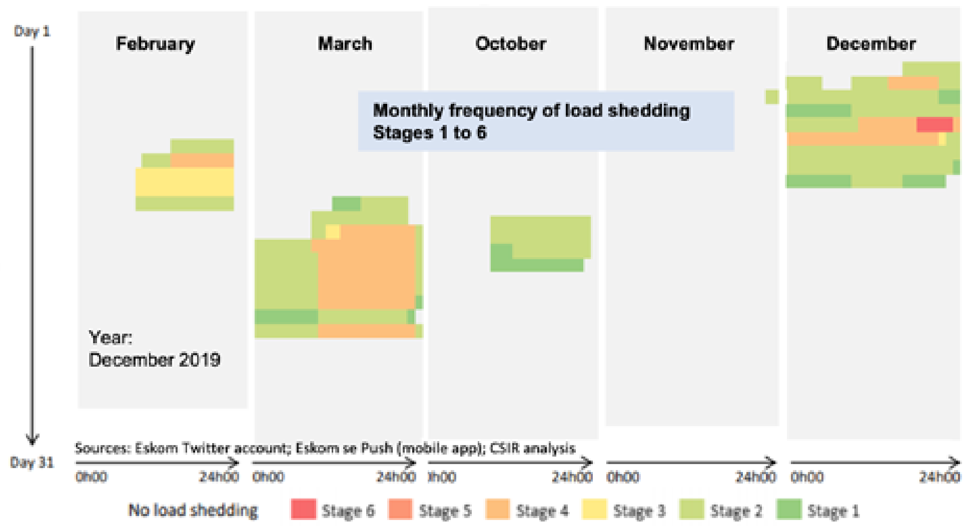
The annual and monthly frequency and level of load shedding stages and the power shed (GWh) are illustrated in the graphics below (Eskom, CSIR, W and C).

The annual colour-coded stages of load shedding and frequency from 2007 to 2020 show a general movement towards higher stages of load shedding in combination with the load shed (GWh). This observation is emphasized, particularly in 2015 and 2019. In 2015, 1,325GWh was shed over Stages 1, 2 and 3. In 2019, 1,352 GWh was shed over Stages 1, 2, 3, 4 and 6.

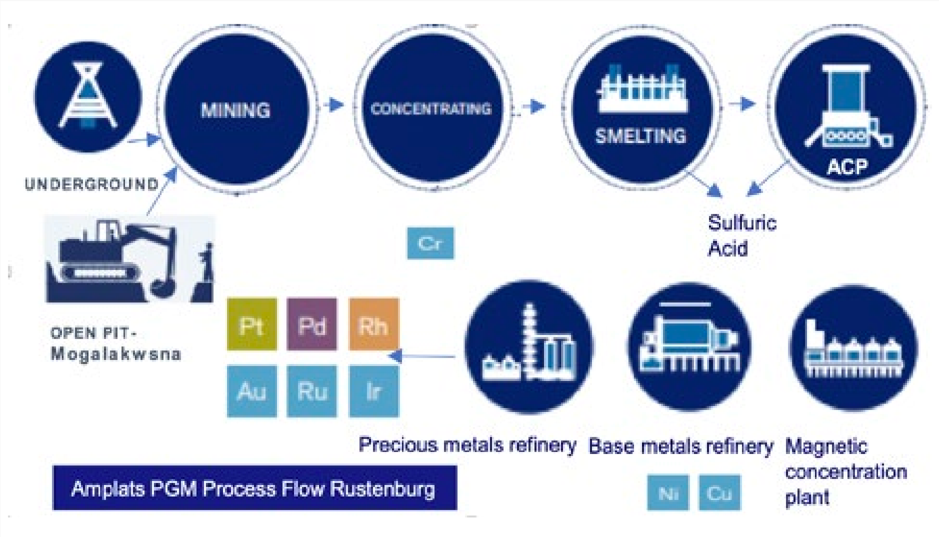
Given the conclusions above regarding the impact of EAF and the slippage of the new build, there is a high probability that load shedding will move up to Stage 8 with increasing frequency from 2022 to 2025.

The monthly load shedding and frequency for 2019 is illustrated in the graphic on the right. A number of stages of load shedding occurred in February, March and October, the most intensive year of load shedding to date, Stage 6 was implemented in December 2019. The discontinuity in the level of load shedding illustrates its disruptive nature to mining and metallurgical processes.





