BRIEFING NOTE
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WHAT DOES SOUTH AFRICA'S UPDATED NATIONALLY DETERMINED CONTRIBUTION IMPLY FOR ITS COAL FLEET?

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1 SOUTH AFRICA'S UPDATED NDC

On the 14th September 2021, Cabinet approved South Africa's updated climate change mitigation target range to 2030 contained in its Nationally Determined Contribution (NDC) for submission to the United Nations Framework Convention on Climate Change (UNFCCC) (Republic of South Africa, 2021). In this note we set out the relationship between the new economy wide mitigation targets, and that required from the power sector.

The updated NDC target range is expressed as being between 398 and 510 Mt CO_2 equivalent (CO_2-eq) in 2025, and between 350 and 420 Mt CO_2-eq in 2030 (South African Cabinet, 2021). South Africa's first NDC (Republic of South Africa, 2016) included a target range of between 398 and 614Mt CO_2-eq in both 2025 and 2030, as part of a 'peak, plateau and decline' trajectory to 2050 (Department of Environmental Affairs, 2015). Therefore, this year's update conveys a significantly more ambitious mitigation target, whereby the country's emissions are set to peak in 2025 at a lower than anticipated 510 MtCO_2-eq, and where the entire target range has been lowered for 2030. The 2015 emissions range together with the 2021 updated range are depicted in Figure 1.

South Africa's latest greenhouse gas emissions inventory (Department of Forestry, Fisheries and Environment, 2021) puts total emissions (including Forestry and Other Land Use) at 482 MtCO_2-eq in 2017 and emissions from the electricity sector at 214 MtCO_2-eq.

