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6 March 2024

Department of Mineral Resources & Energy
Private Bag X59
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Pretoria

Attn: The Director-General, Mr Jacob Mbele

Sent by email to: IRP.Queries@dmre.gov.za

Dear Mr Mbele

SUBMISSION OF COMMENTS BY THE ORGANISATION UNDOING TAX ABUSE (OUTA) TO THE DRAFT INTEGRATED RESOURCE PLAN FOR ELECTRICITY IRP 2023

This submission is in response the publication of the Draft Integrated Resource Plan for Electricity (hereafter referred to as Draft IRP 2023) in the Government Gazette, Vol. 703, No. 49973, of 4 January 2024, and the call for public comments by 23 February 2024 (subsequently extended to 23 March 2024) by the Minister of Mineral Resources & Energy, Samson Gwede Mantashe in terms of Section 4(1) of the Electricity Regulations on New Generation Capacity.

The comments and responses below, and in the Appendix hereto, are submitted in terms of the above by the Organisation Undoing Tax Abuse (OUTA).

OUTA acknowledges and thanks the Director-General and the DMRE for the work and effort that has gone into the preparation of the Draft IRP 2023, and thanks the DMRE Minister for the opportunity to comment and respond to the Draft.

About OUTA

OUTA is a non-profit civil action organisation dedicated to working for a better South Africa. OUTA was established to challenge the abuse of authority, and in particular the abuse of taxpayers' money.

OUTA has a strong interest in the electricity sector, because the sector - including state-owned entity Eskom which has been mismanaged for many years - which has resulted in power supply shortages, higher prices and social hardship for consumers, substantial bailouts with taxpayers' funds which should have been available for alternative socio-economic spending, and a devastating effect on the economy.

About this submission

This submission reflects the technical analyses and its executive and member inputs that underpin the OUTAS's critical appraisal of the DMRE's Draft IRP 2023. The IRP is a key document pertaining to South Africa's national long-term electricity planning.

The analyses, comments and subsequent recommendations contained herein, are based on significant inhouse research and evidence, as well as research, policy positions and reports by government departments, government agencies, Eskom, business and industry associations, civil society and non-governmental agencies (NGOs), and other stakeholders.

1. How an Integrated Resource Plan (IRP) for Electricity is intended to respond to the short-, medium- and long-term issues

An Integrated Resource Plan (IRP) for electricity should be an optimisation study and plan that comprises of the following:

a. Covers a defined period;
b. Uses defined economic assumptions;
c. Takes into account the existing power generation fleet, its performance and decommissioning schedule;
d. Takes into account existing transmission grid constraints and planned grid developments;
e. Considers defined generation technology options and associated technology costs;
f. Applies various assumptions, options and generation technology combinations (scenarios);
g. Proposes achievable new-generation build mixes and pathways required for the period under consideration;
h. Considers the least overall cost to society (i.e. including capex, opex, fuel and associated infrastructure requirements);
i. With the abilitity to meet projected demand and ensure unserved energy is avoided at a defined level of reliability/adequacy;
j. Meets defined boundary conditions / policy imperatives such as pollution limits, carbon emissions, water use, job creation, socio-economic impacts, etc.

2. The broad requirements, expectations and needs for a national IRP for electricity.

In conducting and proposing a national IRP for electricity, significant efforts should be taken to meet the requirements, expectations and needs for the IRP to be:

a. Rational, realistic and achievable.
b. Conducted using a clear and transparent methodology.
c. Indicative and non-prescriptive.
d. Consultative and inclusive.
e. Objective and fact-based.
f. Regularly updated and flexible to include new trends, costs and technologies.

g. Aligned with the principles of restorative, redistributive, procedural and social justice.
h. Aligned with approved government principles, policy initiatives and frameworks.
i. Aligned with an overall integrated energy plan (IEP) covering the other primary energy sources and energy carriers in a wholistic way.
j. Aligned with international commitments and national policy targets for overall and power generation sector carbon emission reduction pathways to net-zero carbon emissions by 2050.
k. Aligned with national mandatory legislation, regulations, environmental constraints and mandatory minimum emission standards.
l. Able to be tested and verified independently.

3. Transparency and achievability: In order to ensure meaningful public input and oversight, the Draft IRP 2023 and its appendicies need to include:

a. Clearly tabulated with realistic economic assumptions and trajectories used over the period of the study.
b. Clearly stated with realistic technology costs (i.e. capex, fixed and variable opex, fuel, infrastructure requirements) and cost trajectories used over the period of study, including learning curves.
c. Clear and realistic technology construction times and roll-out constraints used over the period of study.
d. Clearly stated boundary conditions/policy constraints imposed over the period of the study (e.g. limits in respect of pollution, carbon emissions, water use, health impacts, job losses/creation, etc.).

This submission by OUTA analyses and comments on the extent to which the above expectations, requirements and needs for a substantive and meaningful Draft IRP 2023 have been met.

4. The time allowed for comments and response to the Draft IRP 2023

OUTA is of the view that the initial time allowed (i.e. 4 January to 23 February 2024) for comments and responses from government agencies, industry and business associations, organised labour, community organisations, civil society, NGOs and the public was inadequate and insufficient for affected stakeholders to analyse and respond to the Draft IRP 2023 meaningfully with well-informed submissions of adequate quality.

As a result, OUTA submitted a formal request to extend the closing date for comments by a further 60 days to 23 April 2024. We note the closing date for comments has since been extended to 23 March 2024 i.e. an extra 30 days on the original deadline.

OUTA does not believe the limited online briefing session by the DMRE on 9 January 2023, the three-hour online workshops conducted by the DMRE on 18 January and 31 January 2024 (where no presentations and only limited questions to the DMRE were allowed), and the one-on-one meetings with specific individual stakeholders, constitutes adequate oral consultation with grassroots organisations and the public. Nor does OUTA believe that the above

adequately replaces a series of about five or six one- and two-day public hearings around South Africa, as was done for previous IRPs for electricity.

It is important to note that the DMRE has taken about two years to produce the Draft IRP 2023 for public comment, and finds the department to be disrespecting of the public and civil society at large, for the very necessary and constitutionaly required multiple stakeholder consultation process to be boxed into unrealistic timelines. This will result in an inadequate and flawed public consultation and engagement process that is not adequately consultative and participative.

5. Need to recall, rework and reissue the Draft IRP 2023 for public comment

Since publishing of the Draft IRP 2023 in the Government Gazette on 5 January 2024 for public comment, there have been a number of acknowledged errors and changes arising, identified as necessary for rework and remodelling of the Draft IRP 2023.

These the corrected errors and changes required are not reflected in the current published Draft IRP 2023 and its workings, and the DMRE is said to be embarking on rework and remodelling of the Draft to address these inadequacies and changes.

The serious errors, omissions and changes required in input assumptions, technology costs and available capacity have resulted in erroneous conclusions and observations in the Draft IRP 2023 that are not supported by the facts.

As a result of the significant rework and remodelling required, some of which is underway by the DMRE as indicated above, OUTA is of the view that simply extending the public comment period is inappropriate and the wrong approach, as government agencies, industry and business associations, organised labour, community organisations, civil society, NGOs, NEDLAC and the public will be denied the opportunity of commenting on the reworked and remodelled Draft IRP 2023.

Instead, it is OUTA'S submission that the current Draft IRP 2023, which contains a number of significant acknowledged errors, omissions and inadequacies, should be recalled, reworked and reissued for public comment, with adequate time provided for a meaningful public consultation process including a series of public hearings around South Africa.