The impact of increasing load shedding stages at higher frequencies on PGM supply



The schematic diagram on the left, represents the process flow (Amplats) leading to the production of PGMs, nickel, copper and chrome. This process flow is complex. This complexity means that the relationship between a decline in power supply and its impact on PGM supply cannot be measured directly. The frequency and level of load shedding stages can, however, be measured. This leaves us with a series of "estimated probabilities" as to the likely impact on PGM supply. The frequency and level of load shedding stages are entirely in the hands of Eskom.

It is important to note that the effect of load shedding should not be exactly extrapolated to other PGM mines, as each mine has structural and complex differences that need to be taken into account. Much depends on the load-shedding protocol adopted to take these differences into account.

For example, Mike Rogers, a well-respected, expert mining engineer and independent board member of Royal Bafokeng Rasimone Platinum mine (BRPM) said: "RB Plats' protocol is to reduce power by 10%, 15% and 20% for Stages 2, 3 and 4 respectively. We do this by not hoisting rock at Styldrift (lots of storage capacity in UG silos) and limiting crushing. Beyond that, we stop the Maseve concentrator and the BRPM concentrator if further reductions are required. We don’t stop UG production if we can possibly help it.

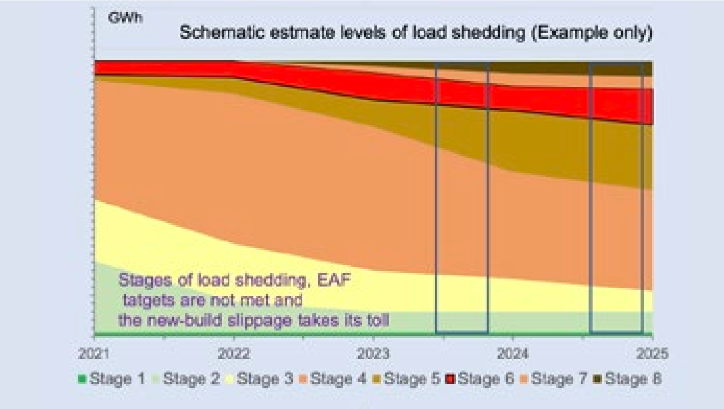
“In the event of a total blackout when the shift is underground, we have a number of 12MW diesel generators to keep the fans going and to operate either the service winder or man hoist at Styldrift. Employees at BRPM would use the chairlifts or be faced with a long walk up the decline shafts”.

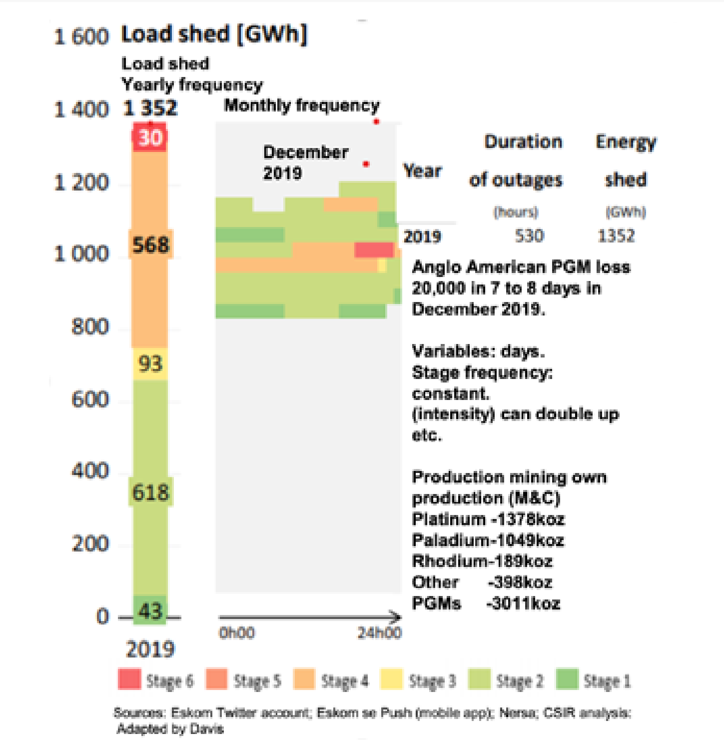
“We are fortunate that we don’t require refrigeration as the deep level mines do. (Sibanye-Stillwater and Northam)”.