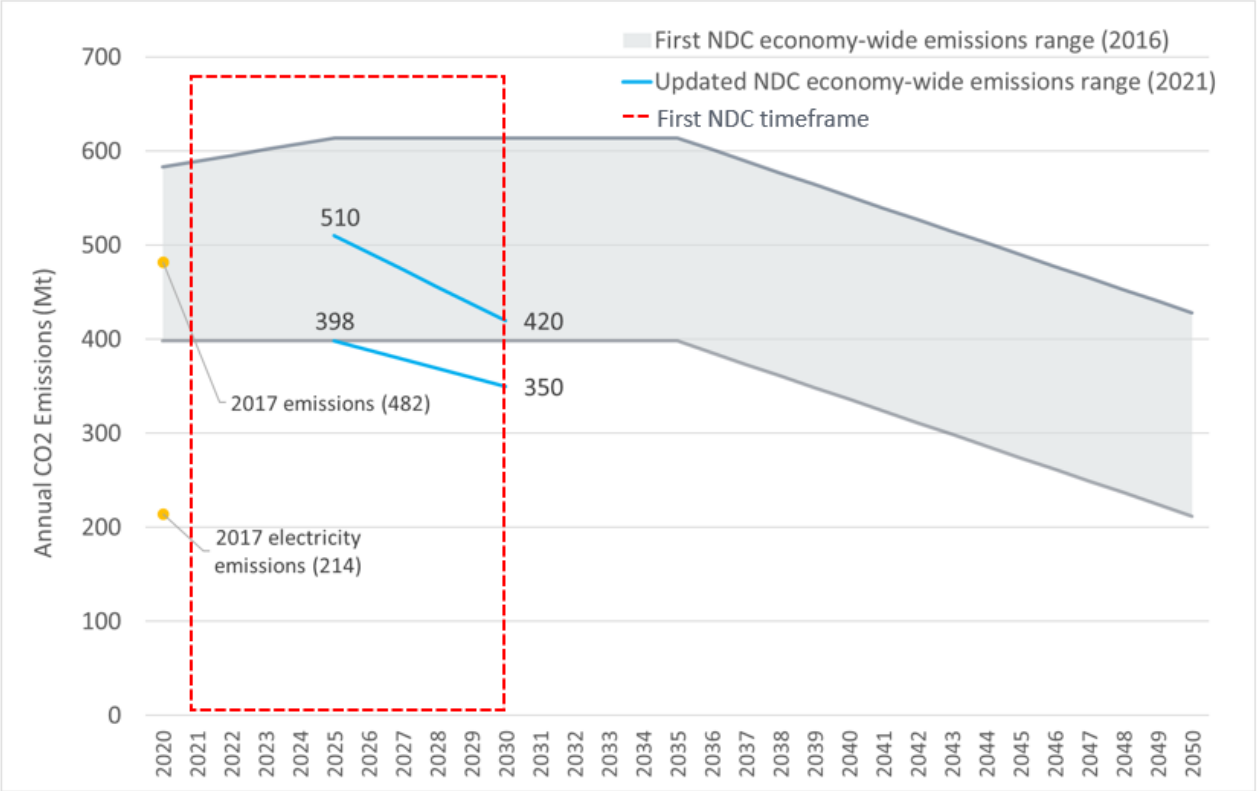

Figure 1: South Africa's First NDC: 2015 version and 2021 update

2 WHAT ANALYSIS UNDERPINS THE UPDATED TARGET MITIGATION RANGE?

The updated NDC target mitigation range is informed by analysis undertaken by the University of Cape Town's (UCT) Energy System Research Group (ESRG), using the country's only economy-wide linked energy-economy-environment model, SATIMGE.

The ESRG provided analysis (UCT, 2021) for the Department of Forestry, Fisheries and Environment (DFFE), who drafted a first version of the update for public consultation in April 2021 (DFFE, 2021). As part of the consultation process, the newly appointed Presidential Climate Commission (PCC) provided a recommended target mitigation range in June (Presidential Climate Commission, 2021), having itself run an extensive consultation process which included commissioning additional analysis from the UCT ESRG (UCT/PCC, 2021). The PCC's recommended range was that which was ultimately approved by Cabinet in September. *The ESRG analysis and subsequent report 'South Africa's NDC targets for 2025 and 2030 – further analysis to support consideration of more ambitious NDC targets' (UCT/PCC, 2021), written for the PCC, therefore form the analytical underpinnings of the updated NDC target.*

During its consultation process, the PCC found that the main mitigation modelling exercises undertaken in the country – those of the National Business Initiative, Meridian Economics and the Council for Scientific and Industrial Research (CSIR), and the ESRG – were all broadly aligned in their conclusions pertinent to the NDC period, albeit using different approaches, models and assumptions.

3 THE UPDATED TARGETS IN LIGHT OF THE PARIS AGREEMENT TEMPERATURE GOAL

Included in the ESRG's approach is consideration of what might constitute South Africa's fair share of the Paris Agreement temperature goal of 'holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5 °C above pre-industrial levels' (UNFCCC, 2015). The ESRG's approach is primarily based on the analysis of the international research organisations: Climate

Equity Reference Calculator (CERC) and Climate Action Tracker (CAT), including these organisation's most recently updated methodologies (UCT/PCC, 2021).

The ESRG finds that the 420 $MtCO_2$-eq upper bound of the updated NDC target range in 2030 is consistent with a fair share contribution to a 'well below 2°C' pathway. The lower bound of 350 $MtCO_2$-eq is found to be consistent with a 1.5°C pathway. *The updated NDC target range could therefore be said to reflect the range as expressed in the Paris temperature goal*[1].

After the PCC released its NDC recommendations in June, CAT issued an analysis largely concurring with the ESRG's view, see Figure 2 below.