6. Proposed re-work and resubmission of the Draft IRP-2023 for public comment:

As an absolute minimum, OUTA proposes the DMRE revises the Draft IRP-2023 to consider the following corrections:

a. Inadequate and out-of-date technology costs were used by the DMRE in the Draft IRP 2023, taken from a January 2021 EPRI study for Eskom which was based on USA pricing. Accordingly, we believe the latest technology cost assumptions that are more specific to the South Africa

landscape and as is published in the latest "Lazard Report", as well as the latest REIPPP costs, should be used for electricity generation from wind, solar PV and battery energy storage (BES).

b. The DMRE used fixed technology costs in the Draft IRP 2023, and appeared not to take into account the cost reductions applicable over the study period from 2024 to 2050, particularly for solar PV, wind and BES, as indicated in numerous local and international studies, including the most recent Lazard report. It is necessary to rework and remodel the various scenarios over the study period from 2024 to 2050 based on realistic technology learning curves.

c. In Figure 9 of the Draft IRP 2023, the Horizon 1 Reference Scenario 2, and Scenario 3, do not show SSEG of 900 MW per year in the period from 2024 to 2030, which totals 7 x 900 MW = 6300 MW of new generation capacity. This omission in the modelling of Scenarios 2 and 3 of Horizon 1 should be corrected and remodelled.

d. The rollout constraint for SSEG of 900 MW per year shown in Table 2 for Horizon 1 from 2024 to 2030 (i.e. 7 x 900 MW = 6300 MW) appears to be significantly incorrect and unrealistically low. In 2023 alone, some 2000 MW of household and business rooftop solar PV was installed as per Eskom and SAPVIA data. This should be conservatively adjusted from 6300 MW to 7 x 2000 MW = 14000 MW and remodelled.

e. In addition, some 3470 MW of additional wind capacity in the Western and Eastern Cape should be added to the Horizon 1 Reference Scenario 2, and Scenario 3, and remodelled. This additional capacity results from Eskom's curtailment addendum to its latest Generation Connection Capacity Assessment, GCCA 2025, published on Eskom's website and approved by NERSA.

f. Figure 9 of Draft IRP 2023 does not show the battery energy storage (BES) of 2080 MW from BES Bid Windows 1, 2, 3 and Eskom for Horizon 1 Scenario 3 that was included in the Horizon 1 Reference Scenario 2. This 2080 MW of BES should be added to Scenario 3 and remodelled.

g. It is also noted the gas-to-power capacity of 6220 MW listed for Horizon 1 Scenario 5 in Figure 9 of IRP 2023 includes 1200 MW from the three Karpowership IPP projects of the Risk Mitigation IPP Procurement (RMIPPP) programme. According to OUTA's views on the Karpowership gas-to-power projects, these should be removed from Table 9 and the analysis of the Draft IRP 2023, and remodelled.

h. It appears from Figures 13, 14, 15, 17 and 18 in the Draft IRP 2023, that new-build constraints on solar PV were applied, because the outcomes across all Horizon 2 pathways show clearly that total solar PV (including REIPPP, private PPAs, wheeling, trading, self-generation and rooftop PV) was constant in all pathways, and were not allowed to exceed 9000 MW cumulative per decade (i.e. 900 MW per annum). Such a constraint is unrealistic and incorrect, requiring a remodelling with realistic and clearly stated rollout constraints.

i. Additionally, wind capacity looks to be constrained, at least in the decade from 2031 to 2040 of Horizon 2, where no more than 17 200 MW cumulative was allowed (i.e. 1700 MW per

year) across four of the scenarios of Horizon 2. Such a constraint is unrealistic and wrong, and remodelling with realistic and clearly stated rollout constraints used, is required.

j. A fixed gas fuel price has been used/assumed for a fuel whose price is denominated in US$. No consideration has been given to realistic US$ gas price and/or US$/ZAR exchange rate trajectories over the study periods of Horizon 1 and 2 in the years from 2024 to 2050. This omission significantly impact the results of all gas-to-power scenarios and pathways modelled.

k. No constraints have been used in the Draft IRP 2023 on CO_2, SO_2, NOx and particulate emissions in the Horizon 2 study period from 2030 to 2050. Attention needs to be given to this in the rework and remodelling of the Draft IRP 2023, as this significantly impacts the conclusions and observations of the Draft IRP 2023.

l. Inadequate attention has been given in the Draft IRP 2023 to the impact of the hydrogen economy, green hydrogen and electric vehicles (EVs) in the Horizon 2 study period from 2030 to 2050. Attention needs to be given to this in the rework and remodelling of the Draft IRP 2023, as this significantly impacts the conclusions and observations of the Draft IRP 2023.

7. Summary of serious inadequacies, errors and omissions identified in the Draft IRP 2023

OUTA has identified a number of serious inadequacies, errors and omissions in the Draft IRP 2023 which are covered in detail in our response to the call for public comments by the Minister of Mineral Resources & Energy, and in the Appendicies hereto.

Broadly speaking the Draft IRP-2023 is inadequate and erroneous due to the following incorrect or missing assumptions and constraints identified:

a. The economic assumptions from 2024 to 2050 are largely missing or inadequate. Key assumptions such as US$/ZAR exchange rate are both outdated and fixed, with no trajectory provided over the study period to from 2024 to 2050, or at least does not contain a sensitivity analysis. Refer to Appendix paragraph 1.1
b. Socio-economic policy constraints are also largely missing and inadequate. Refer Appendix paragraph 1.2.
c. The emissions and water use constraints from 2024 to 2050 are missing and have no sensitivity analysis. Refer to Appendix paragraph 1.3.
d. Demand growth assumptions from 2024 to 2050 is highly inadequate. Only a single demand growth trajectory is provided, with no sensitivity analysis. Refer Appendix paragraph 1.4.
e. Technology rollout constraints (MW per year) from 2024 to 2050 are largely missing and that which is provided, is seriously unrealistic. Refer Appendix paragraph 1.5.
f. Small-scale embedded generation (SSEG) rollout constraints (MW per year) in Draft IRP 2023 – Missing in Horizon 1 Reference Scenario 2, and Scenario 3, and completely unrealistic and artificially constrained at 900 MW per year in Table 2. Refer Appendix paragraph 1.6.
g. Technology construction time and phasing assumptions – Largely missing. Refer Appendix paragraph 1.7.

h. Capacity factor and energy availability factor assumptions for different technologies over time – Capacity factors and EAF missing for the various technologies. Refer Appendix paragraph 1.8.
i. Fuel calorific value assumptions – Missing. Refer Appendix paragraph 1.9.
j. Fuel to electricity conversion assumptions – Missing. Refer Appendix paragraph 1.10.
k. Technology cost assumptions from 2024 to 2050 – Mostly missing, and those included are outdated and unrealistic, particularly wind, solar PV and BES. No price reductions from 2024 to 2050. Refer Appendix paragraph 1.11.
l. Assumptions in respect of the cost of externalities – Mostly missing. No sensitivity analysis. Refer Appendix paragraph 1.12.
m. EAF and capacity factor assumptions for the whole Eskom system over time – Capacity factor missing. Unrealistic EAF assumptions. No sensitivity analysis. Refer Appendix paragraph 1.13.

8. Various additional inadequacies and concerns:

a. **Energy efficiency and demand management initiatives:** It appears that no consideration is given in the Draft IRP 2023, to the role and contribution of energy efficiency and demand management. Refer Appendix paragraph 2.

b. **Delayed shutdown and decommissioning or life-extension schedule for old Eskom coal-fired power plants:** No information is provided in the Draft IRP 2023 on the feasibility and costs associated with delayed shutdown and life-extension of old Eskom coal-fired power stations. No information provided on the feasibility study and recommendations of the VGB Energy Consortium report to National Treasury and Eskom in September 2023. Refer Appendix paragraph 3.

c. **Different versions of Table 2 in the Draft IRP 2023:** In the updated vesion of the Draft IRP-2023, there has been no update provided on the different versions of Table 2 of Draft IRP 2023. Refer Appendix paragraph 4.

d. **Electricity price trajectories missing for the various scenarios:** No electricity price trajectories are provided in the Draft IRP 2023 for the various scenarios modelled in Horizon 1 and 2 for analysis, comment and evaluation of the impact on the electricity price of the various scenarios over the study period from 2024 to 2050. Refer Appendix paragraph 5.

e. **Lack of impact of green hydrogen on the energy and electricity landscape**: Inadequate attention is given in the Draft IRP 2023 to the impact of green hydrogen on the energy and electricity landscape of South Africa. Refer Appendix paragraph 6.

f. **Electric vehicles (EVs) impact on the energy and electricity landscape of South Africa:** Inadequate attention has been provided on the impact electric vehicles (EVs) on the energy and electricity landscape of South Africa. Refer Appendix paragraph 7.