“I would believe that the deeper gold and platinum mines with sub shafts and requiring refrigeration would have standby generating capacity for emergencies and certainly not for operating compressors. As for Stage 4 and higher, I don’t think there would be much production”.

A loss in production from underground would directly impact PGM supply. Power to the smelters would have to be reduced as a consequence of Stage 4 and above, but this would not be counted as a loss in production. It should also be recognised that the disruption caused in the mining and metallurgical process takes time to get back to “normality”.

After canvasing some of the larger platinum mines there was general agreement that load shedding at Stage 6 and above would mean that the miners would not go underground. The loss in PGMs mined would depend on the frequency of Stage 6 load shedding. Stage 8 load shedding would result in a 50% loss of power supply. It should be noted that South Africa experienced Stage 6 load shedding for about 7 hours on 6 December 2019 together with Stages 1, 2, 3 and 4.





In the conversation thus far, I have indicated that there is a high probability that the stages of load shedding will likely move up towards Stage 8. In this regard, I have attempted to illustrate these events in the schematic on the left (example only). The schematic shows that load shedding Stages 2, 3 and 4 will likely fall away over time, while at the same time load shedding Stages 5, 6, 7 and 8 will increase. This is given the fact that the EAF will remain low and there is a three-year slippage on the new build.

As I have indicated, the relationship between a decline in power supply and its impact on PGM supply cannot be measured directly because of the complexities surrounding this calculation. The frequency and level of load shedding stages can, however, be measured. This leaves us with a series of "estimated probabilities" of the likely impact of a decline in power supply on PGM supply.

Anglo American Platinum reported that it had lost 38,000oz of PGMs due to load shedding during 2019, costing the company more than R742m (US$50.2m) in lost production that cannot be recovered.

It is of note that this loss occurred during February, March, October and December, which in total amounted to some 22 days (2019), with a major loss occurring in December (Q4) of 20,000oz over seven consecutive days, which included Stages 3, 4 and 6. Unfortunately, no other companies reported a loss in this manner. In this regard, my calculations are based on one incident with a "health warning" and should be viewed as such. It is, however, important to note that this incident included load shedding Stage 6, which likely reflects, to some extent, the future scenarios.

This loss in PGM supply may not initially be considered significant in terms of global PGM mine supply of around 13.9moz and a South African PGM mine supply of around 9.6moz. This statement may have been insignificant in 2019 but going forward it is likely to become significant due mainly to the energy crisis, especially if Stages 6, 7 and 8 become a regular feature from 2022 to 2025 at least.

So, what have we got by way of information to work with? The graphic on the left illustrates the yearly and December 2019 month of load shedding stages, the duration of load shedding for December, and the duration of outages. As I concluded above, I am of the view that the duration of outages will increase as the ageing power stations are decommissioned, the renewable energy replacement will likely have slipped by at least three years and the EAF will remain problematic, resulting in constrained power supply and as a consequence higher stages of load shedding.

The following conversation focuses on a series of "estimated probabilities" of load shedding, which are likely to impact PGM supply.

The tables on the right show an "estimated" matrix of PGM losses from the South African PGM industry as a result of the number of days of load shedding over the year, together with the multiples

PGM loss oz (Expected)		Days							Source: Davis
		12	24	48	60	72	84	96	108
	1.50	31	62	124	155	186	217	248	279
	2.00	41	83	165	206	248	289	330	372
	2.50	52	103	206	258	310	361	413	465
Intensity	3.00	62	124	248	310	372	434	496	558
	3.50	72	145	289	361	434	506	578	650
	4.00	83	165	330	413	496	578	661	743
	4.50	93	186	372	465	558	650	743	836

Percentage loss (Expected)		Days							Source: Davis
		12	24	48	60	72	84	96	108
	1.50	1%	2%	4%	5%	6%	7%	8%	9%
	2.00	1%	3%	5%	7%	8%	10%	11%	12%
	2.50	2%	3%	7%	9%	10%	12%	14%	15%
Intensity	3.00	2%	4%	8%	10%	12%	14%	16%	19%
	3.50	2%	5%	10%	12%	14%	17%	19%	22%
	4.00	3%	5%	11%	14%	16%	19%	22%	25%
	4.50	3%	6%	12%	15%	19%	22%	25%	28%

Platinum koz (Estimate)		Days							Source: Davis
		12	24	48	60	72	84	96	108
	1.50	19	37	74	93	111	130	148	167
	2.00	25	49	99	123	148	173	197	222
	2.50	31	62	123	154	185	216	247	278
Intensity	3.00	37	74	148	185	222	259	296	333
	3.50	43	86	173	216	259	302	345	389
	4.00	49	99	197	247	296	345	395	444
	4.50	56	111	222	278	333	389	444	500

of intensity as experienced in 2019.