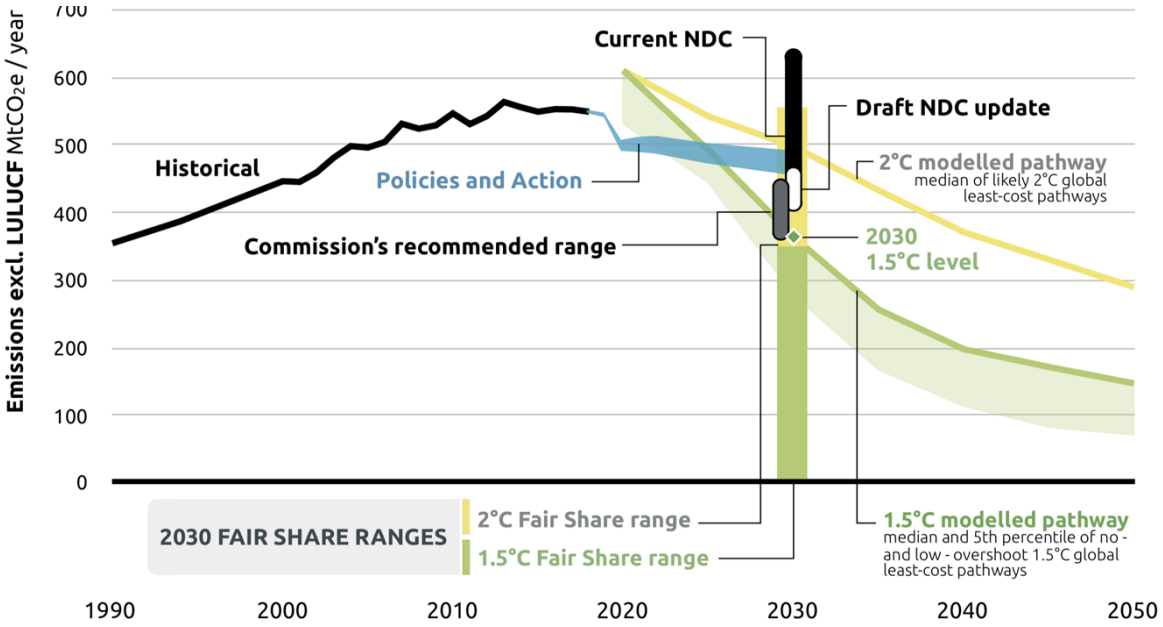

Figure 2: CAT analysis of South Africa's updated NDC (Source: https://climateactiontracker.org/blog/south-africas-presidential-climate-commission-recommends-stronger-mitigation-target-range-for-updated-ndc-close-to-15c-compatible/)

South Africa is clear that that the levels of mitigation and ambition set out in its first NDC 'will be enabled by finance, technology and capacity building support' (Department of Environmental Affairs, 2015; DFFE, 2021).

4 WHAT DOES THE UPDATED TARGET RANGE LIKELY MEAN FOR THE COAL FLEET?

The ESRG analysis is based on modelling that, in order to be tractable, necessarily relies on substantial simplifications of what is in reality a highly complex system. All modelling of this type can only provide a guide as to what may happen in the future *based* on a particular set of inputs and assumptions. Whilst this is invaluable for getting a sense of the direction of travel and the big sensitivities in a system, the 'real world' is of course infinitely more complex and unpredictable. Whilst the ESRG model (and that of Meridian Economics and the CSIR referenced later on in this section) incorporate some detail of the Eskom coal fleet, there is much more detail, and significant levels of uncertainty related to plant performance and other factors, that will impact on how this fleet would or could run to 2030 and beyond. Translating modelling outputs into specific policy and support mechanisms requires cognisance of these realities, and therefore the need for flexibility to guide optimal real-world outcomes.

The UCT/PCC report (2021) provides results for the period 2020-2030 in aggregate; the timing of mitigation within this period is not given. The first NDC end-point of 2030 is the focus for considering the implications for

[1] *Equity considerations are complex and contested, with UCT author's providing a fuller account in (Winkler et al., 2021).*

electricity sector mitigation. The report also does not indicate the implications of the ESRG modelling at an individual coal plant level. Material to the extent of mitigation in the rest of the economy, the ESRG modelling assumes that Sasol's Secunda plant (coal-to-liquids) capacity is fixed until 2036, and that Sasol achieves its 10% emissions reduction target through renewable energy substitution[2].