g. **Inadequate technology combination options modelled in Draft IRP 2023 Horizon 1 and 2:** The technology combination options and rollout constraints modelled in Draft IRP 2023 Horizon 1 are inadequate and do not properly consider practical and realistic scenarios and combinations that can eliminate unserved energy in Horizon 1. Similarly, the technology combination options and rollout constraints modelled Horizon 2 are inadequate and do not

properly consider practical and realistic least cost options that meet the requirement for energy security. Refer Appendix paragraph 8.

h. **Lack of any carbon emission constraints post 2030 in Draft IRP 2023:** There is a absence of any carbon emission constraints in the Horizon 2 study period from 2031 to 2050 in Draft IRP 2023. As a result, none of the scenarios modelled in Horizon 2 meet the South African policy positions contained several government papers to meet nett-zero carbon emissions by 2050. Refer Appendix paragraph 9.

i. **Non-compliance with the minimum emissions standards of South Africa:** There is a absence of any SO_2, NOx or particulate emission constraints in the Horizon 2 study period from 2031 to 2050 in Draft IRP 2023. As a result, none of the scenarios modelled in Horizon 2 meet the legal requirements and mandatory minimum emission standards (MES) for air quality of the National Environmental Management Act (NEMA). Refer Appendix paragraph 10.

j. **Misalignment with other government policy initiatives:** There is significant misalignment of the Draft IRP 2023 with a number of other approved and/or published legislation, regulations, policy positions, initiatives, white papers and reports by Government, the Cabinet and various Government agencies. Refer Appendix paragraph 11.

9. The extent to which Draft IRP 2023 meets the needs the needs and expectations of an IRP

Following our input above and contained in the Appendicies, we say with a significant degree of certainty that the fundamental requirements, expectations and needs from an IRP for electricity, which we listed in section 2 of this submission, have been not met in the Draft IRP 2023, as listed below.

a. *Rational, realistic and achievable:* **Not adequately met**.
b. *Conducted using a clear and transparent methodology*: **Not met.**
c. *Indicative and non-prescriptive.* **Met.**
d. *Consultative and inclusive:* **Not met.**
e. *Objective and fact-based:* **Not met.**
f. *Up-to-date, flexible and regularly updated:* **Not met.**
g. *Aligned with the principles of restorative, redistributive, procedural and social justice:* **Not adequately met.**
h. *Aligned with approved government principles, policy initiatives and frameworks:* **Not met.**
i. *Aligned with an overall integrated energy plan (IEP) covering the other primary energy sources and energy carriers in a wholistic way:* **Not met** (non-existent IEP).
j. *Aligned with international commitments and national policy targets for overall and power generation sector carbon emission reduction pathways to net-zero carbon emissions by 2050:* **Not met.**
k. *Aligned with national mandatory legislation, regulations, environmental constraints and mandatory minimum emission standards:* **Not met.**
l. *Able to be tested and verified independently:* **Not met.**

10. Recommendations by OUTA

As a result of the significant rework and remodelling required, some of which is underway by the DMRE as indicated here, OUTA is of the view that simply extending the public comment period is inappropriate and the wrong approach, as government agencies, industry and business associations, organised labour, community organisations, civil society, NGOs, NEDLAC and the public will be denied the opportunity of commenting on the reworked and remodelled Draft IRP 2023.

It is therefore OUTA'S submission and recommendation that the current Draft IRP 2023, which contains a number of significant acknowledged errors, omissions and inadequacies, should be recalled, reworked and reissued for public comment, with adequate time provided for a meaningful public consultation process including a series of public hearings around South Africa.

11. Conclusion

We trust OUTAs comments detailed in this response to the call for public comments by the DMRE Minister, and the Appendix hereto, will be considered and taken into account in the final published version of the IRP, and OUTA commits to further engagements on this matter.

OUTA again thanks the DMRE Minister and DG for this opportunity to make input and comments to the Draft IRP 2023.

Yours sincerely

The Organisation Undoing Tax Abuse (OUTA)

Wayne Duvenage
Chief Executive Officer

Appendix

1. Detailed comments on the assumptions and constraints used in preparing the Draft IRP 2023

As the modelling done in the Draft IRP 2023 is a essentially mechanistic techno-economic process using a proprietary methodology and platform requiring a licence, as opposed to an open-source platform that can be readily accessed and evaluated, the comments on the modelling done in the Draft IRP 2023 must therefore focus on the specific input data, assumptions and hard-wired constraints used in this modelling, as opposed to the methodology and outputs provided by the platform and its methodology.

Unfortunately, while some input data is made available, in many cases the input data, assumptions and hard-wired constraints used in the modelling of the various scenarios is incomplete, ambiguous and far from clear, transparent and consistent, making meaningful comments on the inputs difficult, and in many cases impossible.

Some of the limitations of the assumptions and input data presented/used in the DMRE modelling are listed as follows:

1.1 Economic assumptions from 2024 to 2050

OUTA would have expected to see a table within the Draft IRP 2023 (or as an appendix) clearly and unambiguously indicating the specific economic assumptions used in the modelling over the period from 2024 to 2050, such as:

- Rate of exchange US $ / Rand.
- Consumer price index.
- GDP growth rate.
- Energy and electricity intensity in South Africa.
- Weighted average cost of capital (WACC) / discount rate.
- Company tax rates.
- Depreciation allowances.
- Carbon tax rates.
- Cross border adjustment mechanism (CBAM) rates.
- Cost of unserved energy resulting from loadshedding.

Only limited and incomplete information is presented in respect of the above economic assumptions. In some cases, such as the US $/ZAR exchange rate, only a single constant figure over the whole IRP period from 2024 to 2050 is given, instead of a more realistic view of the trend and trajectory over the study period.

In addition, there is no indication in the Draft IRP 2030 of any sensitivity analysis done on the above economic assumptions.

1.2 Socio-economic policy constraints

OUTA would have expected to see some analysis and details on the specific hard-wired socio-economic policy constraints used in the Draft IRP 2023 modelling for the period from 2024 to 2050, such as:

- Power system reliability/adequacy level and constraints on the level of unserved energy.
- Job loss constraints.
- Job creation roll-out requirements.
- Skills requirement constraints
- Relocation requirement constraints
- Health impact constraints

While there is a DMRE Socio-Economic Impact Assessment System (SEIAS) report in the documents published on the DMRE website accompanying the Draft IRP 2023, the specifics of any hard-wired socio-economic policy constraints used in the Draft IRP 2023 modelling are unclear.

1.3 Emission and water use constraints from 2024 to 2050

OUTA would have expected to see a table within the Draft IRP 2023 (or as an appendix), clearly and unambiguously indicating the specific emission and water use constraints used in the modelling for the period from 2024 to 2050, such as:

- Carbon emission constraints.
- SO_2 emission constraints.
- NOx emission constraints.
- PM2 particulate emission constraints.
- PM10 particulate emission constraints.
- Bottom ash emission constraints.
- Mercury emission constraints.
- Lead emission constraints.
- High level nuclear waste emission constraints.
- Water use constraints.

Only limited and incomplete information is presented by the DMRE in respect of the above emission and water use constraints, and in some of the constraints listed above, no information is presented at all.

Later sections in this response deal with carbon emission constraints and air quality constraints in more detail, as the failure of the Draft IRP 2030 to address these constrains adequately over the full study period from 2024 to 2050 is deeply problematic.

1.4 Demand growth assumptions from 2024 to 2050

OUTA accepts and supports the work done by the University of Cape Town ESRG on the electricity demand growth assumptions and modelling.

However, OUTA would expect to see a band of possible electricity demand growth trajectories, including low-, medium- and high-demand growth trajectories, in the Draft IRP 2023 for the modelling of the various scenarios. What is shown is just a single electricity demand growth trajectory used, which does not adequately reflect the inherent uncertainty of this assumption.

In addition, as electricity demand growth is impacted also by the electricity price trajectories associated with the different scenarios modelled in the Draft IRP 2023, one may expect that different electricity growth trajectories would be applicable to each of the different scenarios modelled.

