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Alignment of the 2024 Draft IRP with PCC's Proposed NDC Emissions Reduction Recommendation: A Special Focus on Coal and Gas

A Presidential Climate Commission Briefing Note

ABOUT THE PRESIDENTIAL CLIMATE COMMISSION

The Presidential Climate Commission (PCC) is a multi-stakeholder advisory body established by the President of South Africa to guide the country's climate change response and advance a just transition to a low-carbon, climate-resilient economy and society. The PCC provides evidence-based recommendations, fosters dialogue, and builds consensus among social partners on South Africa's climate and energy transition pathways.

ABOUT THIS REPORT

This report assesses the alignment of South Africa's draft Integrated Resource Plan (draft IRP 2024) with the 2035 GHG emissions range proposed in the PCC's draft recommendations for the 2035 Nationally Determined Contribution (NDC) update. It focuses on the emissions implications of coal and gas generation within the draft IRP, given their significant impact on achieving national emissions targets. The analysis uses modelling from the Energy Systems Research Group (ESRG) to determine how coal and gas capacity and capacity factors affect compatibility with the proposed NDC range in the draft recommendations report.

Key findings indicate that although the draft IRP supports renewable energy expansion, the inclusion of large coal and gas capacities operated at high-capacity factors will result in substantially greater fossil fuel use than would be consistent with the PCC's proposed draft recommended range. Given that emissions above the upper bound of the PCC range have high socio-economic risks with minimal corresponding benefits[1], the extent of fossil fuel use in the draft IRP is also anticipated to have negative socio-economic impacts for South Africa. The report: 1) underscores the need for urgent investigation of this misalignment; and 2) emphasises how critical it is that electricity and climate policy in the form of the final NDC, IRP and electricity sector SET are aligned.

ACKNOWLEDGMENTS

Developed under the leadership of the Presidential Climate Commission, this report was prepared by Emily Tyler, Brett Cohen, and Nicholas van Doesburgh from by Meridian Economics, the contracted technical partner. It draws on modelling work from the Energy Systems Research Group (ESRG) and incorporates input from PCC Commissioners, and social partners. The PCC thanks all contributors and stakeholders whose insights enriched the findings and recommendations contained in this report.

[1] *PCC draft NDC Recommendations*

1 Introduction

Signatories to the Paris Agreement are required to submit Nationally Determined Contributions (NDCs), which specify, *inter alia*, commitments to mitigating greenhouse gas (GHG) emissions and adapting to the impacts of climate change. NDCs are updated every five years, with each successive iteration representing a progression that reflects the signatory's highest possible ambition. South Africa is drafting an update to its 2021 NDC, to be submitted towards the end of 2025. The update will cover the period to 2035.

In its 2021 NDC, South Africa framed its GHG mitigation commitment as a target national emissions range, which in turn provides a basis for setting emissions reductions across the economy.

The power sector is recognised to be central to achieving the economy-wide emissions reduction targets under the NDC update due to its high contribution to national emissions (approximately 43% currently) and the relative ease of achieving emission reductions at little to no additional cost[2]. Decarbonising the power sector also has a catalytic benefit for emissions in the remainder of the economy, particularly due to the potential for electrification of end-use sectors such as transport and industry[3]. In addition, power sector decarbonisation contributes to broader economic development and just transition objectives as South Africa seeks to build industrial and economic capabilities and employment opportunities to support its competitiveness in a decarbonising world. Given the concentration of the existing fossil-based power generation capacity in the Mpumalanga Province, policy certainty regarding the pace of the transition away from coal is essential for ensuring adequate transition planning for vulnerable coal communities.

The Integrated Resource Plan (IRP) is a key electricity sector policy document that sets out the generation technologies needed to meet the country's future electricity demand. As such, the IRP has significant implications for national emissions. The IRP is in the process of being updated, with the most recent version (draft IRP 2024) having been submitted to the National Economic Development and Labour Council (NEDLAC) for review before going to cabinet for final approval.

The Presidential Climate Commission (PCC) published draft recommendations for South Africa's forthcoming Nationally Determined Contribution (NDC) for stakeholder comment in June 2025, including a target GHG emissions range for the year 2035. In the draft recommendations the PCC supported the proposed new renewables and battery capacity included in the draft IRP 2024 as being in line with the modelling which underpins the PCC's draft 2035 national emissions range.