In my view, the blue shaded area represents the most likely area of the quantum PGM supply loss as the energy gap widens. This would move the estimated PGM loss to the right-hand side of the tables.

This “estimate” was also used to calculate the expected quantum loss of platinum, palladium and rhodium.

It should be noted that the “estimated” matrix only touches on load shedding Stage 6. Mining operations would cease at Stage 6 and above. Under these circumstances, these PGM estimates could be on the low side and could very well double.

Palladium koz (Estimate)		Days						Source: Davis	
		12	24	48	60	72	84	96	108
Intensity	1.50	10	21	42	52	63	73	84	94
	2.00	14	28	56	70	84	98	112	126
	2.50	17	35	70	87	105	122	140	157
	3.00	21	42	84	105	126	147	168	189
	3.50	24	49	98	122	147	171	196	220
	4.00	28	56	112	140	168	196	224	252
	4.50	31	63	126	157	189	220	252	283

Rhodium koz (Estimate)		Days						Source: Davis	
		12	24	48	60	72	84	96	108
Intensity	1.50	2	4	8	10	12	14	16	18
	2.00	3	5	10	13	16	18	21	24
	2.50	3	7	13	16	20	23	26	30
	3.00	4	8	16	20	24	28	31	35
	3.50	5	9	18	23	28	32	37	41
	4.00	5	10	21	26	31	37	42	47
	4.50	6	12	24	30	35	41	47	53

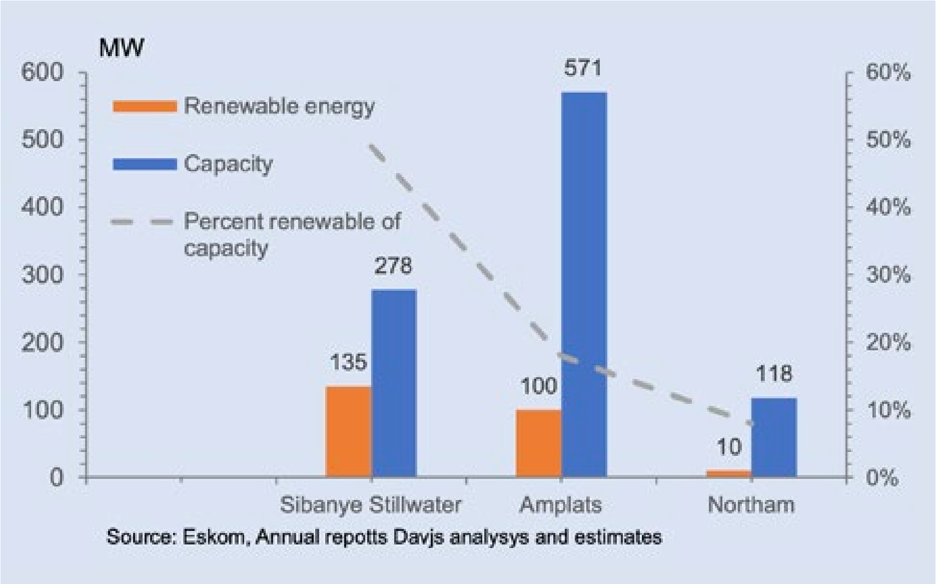
In summary:

My research presents an “estimated” matrix of PGM loss in supply from the South African PGM industry between the number of days of load shedding over the year, together with the multiples of intensity. The impact of these variables cannot be measured directly because of the complexities surrounding this calculation. The “estimated” matrix covers load shedding Stages 1, 2, 3 and 4, and only touches on load shedding Stage 6. Mining operations would cease at Stage 6 and above.

REDUCING THE IMPACT OF LOAD SHEDDING IN THE PGM INDUSTRY

As indicated in the introduction, on 10 June, 2021 South Africa's President Cyril Ramaphosa announced that the licence-exemption cap on self- or distributed-generation plants would be raised from 1MW to 100MW. The increase in the threshold will enable mining companies and other entities to build power generation units of up to 100MW without applying for a licence through the National Energy Regulator of South Africa (Nersa). This move was welcomed by the mining industry.