1.5 Technology rollout constraints (MW per year) from 2024 to 2050

OUTA would have liked to see a table within the Draft IRP 2023 (or as an appendix) clearly and unambiguously indicating the assumptions used in the modelling in respect of technology rollout constraints (MW per year) for the major technology options, such as:

- Clean coal-fired power
- Diesel-fired OCGT
- Gas-fired OCGT
- Gas-fired CCGT
- Gas engines
- Nuclear PWR
- Nuclear SMR
- Utility-scale hydro
- Small-scale hydro
- Utility-scale solar PV
- Rooftop-scale solar PV
- Utility-scale solar CSP
- Utility-scale wind
- Utility-scale pumped-storage
- Utility-scale BES
- Residential- and commercial-scale BES
- Demand management
- Energy efficiency

The information provided in this regard is very limited, and in some cases – such as the constraint of 900 MW per year for small-scaled embedded generation (SSEG) from 2024 to 2030 – appears unrealistically low.

1.6 Small-scale embedded generation (SSEG) rollout constraints (MW per year) in Draft IRP 2023

Table 2 of the Draft IRP 2023 shows a rollout of SSEG of 900 MW per year in the Horizon 1 study period from 2024 to 2030 i.e. total 6300 MW. This rollout appears to be a hard-wired constraint in the Draft IRP 2023 modelling process that is quite unrealistic and misaligned with reality.

All independent data, including data from Eskom, the South African Photovoltaic Industry Association (SAPVIA) and Trade & Industry Strategies (TIPS), indicate that in 2023 alone, about 2000 MW of rooftop solar PV and BES were installed in South Africa.

With continued load shedding, further incentivisation for rooftop solar PV, and ongoing solar PV, inverter and BES price reductions, this trend is likely to continue and even increase in the years ahead.

The rollout of rooftop PV and BES in countries such as Australia, Vietnam and many others indicates that a rollout constraint of 900 MW per year is an unambitious and unrealistically low SSEG rollout constraint for South Africa. The annual rollout could indeed be increased very significantly, even beyond the 2000 MW of rooftop solar PV that was installed in South Africa in 2023.
There are no notable grid access constraints for a major rollout of rooftop solar PV and BES, as these systems are embedded within distribution networks, behind the meter, and on the customer's premises, where an existing network connection already exists.. SSEG serves to reduce the burden on the external network, grid and Eskom generators, and therefor serves to reduce loadshedding across the country.

1.7 Technology construction time and phasing assumptions

OUTA would have liked to see a table within the Draft IRP 2023 (or as an appendix) clearly and unambiguously indicating the assumptions used in the modelling in respect of construction time and phasing for the major technology options, such as:

- Clean coal-fired power
- Diesel-fired OCGT
- Gas-fired OCGT
- Gas-fired CCGT
- Gas engines
- Nuclear PWR
- Nuclear SMR

- Utility-scale hydro
- Utility-scale solar PV
- Utility-scale solar CSP
- Utility-scale wind
- Utility-scale pumped-storage
- Utility-scale BES

These construction time and phasing assumptions modelling assumptions are important in determining the total capex (Rands per kW of installed capacity) from the overnight capex costs, particularly for longer lead-time options such clean coal-fired power and nuclear power.

The information provided in this regard is very limited, and in some cases – such as such as clean coal-fired power and nuclear power – appears quite unrealistic.

1.8 Capacity factor and energy availability factor assumptions for different technologies over time

OUTA would have liked to see a table or trend graphs within the Draft IRP 2023 (or as an appendix) clearly and unambiguously indicating the assumptions used in the modelling in respect of the capacity factor and energy availability factor over time for the major technology options, such as:

- Clean coal-fired power
- Diesel-fired OCGT
- Gas-fired OCGT
- Gas-fired CCGT
- Gas engines
- Nuclear PWR
- Nuclear SMR
- Utility-scale hydro
- Utility-scale solar PV
- Utility-scale solar CSP
- Utility-scale wind

No information appears to be provided in the Draft IRP 2023 or attachments in this regard.

1.9 Fuel calorific value assumptions

OUTA would have liked to see a table within the Draft IRP 2023 (or as an appendix) clearly and unambiguously indicating the assumptions used in the modelling in respect of the calorific value for the major fuel options, such as:

- Coal
- Diesel
- LNG gas
- Natural gas
- Nuclear fuel

No information appears to be provided in the Draft IRP 2023 or attachments in this regard.

1.10 Fuel to electricity conversion assumptions

OUTA would have liked to see a table within the Draft IRP 2023 (or as an appendix) clearly and unambiguously indicating the assumptions used in the modelling in respect of the conversion of fuel to net electricity output, for each of the generation technology options that use fuel, such as:

- Coal-fired power plant
- Diesel-fired OCGT
- Gas-fired OCGT
- Gas-fired CCGT
- Gas engines
- Nuclear power

No information appears to be provided in the Draft IRP 2023 or attachments in this regard.

1.11 Technology cost assumptions from 2024 to 2050

The Draft IRP 2023 indicates that, in general, the technology price assumptions (capex, fixed and variable opex, fuel) for the different generation technology options used in the modelling process were based on an EPRI report prepared for Eskom, dated January 2021.

The DMRE has since acknowledged in a PCC Net-Zero Working Group meeting on 1 February 2024 that the EPRI report data is significantly out-of-date and is largely based on technology costs in the USA.

As a result, the DMRE says it has since updated certain technology cost assumptions based on the latest report by Lazard in 2023, which also covers technology costs in other regions such as Europe and Asia.

Furthermore, the DMRE says that the latest actual bid window prices in the REIPPP programme have been used for utility-scale wind and solar PV, in the Draft IRP 2023 modelling process.

While EPRI and other data sources take into account technology cost reductions arising from learning curves over time, the DMRE has also indicated that it has not taken learning curve price reductions into account in its technology cost assumptions. OUTA considers this to be a major flaw in respect or wind, solar PV and BES capex cost assumptions, where significant further technology capex cost reductions are expected over time in the study period from 2024 to 2050.

As a result of all of the above, there is significant confusion, ambiguity and lack of clarity as to exactly what technology cost assumptions have been actually used by the DMRE in the modelling process of the Draft IRP 2023.

OUTA would hope that the DMRE will take into account the significant work done by Meridian Economics in respect of a comparative analysis of technology costs from a number of respected data sources (such as EPRI, IEA and several others) in determining and publishing a set of clear, unambiguous and consistent technology cost assumptions, including learning curves over the study period of Draft IRP 2023 from 2024 to 2050, and in particular:

1.11.1 Overnight capex cost assumptions from 2024 to 2050

OUTA would have liked to see a table within the Draft IRP 2023 (or as an appendix) clearly and unambiguously indicating the overnight capex cost assumptions used in the modelling for the period from 2024 to 2050, incorporating also any learning curve cost reductions in this period, for the various technology options, such as:

- Clean coal-fired power
- Diesel-fired OCGT
- Gas-fired OCGT
- Gas-fired CCGT
- Gas engines
- Nuclear PWR
- Nuclear SMR
- Utility-scale hydro
- Small-scale hydro
- Utility-scale solar PV
- Rooftop-scale solar PV
- Utility-scale solar CSP
- Utility-scale wind
- Utility-scale pumped-storage
- Utility-scale BES
- Residential- and commercial-scale BES
- Demand management
- Energy efficiency

1.11.2 Fixed and variable opex cost assumptions from 2024 to 2050

OUTA would have liked to see a table within the Draft IRP 2023 (or as an appendix) clearly and unambiguously indicating the fixed and variable opex cost assumptions used in the modelling for the period from 2024 to 2050, such as:

- Clean coal-fired power
- Diesel-fired OCGT
- Gas-fired OCGT
- Gas-fired CCGT
- Gas engines
- Nuclear PWR
- Nuclear SMR
- Utility-scale hydro
- Small-scale hydro
- Utility-scale solar PV
- Rooftop-scale solar PV
- Utility-scale solar CSP
- Utility-scale wind
- Utility-scale pumped-storage
- Utility-scale BES
- Residential- and commercial-scale BES
- Demand management
- Energy efficiency

1.11.3 Fuel and water cost assumptions from 2024 to 2050

OUTA would have liked to see a table within the Draft IRP 2023 (or as an appendix) clearly and unambiguously indicating the fuel and water cost assumptions used in the modelling for the period from 2024 to 2050, such as:

- Coal price
- Diesel price
- LNG gas price
- Natural gas price
- Nuclear fuel price
- Water price

No information appears to be provided in the Draft IRP 2023 or attachments in this regard.