Emissions from the power sector are, however, primarily determined by coal and gas generation. The energy generated, and hence the amount of fossil fuels burnt and consequently emissions from these sources, is a function

[2] *Meridian Economics (2023) Achieving net-zero in South Africa's power sector. https://meridianeconomics.co.za/publications/achieving-net-zero-in-south-africas-power-sector/*

[3] *IEA. 2024. Net zero roadmap: A global pathway to keep the 1.5°C goal in reach. https://www.iea.org/reports/net-zero-roadmap-a-global-pathway-to-keep-the-15-0c-goal-in-reach*

of two key parameters[4]: plant **capacity**, and the **capacity factor** (see Box 1 below). Whereas the draft IRP lists the capacities of the various technologies in the proposed generation mix, it does not specify the capacity factors associated with each technology.

Box 1: Capacity vs Capacity Factor

Capacity refers to the maximum power that could be generated by a power plant at any one time if operating at full output. Capacity is typically measured in megawatts (MW).

Capacity factor is the ratio of the actual electricity generated by the plant over a period of time relative to the theoretical maximum that could have been produced had the plant been operating at full capacity over that period. It is often expressed as a percentage.

Together, these two concepts determine the amount of energy produced and, for fossil generators, the amount of fuel burnt and the GHG emissions at the plant level.

The relationship between the two concepts is analogous to a car and its fuel consumption. Capacity is like the size of the engine – it indicates the potential power. Capacity factor reflects how often and how intensively the engine is used. The total fuel used depends not only on the engine size (capacity) but also, crucially, on how hard and how frequently it is driven (capacity factor).

This briefing note was developed to explore the extent to which the fossil capacity included in the Proposed Balanced Plan of the draft IRP 2024 might be aligned with the modelling that underpins the PCC's draft NDC 2035 GHG emissions trajectory range.

2 Coal and gas capacity factors in the PCC's DRAFT recommended NDC target range

The PCC's draft recommendation for the NDC emissions range for 2035 is between 248 and 329 $MtCO_2e$. This range is based on 19 different modelled emissions pathways reflecting emissions under different assumptions about the future. These include that the country remains within a national carbon budget of 8 or 9 $GtCO_2e$ between 2021 and 2050 and achieves net zero by 2050 or 2055.[5] These carbon budgets are within the range of those considered to be indicative of South Africa's fair share of the global carbon budget,[6] and are aligned with those used in other studies of the country's decarbonisation trajectories[7].

The following observations are made with respect to the capacity and capacity factors for coal and gas in the modelling

[4] *Other parameters that play a more minor role in determining emissions include efficiency, technology variations, and feedstock variations.*

[5] *The pathways were developed using a least-cost optimisation model by the Energy Systems Research Group (ESRG) at the University of Cape Town (ESRG, February 2024, Net Zero CO2 Emissions Pathways for South Africa) .*

[6] *A study by UCT (2021) South Africa's "fairshare": mitigation targets in the updated first NDC in an international context argues that a fair share carbon budget could lie between 6 and 9 GtCO2e. The ESRG 2024 study only presents modelled results for 8 GtCO2e and above.*

[7] *See, for example, NBI. 2022. South Africa's Net-Zero Transition. National Business Initiative. https://www.nbi.org.za/focus-areas/environmental-sustainability/climate-pathways-and-a-just-transition-for-south-africa/*

underpinning the recommendations for the draft NDC range.

2.1 CAPACITY

- No new coal capacity is built in any of the modelled scenarios as new coal is more costly than other alternatives.
- By 2035 the power system includes 23.5 GW of coal, down from around 39 GW in 2025. Around 15.5 GW of coal capacity is thus retired.
- There is a large variation in natural gas fired generation capacity built by 2035 across the different pathways, between 3.8 and 11.3 GW.

2.2 CAPACITY FACTORS

- Coal capacity factors also vary significantly across the 19 modelled pathways, between 14% and 52% in 2035. The majority lie well below Eskom's 2022 coal capacity factor of 51.1%.[8,9]
- This wide range of modelled capacity factors results in significant variations in the emissions from the power sector under the different pathways.
- The gas plants in the modelling all have capacity factors of 5%, regardless of the pathway.