The UCT/PCC report finds the following about the implications of the updated target range for the electricity sector for the period 2020-2030:

- The economy-wide emissions outcome associated with current policies, including the Integrated Resource Plan (IRP) 2019 in the electricity sector, lies between 370-395 $MtCO_2$-eq depending on assumptions made around economic growth. (It is noteworthy that South Africa is already behind on building the renewables capacity planned for in the IRP).
- Most mitigation in the economy in the updated NDC target range comes from the electricity sector, and the relationship between national greenhouse gas emissions and electricity sector emissions in 2030 is almost linear (Figure 3).
- The extent of electricity sector mitigation is highly related to whether the coal fleet is modelled as being able to endogenously retire, or whether retirement dates are fixed according to the IRP 2019 schedule (both options were modelled). In order for South Africa to mitigate affordably below 370 $MtCO_2$-eq (green dots in Figure 3), earlier plant retirement than that contained in the IRP schedule would be required, which is politically and socially challenging. Mitigation in the electricity sector is traded off against more expensive mitigation in harder-to-abate sectors.
- Mitigation below 370 $MtCO_2$-eq to around 350 $MtCO_2$-eq is possible with earlier retirement of coal capacity of between 3.5 Gigawatts (GW) and 9.2GW, together with avoiding building the new coal capacity anticipated in the IRP currently[3]. The coal capacity would need to be replaced with a combination of up to 20GW additional renewables and up to 9GW battery / Open Cycle Gas Turbine capacity by 2030. The higher the economic growth rate, the more renewable capacity must be added in order to service demand. More research is needed to better understand the economic impacts of mitigating below the 370 $MtCO_2$-eq level.

[2] Sasol has subsequently committed to a 30% emissions reduction target, through continued switching to natural gas as a transition feedstock, energy and process efficiencies, and renewable energy investments, see: https://www.sasol.com/media-centre/media-releases/sasol-commits-net-zero-ambition-2050-triples-2030-ghg-emission-reduction

[3] In the ESRG modelling, coal plant running below 40% utilisation is retired. This high minimum utilisation rate required is due to the particular design and coal usage of the South African coal fleet.

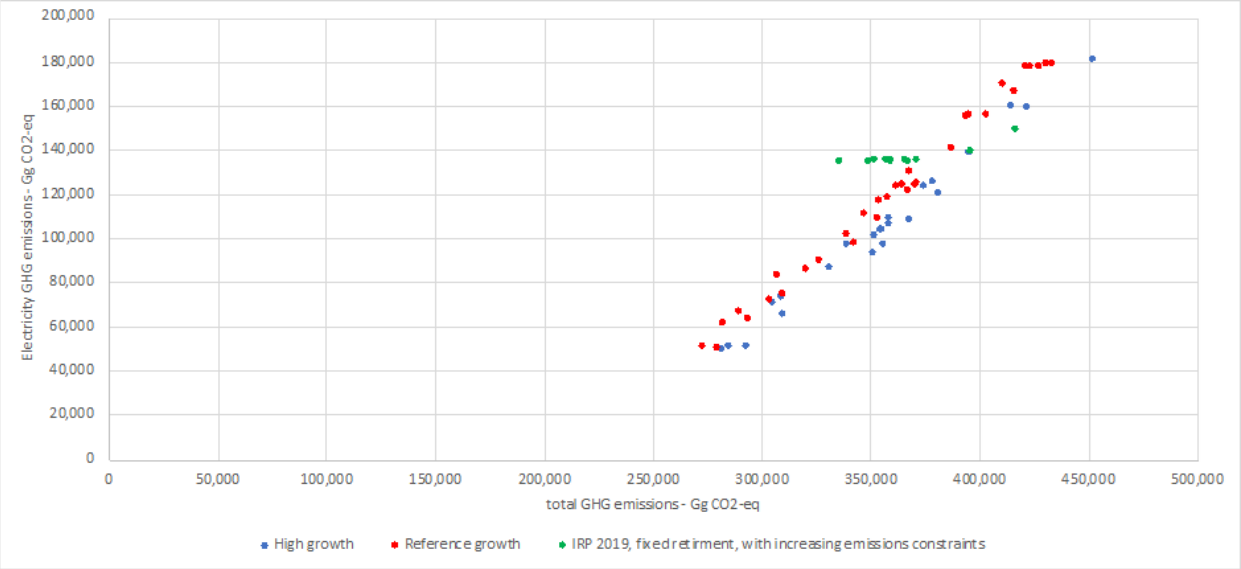

Figure 3: Electricity sector emissions vs total GHG emissions for various levels of economy-wide mitigation in 2030 (Source, Marquard et al, 2021, Figure 12)