1.12 Assumptions in respect of the cost of externalities

OUTA would have liked to see some analysis and a table within the Draft IRP 2023 (or as an appendix) clearly and unambiguously indicating the cost of externalities and assumptions used (or not used) in the modelling for the period from 2024 to 2050, such as:

- Climate mitigation and adaptation costs
- Health costs associated with the burning of coal
- CBAM costs
- Road repair costs
- Coal decommissioning costs
- Coal cleanup/reclamation costs
- Nuclear decommissioning costs
- Nuclear cleanup/reclamation costs
- Nuclear low- and medium-level waste storage and disposal costs
- Nuclear high-level waste storage and final disposal costs

No meaningful analysis or information appears to be provided in the Draft IRP 2023 or attachments in this regard.

1.13 EAF and capacity factor assumptions

For the period from 2024 to 2030, three energy availability factor (EAF) trajectories are considered for the existing Eskom generation fleet in the five scenarios modelled in the Draft IRP 2023, namely:

- The low-EAF trajectory used in Scenarios 1 to 4 of the Draft IRP 2023, where the EAF stabilises at around 50% to 52% in the period from 2024 to 2030.
- The high-EAF trajectory where the EAF shows a step-change from 54% in 2023 to 66% in 2024, and then rises steadily to 69% in the period from 2025 to 2030.
- The modified high-EAF trajectory of the Eskom generation recovery plan used in Scenario 5 of the Draft IRP 2023, where the EAF rises from 54% in 2023 to 60% in 2024, then to 67% in 2025, and then rises steadily to 69% in the period from 2026 to 2030.

In Scenario 5 of the Draft IRP 2023, the modified high-EAF trajectory is used to show that if the EAF were to increase along this trajectory, then even with only the existing firm new generation initiatives of Scenario 1, load shedding could be ended in the period from 2024 to 2030.

However, it should be appreciated that the EAF is not one of the practical options that can simply be increased, or one of the levers that can simply be pulled to end load shedding, and that the low-EAF trajectory, as used in Scenarios 1 to 4 of the Draft IRP 2023, is more realistic.

In fact, some analysts consider that the EAF trajectory in the period from 2024 to 2030 may even slowly decline still further as the existing generation fleet continues to age and deteriorate, and the shutdown of poorly performing coal-fired plant is delayed.

It should also be appreciated that the actual capacity factors of the generation plant within the Eskom fleet are always lower than (or, at most, equal to) the actual EAF of the plant. When the capacity factor of a generation plant is operating close to its EAF, as is the case at present under load shedding conditions, this indicates that the plant is being operated hard, thus further increasing the deterioration of the plant performance in the months and years ahead.

2. Comments on the lack of energy efficiency and demand management initiatives shown in the Draft IRP 2030

Energy efficiency and demand management is seen by OUTA as an important option to reduce demand and load shedding, and optimise existing and future generation, transmission and distribution infrastructure and resources in the Horizon 1 period from 2024 to 2023 of the Draft IRP 2023, as well as the Horizon 2 period from 2031 to 2050, at least cost.

The importance of energy efficiency and demand management is reflected in the President's emergency energy plan to end load shedding, published in July 2022, and in the establishment of a dedicated Workstream 5 of NECOM dealing with energy efficiency and demand management.

However, there is no indication of any analysis of the contribution that could come from energy efficiency and demand management in Horizon 1, Table 2 and/or Horizon 2 of the Draft IRP 2023. OUTA sees this as a significant omission that needs to be addressed.

3. Comments on the delayed shutdown, delayed decommissioning and life-extension schedule for old Eskom coal-fired power plant in the Draft IRP 2023

The Draft IRP 2023 has suggested delayed shutdown, delayed decommissioning and life-extension of Eskom's old coal-fired power plant, in order to reduce load shedding and unserved energy in the in the years from 2024 to 2035 and beyond.

However, it is not clear whether or not the Draft IRP 2023 has used the suggested delayed shutdown, delayed decommissioning and life extension of Eskom's old coal-fired power plant in the modelling of Scenarios 1 to 5 in the Horizon 1 period from 2024 to 2030 and beyond.

OUTA would have liked to see a table within the Draft IRP 2023 (or as an appendix) clearly and unambiguously indicating the delayed shutdown, delayed decommissioning and life-extension schedule for old Eskom coal-fired power plant used in the Draft IRP 2023 modelling for the period from 2024 to 2035.

In addition, if indeed the Draft IRP 2023 has used the suggested delayed shutdown, delayed decommissioning and life-extension of Eskom's old coal-fired power plant for the period from 2024 to 2035, it would be important to know the outcomes and recommendations of the independent report by the VGB Energy Consortium commissioned by National Treasury in this regard. This report has still not been made available by National Treasury, and it is difficult if not impossible for affected stakeholders and the public to comment meaningfully on the suggested delayed shutdown, delayed decommissioning and life-extension of Eskom's old coal-fired power plant for the period from 2024 to 2035 without this information.

Furthermore, if indeed the Draft IRP 2023 has used the suggested delayed shutdown, delayed decommissioning and life-extension of Eskom's old coal-fired power plant in the period from 2024 to 2035, it would be important to know the time, costs and socio-economic impacts associated with this, in terms of:

- The direct increased fixed and variable operating and maintenance costs.
- The direct capital costs and downtime required for any life-extension works, including installation of flue-gas desulphurisation plant and other pollution abatement measures.
- The indirect costs associated with potential loss of international preferential loans and grants linked to an accelerated decommissioning of old coal-fired power plant.
- The costs of externalities, including additional health-impact costs, CBAM costs and road-repair costs.
- Other socio-economic impacts.

No clear information appears to be provided in the Draft IRP 2023 or attachments in this regard.

4. Comments on iterations, updates and different versions of Table 2 in the Draft IRP 2023

The DMRE has indicated that the initial Table 2 published in the Draft IRP 2023 on 4 January 2024 was unclear and ambiguous to the extent that it had been misinterpreted by a number of stakeholders.

As a result, the DMRE indicated that there had been a number of subsequent iterations, updates and different versions of Table 2, which have not been published in the Draft IRP 2023.

In the Draft IRP 2023, Table 2 is stated as being "the emerging plan from the Horizon 1 analysis". Table 2 will therefore be considered by stakeholders, the media and the public as the most important and visible outcome from the modelling process of Horizon 1 of the Draft IRP 2023, and will be studied most closely, and referred to most often.

It is therefore critical that there should be no ambiguity or misunderstanding of Table 2, and the fact that there are number of subsequent iterations, updates and different versions of Table 2, which have not been published in the Draft IRP 2023, is concerning to OUTA.

5. Comments on the absence of electricity price trajectories in the Draft IRP 2023

An important output of the Draft IRP 2023 modelling process should be a set of electricity price trajectories associated with the various scenarios modelled. This is of particular relevance and importance to stakeholders and the general public.

While it is understood and accepted that the electricity price trajectories associated with the various scenarios modelled may not have a direct correlation with NERSA's electricity price determinations, these price trajectories would indicate the relative implications and pressures on the electricity price paths in the years ahead for the different scenarios modelled.

OUTA would therefore have liked to see a set of trend graphs within the Draft IRP 2023 (or as an appendix) clearly and unambiguously indicating the electricity price trajectories associated with the various scenarios modelled in the Draft IRP 2023 for the period from 2024 to 2050.

Without this, the objectives of transparency, restorative, redistributive, procedural and social justice cannot be considered to have been met at grass-roots level.

6. Comments on the impact of green hydrogen on the energy and electricity landscape of South Africa

Within the Draft IRP 2023, there does not appear to be any cognisance taken or shown in respect of the impact of green hydrogen and its derivatives as emerging primary energy sources and/or energy carriers within both the wider energy sector of South Africa, and within the country's electricity sector, particularly in the Horizon 2 period from 2031 to 2050.

It is acknowledged that the solar PV and wind energy generation requirements of green hydrogen production facilities will largely be self-contained generation islands for each green hydrogen production facility, and that these will therefore not draw on Eskom and other external power generation facilities, or on the Eskom transmission grid.