For gas-fired power, capacity factors are linked to choice of plant technology. Both open-cycle gas turbines (OCGT) and combined-cycle gas turbines (CCGT) generate electricity using turbines, but CCGTs incorporate a heat recovery system that captures exhaust gases to drive a secondary steam turbine. This significantly increases efficiency, but only if used for extended periods, making CCGTs more suitable continuous or mid-merit supply. This implies high-capacity factors over time. In contrast, OCGTs are less efficient but can start and ramp quickly, making them ideal for short, flexible operation and yielding lower capacity factors over time. Matching the type of gas plant to the power system requirements is critical. The 5% capacity factor of the ESRG modelling suggests that Open Cycle Gas Turbine (OCGT) peaking plants are represented in the modelling.[10]

3 Alignment with the draft IRP

The analysis now turns to attempting to determine the extent to which the draft IRP 2024's coal and gas capacity and underlying capacity factors are consistent with achieving the NDC. As indicated previously, the draft IRP does not report capacity factors from its underlying modelling. Indications of the draft IRP's capacity factors have therefore been made drawing on alternative metrics and sources.

3.1 COAL

Capacity

- Given the economics of building new coal capacity, no new coal is provided for in the draft IRP.
- The draft IRP is not clear about the reduction in existing coal capacity,

[8] *At the lower end, six scenarios have capacity factors of between 14% and 26%. Ten of the scenarios have capacity factors of between 35% and 45%. At the upper end, only two pathways exceed 50% capacity factors, with the highest being 52%.*

[9] *The Eskom coal capacity for 2022 was calculated by the authors based on publicly available information. 2022 was the most recent year for which the necessary data could be found.*

[10] *An important caveat to the low gas capacity factors is that the modelling does not take gas contracting constraints into account. In practice, a minimum annual gas demand for power generation and industrial process heating applications is required for liquified natural gas (LNG) import infrastructure to be economically viable (see Meridian Economics, 2022. Hot air about gas). The implication is that although OCGT running at low capacity factors may be theoretically preferred and selected by the model, taking contracting considerations into account might limit OCGT as an option for South Africa.*

but implies that 28 GW remains by the middle of next decade[11,12].

- Therefore, the implied **remaining coal capacity in the draft IRP is 4.5 GW higher in 2035 than that represented by the ESRG modelling.**

Capacity factors

- Although no capacity factors are provided in the draft IRP, these can be estimated by considering the Energy Availability Factor (EAF)[13]. When supply across the system is constrained, the capacity factor is close to the EAF.
- The draft IRP presents an average EAF trajectory for Eskom's entire fleet[14]. Over the past five years, the coal fleet's EAF was an average of 6% lower than the average fleet EAF, according to data from Eskom's Data Portal.
- Assuming this differential remains constant until 2035, the coal fleet capacity factor could be around 63% in 2035.
- **The indicative draft IRP 2024 coal capacity factor of 63% in 2035 exceeds the NDC modelling range of 14–52% by 11-49 percentage points.**

3.2 GAS

Capacity

- The draft IRP 2024 indicates a total of 14.6 GW of gas capacity is planned to be online by 2035.
- **This is significantly higher than the gas capacity in any of the ESRG model pathways which are between 3.8 and 11.3 GW in 2035.**

Capacity factors

- As with coal, the draft IRP does not specify the capacity factors for gas.
- It does, however, state that the addition of 6 GW of CCGT capacity (typically run at high-capacity factors) is 'critical' to account for the impending loss of dispatchable coal plant by 2030.
- Furthermore, a recent announcement by the Minister of Electricity and Energy at the release of Eskom's winter outlook in May this year suggested that gas capacity factors should be increased to 50% or above in order to create sufficient anchor demand to support broader industrial gas usage across the economy.[15]
- **Gas capacity factors seem therefore to be significantly higher than the 5% indicated by the ESRG modelling.**

3.3 IMPLICATIONS FOR 2035 EMISSIONS

Given both the higher coal installed capacity and the higher capacity factors implied by the draft IRP compared to modelling underpinning recommendations in the PCC draft

[11] *The draft IRP 2024 states: "Regarding the planned decommissioning of Eskom's coal fleet, the TDP [Transmission Development Plan][11] 2024 is aligned with the Generation Continued Operations (GCO) shutdown plan. This plan sees a decline in the coal fleet from 42 GW in 2024 to 28 GW in 2034."*

[12] *For the purposes of argument in the remainder of this paper, and given the uncertainties in coal power station decommissioning, it is assumed that the 2034 TDP figure for remaining coal capacity will be the same in 2035. This is also aligned with the ESRG modelling, where no coal capacity is retired across the pathways between 2034 and 2035.*

[13] *An Electricity Availability Factor (EAF) is the fraction of installed capacity that is available for dispatch. The available capacity is equal to the installed capacity less any capacity that is unavailable due to planned or unplanned outages. Expressed as a percentage.*