Therefore, recalling that the updated NDC range is broadly aligned with the range implied by the Paris temperature goal, it would appear that *the IRP2019 may enable the upper bound of the updated NDC range to be achieved, but that lower utilisation of the coal fleet during this decade, including accelerated retirement of plant by 2030, would be required to achieve the lower bounds affordably (370-350 $MtCO_2$-eq). This requires a commensurate renewables build programme.*

In 2020, Meridian Economics published an indication of what might be required at a power plant level in various decarbonising power sector trajectories based on the Vital Ambitions project undertaken with the CSIR (Meridian Economics, 2020). Whilst not the analysis that directly underpins the updated NDC targets, this work adds some insight into the implications of the updated NDC range for the coal fleet during the present decade.

The graphs in Figure 4 show coal plant utilisation (annual energy generation), in the context of power sector pathways to 2050 for two scenarios. The first is the IRP2019. The second is a scenario which is likely broadly aligned to a fair share 1.5˚C trajectory from the electricity sector, with all coal power generation retired by 2040 (the 'Ambitious RE and all coal off by 2040' scenario).

In this 1.5˚C scenario, a combination of lower plant utilisation (primarily Kriel, Arnot, Tutuka and Kusile), together with earlier closure of Kriel occurs. Similar levels of coal power plant reduction may therefore be required to achieve the lower bounds of the recent NDC update. The 'Ambitious RE and all coal off by 2040' scenario was cost optimised against an overall carbon constraint (budget), and adjusted for a realistic renewable energy build ramp-up that also accommodates delays in addressing grid capacity constraints. *The Ambitious RE scenario results highlight the cost efficiency and reliability benefits of reducing coal utilisation across the fleet rather than a singular focus on bringing individual plant retirement dates forward.*

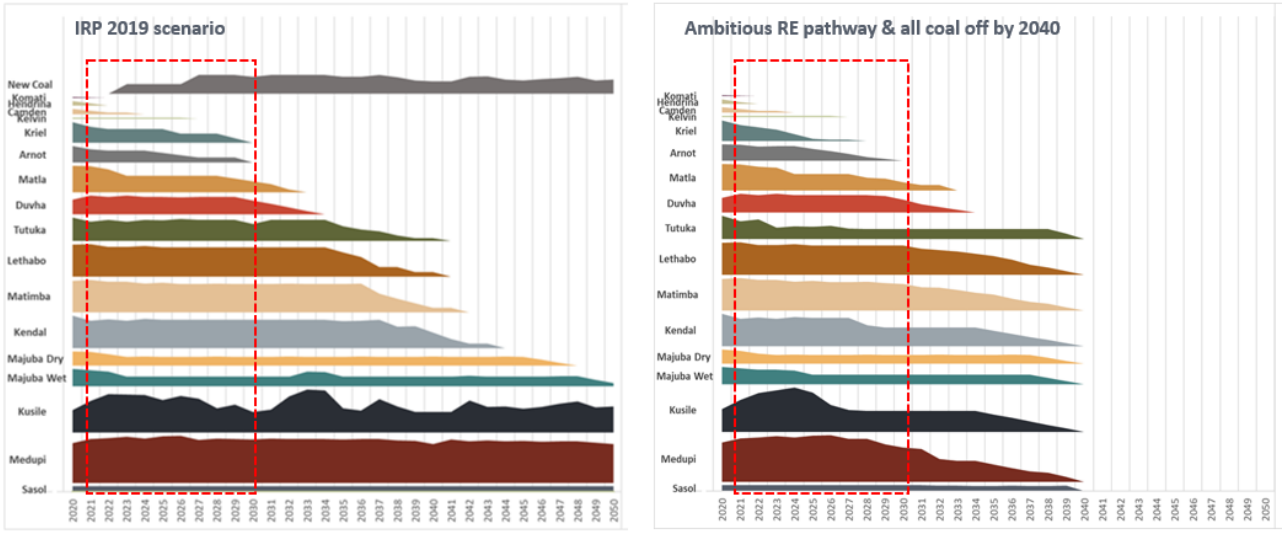

Figure 4: Coal plant utilisation in scenarios possibly aligned with the upper and lower bounds of the NDC (Source, Meridian Economics, 2020)