However, green hydrogen production facilities incorporating self-contained power islands with wind, solar PV and BES resources, in addition to producing a green hydrogen stream into a hydrogen transmission pipeline that with serve as a hydrogen gas storage facility, will also produce a steady stream of green electricity for delivery into the national transmission grid.

It is therefore clear that green hydrogen production facilities also serve as green electricity production facilities that can and should be taken into account in the modelling in the Draft IRP 2023, particularly in the Horizon 2 period from 2031 to 2050, and in the development plans of the transmission grid to benefit from the steady green electricity output from these facilities.

This points to an urgent need to develop a overall Integrated Energy Plan (IEP) covering the other energy sectors, primary energy sources and energy carriers in a wholistic way. OUTA is

of the view that the omission of an IEP and due consideration of the impact of green hydrogen on South Africa's electricity system should be addressed in the Draft IRP 2023.

7. Comments on the impact electric vehicles (EVs) on the energy and electricity landscape of South Africa

Within the Draft IRP 2023, there does not appear to be any cognisance taken or shown in respect of the impact of electric vehicles as an emerging transportation technology, and as a distributed battery energy storage resource for demand management, within both the wider energy sector of South Africa and within the country's electricity sector, particularly in the Horizon 2 period from 2031 to 2050.

It is acknowledged that charging points along the major transportation corridors in South Africa will most likely be largely off-grid, self-contained, generation islands comprising solar PV, BES and generators driven by reciprocating engines fuelled by biofuels, and that these will therefore not draw on Eskom, municipal and other external power generation facilities, or on Eskom or municipal networks.

However, it is expected that a significant number of charging facilities will be at individual residential homes and commercial parking facilities, that would indeed draw on power from Eskom, municipal and other external generation sources, via Eskom and municipal networks.

In addition, EVs can provide an important source of distributed battery energy storage for residential self-generation while the EVs are parked at home, and in particular during morning and evening peak periods in order to reduce the impacts of load shedding, and to save on grid electricity supply costs. Such dual functionality (transport and demand management) makes the business case for EVs ever more compelling.

It is therefore clear that the impact of EVs on the energy and electricity landscape of South Africa can and should be taken into account in the modelling in Draft IRP 2023, particularly in the Horizon 2 period from 2031 to 2050.

This points to an urgent need to develop a overall Integrated Energy Plan (IEP) covering the other energy sectors, primary energy sources and energy carriers in a wholistic way. OUTA is of the view that the omission of an IEP and due consideration of the impact of EVs on South Africa's electricity system should be addressed in the Draft IRP 2023.

8. Comments on technology combination options modelled in Draft IRP 2023 Horizon 1 and 2

8.1 Horizon 1: Period from 2024 to 2030

The scenarios modelled and the technology options included in the Horizon 1 period from 2024 to 2030 appear quite artificial and unrealistic.

8.1.1 Scenario 1: Entitled "Firm initiatives"

From Figure 9 in Draft IRP 2023, Scenario 1 of the Horizon 1 period for 2024 to 2030 includes:

- Business: 2842 MW
- RMIPPP: 150 MW
- REIPPP BW5: Wind: 784 MW

It is not clear why this scenario is modelled or listed at all, as it is clearly completely unrealistic as to what must and will play out in terms of new generation capacity in the period from 2024 to 2030.

8.1.2 Scenario 2: Entitled "Reference case"

From Figure 9 in Draft IRP 2023, Scenario 2 of the Horizon 1 period from 2024 to 2030 includes:

- Business: 5304 MW
- RMIPPP: 626 MW
- REIPPP BW5: Solar PV: 975 MW
- REIPPP BW5: Wind: 1608 MW
- REIPPP BW6: Solar PV: 1140 MW
- BES BW1, 2, 3 + Eskom: 2080 MW

It is not clear why this scenario as detailed is modelled or listed as the "Reference case" scenario, as it is clearly unrealistic as to what must and will play out in terms of new generation capacity in the period from 2024 to 2030.

For example, the Reference Scenario 2 does not show SSEG of 900 MW per year in the period from 2024 to 2030, which totals 7 x 900 MW = 6300 MW of new generation capacity is not listed for Scenario 2 in Figure 9. Yet Table 2, which is stated as the "Emerging plan from the Horizon 1 analysis", does show the 900 MW per year of SSEG from 2024 to 2030. The reason for this omission is unclear.

Furthermore, it is obvious that a rollout constraint of 900 MW per year for SSEG is singularly unambitious and unrealistically low. The annual rollout of SSEG could indeed be increased very significantly, even beyond the 2000 MW of rooftop solar PV that was physically installed in South Africa in 2023. This matter has been covered in more detail earlier in this response.

Furthermore, 3470 MW of additional wind capacity in the Western and Eastern Cape should be added to Scenario 2. This additional capacity results from Eskom's curtailment addendum to its latest Generation Connection Capacity Assessment, GCCA 2025, published on Eskom's website and approved by NERSA.

With the inclusion of the missing 6300 MW of SSEG (adjusted also to be a more realistic figure of 7 x 2000 MW = 14 000 MW), and the additional 3470 MW of wind capacity enabled by the Eskom curtailment addendum, all as detailed above, Scenario 2 would perhaps be a more realistic "Reference case" scenario.

8.1.3 Scenario 3: Entitled "Firm initiatives + all initiatives"

From Figure 9 in Draft IRP 2023, Scenario 3 of the Horizon 1 period from 2024 to 2030 includes:

- Business: 10436 MW
- RMIPPP: 626 MW
- REIPPP BW5: Solar PV: 975 MW
- REIPPP BW5: Wind: 1608 MW
- REIPPP BW6: Solar PV: 1140 MW
- REIPPP BW7: Solar PV: 2000 MW
- REIPPP BW7: Wind: 3000 MW

As per Scenario 2, Scenario 3 does not show SSEG of 900 MW per year in the period from 2024 to 2030, which totals 7 x 900 MW = 6300 MW of new generation capacity not listed for Scenario 3 in Figure 9, and the same comments apply as for Scenario 2 in this regard.

Furthermore, Scenario 3 does not show the BES of 2080 MW from BES BW1, 2, 3 + Eskom that was included in Scenario 2. The reason for this omission is unclear.

Furthermore, 3470 MW of additional wind capacity in the Western and Eastern Cape should be added to Scenario 3. This additional capacity results from Eskom's curtailment addendum to its latest Generation Connection Capacity Assessment, GCCA 2025, published on Eskom's website and approved by NERSA.

With the inclusion of the missing 6300 MW of SSEG (adjusted also to be a more realistic figure of 7 x 2000 MW = 14 000 MW), and the missing 2080 MW of BES, and the additional 3470 MW of wind capacity enabled by the Eskom curtailment addendum, all as detailed above, Scenario 3 would perhaps be a more realistic "Reference" scenario than Scenario 2, and OUTA recommends that this should be considered.

8.1.4 Scenario 4: Entitled "Firm initiatives plus gas"

From Figure 9 in Draft IRP 2023, Scenario 4 of the Horizon 1 period from 2024 to 2030 includes the same new capacity as per Scenario 1, plus 6220 MW of new gas capacity, as follows:

- Business: 2842 MW
- RMIPPP: 150 MW
- REIPPP BW5: Wind: 784 MW
- Gas to power: 6220 MW

It is really puzzling as to why the DMRE modellers have chosen to use Scenario 1 instead of the Reference Scenario 2, or even Scenario 3, both adjusted suitably as indicated above, in considering how much gas-to-power, and its associated capacity factor, that may be needed to eliminate unserved energy and load shedding.

As indicated previously, Scenario 1 is considered quite unrealistic as to what must and will play out in terms of new generation capacity in the period from 2024 to 2030, and obviously the reference case scenario should be something of a realistic view, otherwise it would not be labelled as the reference case scenario.

It is also noted that the gas-to-power capacity of 6220 MW listed for Scenario 5 includes DMRE gas, Eskom Richards Bay gas, and RMIPPP dispatchable gas (which includes about 1200 MW from three Karpowership IPP projects). As the Karpowership projects no longer have any reserved grid access and are off the table at least for the time being, they should not be included in this analysis.

It is suggested that for Scenario 4, the Reference Case Scenario 2, or even Scenario 3, both adjusted suitably as indicated above, should be used to determine what the minimum gas-to-power capacity and the associated load factor would be necessary in order to eliminate unserved energy and load-shedding.