[14] *Eskom's fleet EAF trajectory in the draft IRP 2024 is presented as 59.8% in 2024 to 69% by 2035. The improvement is based on the assumption of partial success in Eskom's Generation Recovery initiatives.*

[15] *Creamer, T. 2025. Ramokgopa announces big increase in gas-to-power load factor to 50%-plus. Engineering News, 5 May. https://www.engineeringnews.co.za/article/ramokgopa-announces-big-increase-in-gas-to-power-load-factor-to-50-plus-2025-05-05*

recommendations paper proposed NDC targets (see **Error! Reference source not found.**), both the generation of electricity and CO_2 emissions from coal-fired power will be significantly higher in the IRP. This indicates poor alignment between the draft IRP and the PCC's draft NDC trajectory range in terms of emissions from coal.

Similarly, the draft IRP's emissions from gas would be 13 – 38 times higher than those included in the modelling underpinning the NDC recommendations. Locking in high gas capacity factors through technology choice (CCGT rather than OCGT) will result in a more expensive and emissions intensive power system.

While the discussion presented here relates to a single year (2035), similar observations apply throughout the period leading up to 2035. The result is that, following the draft IRP 2024, the power sector will utilise a significantly larger share of the total national emissions budget than is reflected in the modelling that underpins the PCC's draft trajectory. This will have implications for the country's remaining share of global emissions in the future, together with negative socio-economic implications for the economy[16].

Table 1: Comparing capacity and capacity factor ranges for gas and coal in 2035

		ESRG net zero modelling	**Draft IRP 2024**
Coal	Capacity	23.5MW	28MW
	Capacity Factor	14-52%	63%
Gas	Capacity	3.8-11.3MW	14.6MW
	Capacity Factor	5%	Significantly higher

It is important however to note that South Africa's electricity sector is undergoing fundamental reforms, including Eskom's unbundling and the introduction of a competitive wholesale market, which is set to take effect on 1 April 2026. Under this future structure, the IRP will evolve from a *prescriptive*, centralised plan outlining state procurements to an *indicative* report that helps guide investment decisions across the market, without binding participants to its provisions. Furthermore, dispatch decisions will be made by an independent System Operator, guided by

[16] *The ESRG does not explicitly show the demand projections used in the modelling, whereas whilst the IRP shows the demand profile used (which was originally developed by the ESRG). Whilst slight variation in demand profile between the two could introduce some minor differences in findings between the IRP and ESRG results, it is unlikely to account for the extent of misalignment being explored in this paper. It is further noted that it is not clear that the IRP demand profile aligns with the combination of the capacity plan and implied coal and gas capacity factors represented in the Proposed Balance Plan included in the IRP document*.

the economic merit order established by the Market Operator. Consequently, the capacity factors of the coal fleet, gas capacity additions and gas capacity factors should be determined by their relative cost competitiveness to equivalent capacity and energy sources.

As more economically competitive renewable generation and battery storage sources are added to the grid, coal and gas will be less able to compete, and therefore will be dispatched less often. Depending on the pace of renewable and battery build out, the market structure has the potential to deliver a faster decarbonisation trajectory, more aligned to the PCC's draft NDC recommended range, and with the associated socio-economic benefits.

4 Moving Forward

The power sector is recognised to be central to achieving 2035 economy-wide emissions reduction due to its high contribution to national emissions and the relative ease of achieving emission reductions at little to no additional cost. In addition, power sector decarbonisation contributes to broader economic development and just transition objectives as South Africa seeks to build industrial and economic capabilities and employment opportunities to support its competitiveness in a decarbonising world.

For a clear and coherent policy position on climate and electricity policy, it is critical that there is alignment between the primary policy and planning documents in each area; the IRP and South Africa's NDC. Moving ahead, the PCC suggests the following:

- Given the significance of the findings of this report, further analysis using the actual modelling data underlying the IRP and final NDC should be undertaken by government as a matter of urgency[17].
- The electricity sector's sectoral emissions target (SET) [18] needs to be finalised, in alignment with the NDC emissions range.
- Going forward, the electricity SET, and the IRP need to align with and support implementation of the NDC. Policy coherence and certainty is crucial for attracting the extent of power sector investment identified as being required by the country's Just Energy Transition Investment Plan.

[17] *The analysis in the report is based on information available at the time of writing.*

[18] *The Climate Change Act operationalises the NDC target through Sectoral Emissions Targets (SETs), which serve as key instruments for implementing the NDC. Under the Act, each sector department is responsible for aligning its policies and measures with its designated SET — and, by extension, with the national NDC.*

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