These envelope scenarios are shown in their full 2050 pathway context in Figure 5, which emphasises how embarking on a coal phase down and large renewables build programme this decade is necessary to put the electricity sector on a 1.5˚C pathway, but that the bulk of the emissions savings is only realised after 2030.

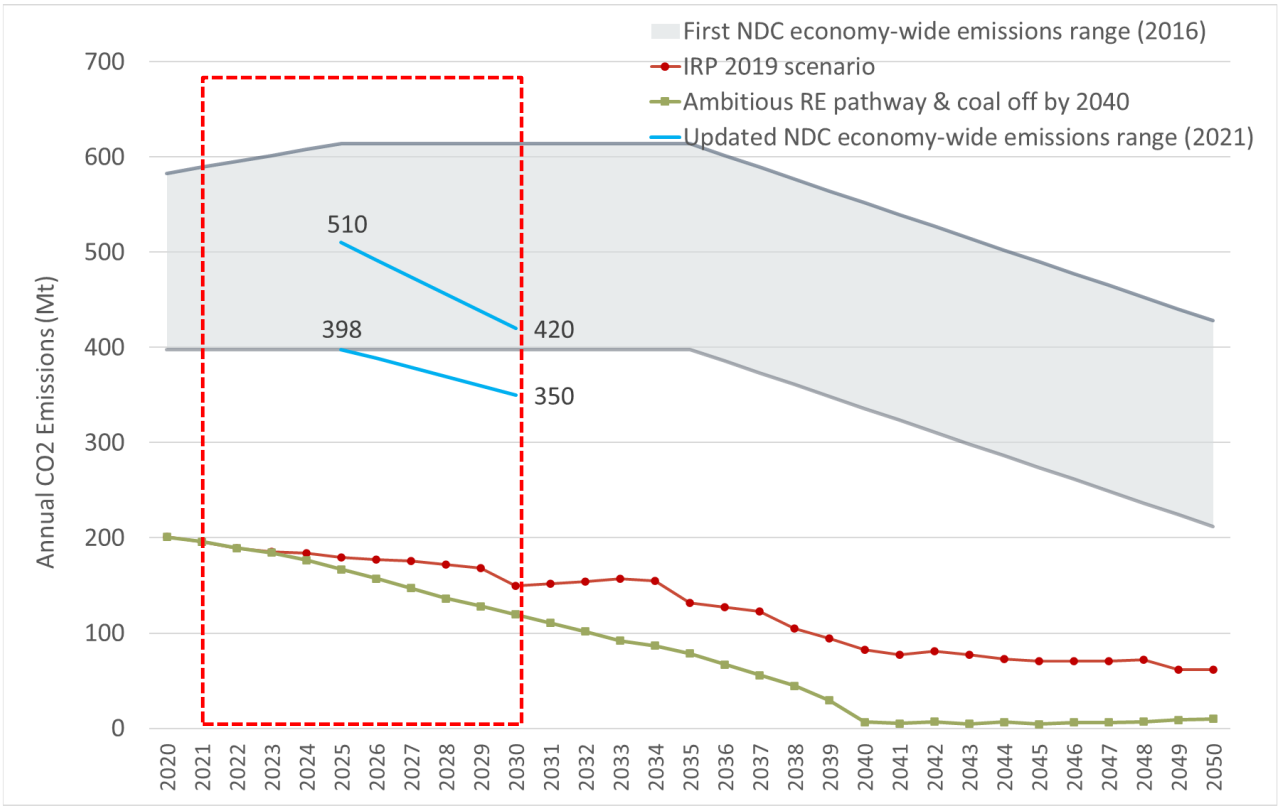

Figure 5: The Meridian-CSIR envelope scenarios against the updated NDC targets

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