8.1.5 Scenario 5: Entitled "Firm initiatives plus EAF recovery"

From Figure 9 in Draft IRP 2023, Scenario 5 of the Horizon 1 period from 2024 to 2030 includes the same new capacity as per Scenario 1, plus an increasing EAF trajectory corresponding to the Eskom generation recovery plan, as follows:

- Business: 2842 MW
- RMIPPP: 150 MW
- REIPPP BW5: Wind: 784 MW
- EAF: Per Eskom generation recovery plan

As per Scenario 4, it is really puzzling as to why the DMRE modellers have chosen to use Scenario 1 instead of the Reference Case Scenario 2, or even Scenario 3, both adjusted

suitably as indicated above, in considering how the EAF trajectory corresponding to the Eskom generation recovery plan would eliminate unserved energy and load shedding.

As indicated previously, Scenario 1 is considered quite unrealistic as to what must and will play out in terms of new generation capacity in the period from 2024 to 2030, and obviously the reference case scenario should be something of a more realistic view, otherwise it would not be labelled as the reference case scenario.

It is suggested that for Scenario 5, the Reference Case Scenario 2, or even Scenario 3, both adjusted suitably as indicated above, should be used to determine what minimum Eskom EAF trajectory would be necessary in order to eliminate unserved energy and load-shedding.

8.2 Horizon 2: Period from 2024 to 2030

For the Horizon 2 period from 2031 to 2050, the Draft IRP 2023 models and presents five pathways, each with different combinations of technologies as follows:

Pathway 1: Entitled "Least cost"
Wind + Solar PV + BES + Gas OCGT + Gas CCGT

Pathway 2: Entitled "Renewable energy"
Wind + Solar PV + Solar CSP + BES + Pumped storage + Gas OCGT + Gas CCGT

Pathway 3: Entitled "Renewable energy and nuclear"
Wind + Solar PV + BES + Pumped storage + Nuclear + Gas OCGT + Gas CCGT

Pathway 4: Entitled "Delayed coal shutdown"
Delayed shutdown of existing coal + Wind + Solar PV + BES + Gas OCGT+ Gas CCGT

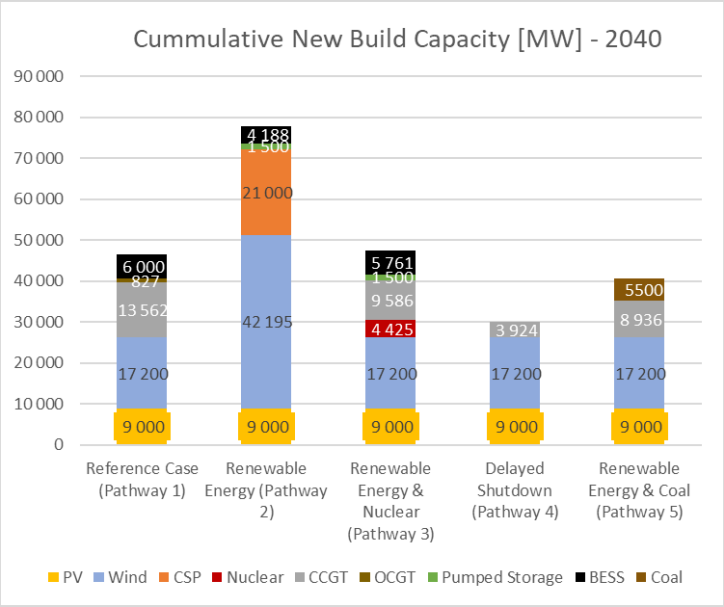
Pathway 5: Entitled "Renewable energy and clean coal"
Clean coal + Wind + Solar PV + BES + Gas OCGT + Gas CCGT

Overall, it must be said that it is impossible to meaningfully analyse, comment on, or make any logical sense of the outcomes of the five pathways modelled in the Draft IRP 2023 Horizon 2 period from 2031 to 2050, because:

- The IRP methodology applied in Horizon 2 from 2031 to 2050 is inconsistent with international norms and best practice.
- There is inadequate transparency and inadequate information provided, particularly in respect of economic assumptions, socio-economic policy/boundary constraints, technology costs, fuel costs, life-extension costs, technology rollout constraints, and costs of externalities used in the modelling process.

- It is unclear whether an energy production cost model was used for Horizon 2, or whether a capacity expansion model was used, or both.
- Solar PV rollout has been constrained to 900 MW per year in all pathways modelled, and wind rollout has been constrained in three of the pathways modelled.
- Unrealistically high solar PV, wind and BES technology costs have been used without reference to the REIPPP bid windows in South Africa, and without cognisance taken of ongoing cost reduction learning curves for solar PV, wind and BES.
- Certain technologies such as nuclear, clean coal and life extension of coal-fired plant appear to have been forced into the mix with inadequate disclosure of the true costs (including the cost of externalities) of these.
- Inadequate attention has been given as to how the pathways of Horizon 2 are to comply with the law in respect of minimum emission standards, and with approved government policies requiring net-zero carbon emissions by 2050.

However, the figure below gives an indication of the cumulative new build capacity for each of the pathways for the first decade of the Horizon 2, namely from 2031 to 2040, in order to illustrate some of the comments made thereafter:



<-Solar PV constraint is evident when looking across scenarios.

<-Wind constraint seems to have been lifted for Pathway 2 only.

<-Results give no indication of how the existing coal fleet operates

Based on the above figure, and what one can glean from the very limited and incomplete information presented in the Draft IRP 2023 and the attachments thereto, the following points are made:

- It is not clear whether an energy production cost model was used for Horizon 2, or whether a capacity expansion model was used, or whether there was any feedback and linkage between the energy and capacity models.

- It appears from the above figure, and Figures 13, 14, 15, 17 and 18 in the Draft IRP 2023, that new-build constraints were applied, because the outcomes across all Horizon 2 pathways show clearly that solar PV was constant in all pathways and could not exceed 9000 MW cumulative per decade (900 MW per annum).
- Additionally, wind capacity looks to be constrained, at least in the decade from 2031 to 2040, where no more than 17.2 GW cumulative was allowed across four of the scenarios.
- Unless constrained, it does not make sense that a model would choose the same amount of solar PV to be built in all five Horizon 2 pathways, and the same amount of wind is to be built in four of the Horizon 2 pathways in the decade from 2030 to 2040.
- The "Least cost" Reference Pathway 1 builds wind, solar, BES and high load factor gas. Due to inadequate transparency around the modelling constraints, it is unclear to what extent the modelling constraints are forcing a high load factor of the gas fleet. High load factor gas is not consistent with the outcomes of the Draft IRP 2019 least-cost plan, which justifies a more thorough explanation of the results.
- It is not clear what US$ gas fuel price trajectory is being used/assumed and what US$/ZAR exchange rate trajectory is being used/assumed in all the pathways of Horizon 2 in the years from 2031 to 2050, and this assumption would significantly impact the results of all pathways modelled.
- The "Renewable energy" Pathway 2 has a puzzling outcome of building large amounts of CSP as opposed to the much cheaper combination of solar PV and BES. This is likely a result of new build limits applied to solar PV of 900 MW per year, in combination with high cost assumptions for solar PV and BES new build, with no learning curve reductions.
- Draft IRP 2023 states that "Renewable energy" Pathway 2 and the "Renewable energy and nuclear" Pathway 3 "sought to explore the impact on security of supply". This is a fundamentally flawed objective in a capacity expansion model as security of supply is a function of user defined energy modelling adequacy specifications. A properly conducted IRP study would ensure that the same level of security of supply is achieved across all pathways. If a pathway resulted in an inadequate level of security of supply, this is a failure of the modelling approach used, likely caused by an impossible boundary constraint where insufficient new build capacity was allowed, failure to run production cost modelling after the capacity optimisation, and/or inappropriate reliability criteria.
- Figure 20 shows the unserved energy for each of the pathways of Horizon 2. This shows that the modelling approach is deeply flawed, as detailed above, as significant differences in unserved energy can be observed across scenarios.
- The comment in Section 6.2 stating that a renewable energy pathway (such as "Renewable energy" Pathway 2) does not result in security of supply, is not adequately supported by the work that was done or presented.
- The outcomes of the "Renewable energy and nuclear" Pathway 3 is puzzling in that the pathway shows minimal new-build of flexible capacity, to complement the large new-build of (low flexibility) nuclear capacity, and a three-fold increase in (low flexibility) wind capacity in the last decade, when compared to the "Least cost" Reference Pathway 1.
- The "Renewable energy" Pathway 2 is also vastly different to the "Renewable energy and nuclear" Pathway 3 in capacity mix and expected energy shares (which are not shown) by 2040, which does not make sense.
- There is no mention of the actual energy storage value (MWh) for the BES of the various pathways. BES cannot be reported in MW alone, and the MWh storage capacity of the technology needs to be stated as well.