In this regard, Sibanye-Stillwater is preparing feasibility studies for prospective 50MW and 85MW solar PV projects for its Rustenburg and Marikana operations respectively. Anglo American Platinum is looking at building a 75MW to 100MW solar PV plant to support its Mogalakwena mine and concentrator, while Northam Platinum will likely install modules of 10MW. Notwithstanding, the move to privatising supply will likely encounter regulatory bumps along the way.



The graphic above illustrates the capacity in MW attributed to Sibanye-Stillwater, Anglo American Platinum and Northam compared to the allowance of 100MW. It is important to note that the exemption is applied not only to the company, but also to the entities and projects within the company for example, Sibanye-Stillwater can install 50MW and 85MW solar PV projects at its Rustenburg and Marikana operations respectively. Similarly, Anglo American Platinum, apart from Mogalakwena mine, the company can install a solar PV plant at its Amandelbult mine etc.

According to Gold Fields CEO Chris Griffith, the solar PV plant it is currently building will generate more than 20% of the mines' electricity and will save Gold Fields R120m (US$8.1m) a year in power costs. The introduction of solar PV energy will reduce operating costs, which currently make up about 13% of Gold Fields' operating costs.

The introduction of a renewable energy source brings an additional advantage as this will reduce the carbon footprint of the mines, thereby reducing carbon tax payments.

About Dr David Davis PhD. MSc. MBL. CEng. CChem. FIMMM. FSAIMM. FRIC.

David has been associated with the South African mining industry and mining investment industry for the past 43 years (mainly PGM, gold and uranium). At present, David is working as an independent precious metal consultant. David's PhD involved: "Studies in the catalytic reduction and decomposition of nitric oxide 1976".

Important Notice
General Disclosures, Disclaimers and Warnings

This Report ("the report") in respect of the global PGM Industry is directed at and is being issued on a strictly private and confidential basis to, and only to, Professional Clients and Eligible Counterparties ("Relevant Persons") as defined under the Investment Research Regulatory Rules and is not directed at Retail Clients. This report must not be acted on or relied on by persons who are not Relevant Persons. Any investment or investment activity to which this Report relates is available only to Relevant Persons and will be engaged in only with Relevant Persons.

The Report does not constitute or form part of any invitation or offer for sale or subscription or any solicitation for any offer to buy or subscribe for any securities in any Company discussed nor shall it or any part of it form the basis of or be relied upon in connection with any contract or commitment whatsoever.

The opinions, estimates (and where included) projections, forecasts and expectations in this report are entirely those of Dr David Davis as at the time of the publication of this report, and are given as part of his normal research activity, and should not be relied upon as having been authorised or approved by any other person, and are subject to change without notice. There can be no assurance that future results or events will be consistent with such opinions, estimates (where included) projections, forecasts and expectations. No reliance may be placed for any purpose whatsoever on the information or opinions contained in this Report or on its completeness and no liability whatsoever is accepted for any loss howsoever arising from any use of this Report or its contents or otherwise in connection therewith. Accordingly, neither Dr David Davis nor any person connected to him, nor any of his respective Consultants make any representations or warranty in respect of the contents of the Report. Prospective investors are encouraged to obtain separate and independent verification of information and opinions contained in the Report as part of their own due diligence. The value of securities and the income from them may fluctuate. It should be remembered that past performance is not necessarily a guide to future performance.

Dr David Davis has produced this report independently of the companies that may be named in this report except for verification of factual elements. Any opinions, forecasts, projections, or estimates or other forward-looking information or any expectations in this Report constitute the independent judgement or view of Dr David Davis who has produced this report (independent of any company discussed or mentioned in the Report or any member of its group).

The Report is being supplied to you for your own information and may not be reproduced, further distributed to any other person or published, in whole or in part, for any purpose whatsoever, including (but not limited to) the press and the media. The distribution of the Report in certain jurisdictions may be restricted by law and therefore any person into whose possession it comes should inform themselves about and observe any such restriction.

The Report has been prepared with all reasonable care and is not knowingly misleading in whole or in part. The information herein is obtained from sources that Dr David Davis considers to be reliable but its accuracy and completeness cannot be guaranteed.

Dr David Davis Certification

Dr David Davis attests that the views expressed in this report accurately reflect his personal views about the global Platinum Industry. Dr David Davis does not hold any interest or trading positions in any of the Companies mentioned in the report.