- For all pathways, no tables or graphs are provided showing the energy generated per technology. This should be a fundamental outcome of any energy system modelling study. The energy mix cannot be determined based on installed capacity alone, and the Draft IRP 2023 is thus inadequate in its reporting of the various pathways.
- None of the pathways give any figures of the cumulative installed capacity (including cumulative decommissioning), and there is thus no indication of the actual installed capacities and energy delivered per pathway in the Horizon 2 period from 2031 to 2050. This is also quite inadequate for an energy plan.
- In the "Delayed coal shutdown" Pathway 4, it is unclear what cost assumptions were assumed in extending the life of the coal stations, including retrofitting of flue gas desulphurisation and other pollution abatement plant. There seems to be an increase in total system cost relative to the "Reference" Pathway 1 (Figure 22), attributed to a three-fold increase in fixed operating costs. Overall, capex is reduced due to the delayed capacity new-build. and variable operating costs are reduced due to lower capacity factors of expensive-to-run gas plants.
- The "Renewable energy and clean coal" Pathway 5 is essentially the same as the "Least cost" Reference Pathway 1, but with a specific and constrained amount of clean coal apparently forced into the mix. It is very puzzling to see such an expensive technology being chosen as part of the energy mix, seemingly replacing BESS and gas. Comparing the "Renewable energy and nuclear" Pathway 3 and the "Renewable energy and clean coal" Pathway 5 also indicates puzzling results.

9. Comments on the carbon emission constraints and lack thereof post 2030 in Draft IRP 2023

Figure 21 in the Draft IRP 2023 (below) indicates the generation output (GWh) of carbon emitting generators in the Horizon 1 period from 2024 to 2030, and the Horizon 2 period from 2031 to 2050.

Alongside this in Figure 21, the corresponding carbon emissions (GtonneCO2e) is shown in the Horizon 1 period from 2024 to 2030, and the Horizon 2 period from 2031 to 2050, presumably using the domestic generation grid emission factor of 1.013 tonneCO2e/MWh published by the DFFE for the conversion.

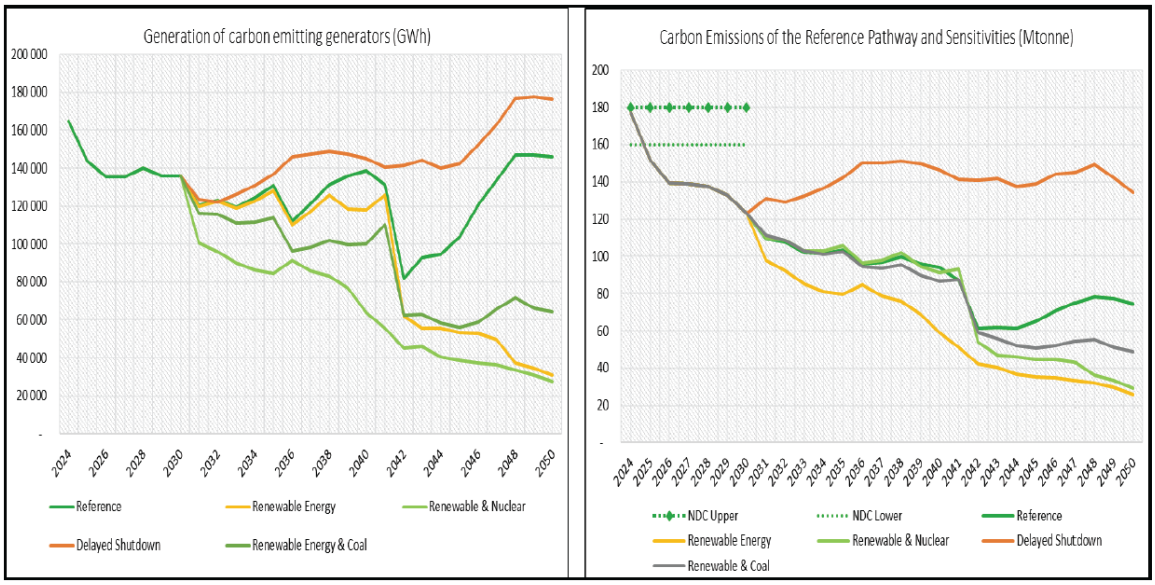


Figure 21: Carbon Emissions Analysis for both Horizons

OUTA makes the following comments in this regard:

- The emissions starting point at the end of 2023 is 180 MtonneCO2e, which is significantly below the emissions of 200 MtonneCO2e reported for the end of 2022 by Eskom in their annual reports. It is possible that this discrepancy is due to extreme levels of loadshedding in 2023, but the DMRE needs to provide its emissions reduction calculations in this regard..

- The reduction in CO2e emissions from 2024 to 2030 is disproportionate to the reduction in energy output. Figure 21 shows a reduction in roughly 23 000 GWh with corresponding reduction of 40 000 MtonneCO2e. This does not align with emissions factor of 1.013 tonneCO2e/MWh published by the DFFE, and requires further explanation by the DMRE.

- The range of CO2e emissions limits for the Horizon 1 period from 2024 to 2030 is indicated in Figure 21 as 160 to 180 MtonneCO2e. This is different to that calculated by OUTA of 140 to 190 MtonneCO2e (based on an 80% share of reductions). It is important to align on the contribution by the power sector towards meeting the NDC (Nationally Determined Contribution) targets for reduction of CO2e, and OUTA and the DMRE need to resolve this issue.

- The NDC target range will be extended and reduced over time to include targets beyond 2030 in 5-year periods (in alignment with the Paris Agreement, the COP28 Consensus and UNFCCC 2023). Therefore, the NDC commitment levels for 2031 to 2035 will be lower than those from 2024 to 2030. This needs to be considered, noting also the various Government policy commitments to pathways that reach nett-zero carbon emissions for South Africa by 2050.

- OUTA notes with concern that none of the pathways presented by the DMRE for Horizon 2 in the period from 2030 to 2050 in the draft IRP 2023 comply with various Government and PCC policy commitments to reach nett-zero carbon emissions for South Africa by 2050. OUTA is of the view

that this requirement should actually be a hard-wired socio-economic policy constraint within the modelling process.

10. Comments on noncompliance with the minimum emissions standards of South Africa

Air quality regulations under the National Environmental Management Act (NEMA) provide that Eskom's fleet of power stations must meet mandatory minimum emission standards (MES) by a certain date, or they will be considered noncompliant and cannot be legally operated.

Currently, not a single Eskom coal-fired power station in South Africa complies with the minimum emissions standards, despite repeated extensions of the compliance deadlines by the DFFE to accommodate Eskom.

South Africa's minimum emission standards for air quality are in fact amongst the most lenient in the world, far less demanding than those of China, India and virtually every other country. A recent study by the Centre for Research on Energy and Clean Air (CREA) found that SO2 emissions by Eskom's coal-fired power stations in South Africa exceed those of the entire power generation sectors of China and the USA combined.

In considering the health impacts of Eskom's coal-fired generation fleet, another recent report in 2023 by CREA suggests that, based on Eskom's current planned retirement schedule and emission control retrofits, air pollution from the utility's power plants would be responsible for 79 500 air pollution-related deaths from 2025 until their end of life.

The study estimates that requiring the application of the best available pollution abatement technology at all plants, instead of simply meeting the current minimum emissions standards, would avoid economic costs of R1-trillion (US$ 68-billion) by 2030 compared to the Eskom plan.

Other avoided health impacts would include 140 000 asthma emergency room visits, 5 900 new cases of asthma in children, 57 000 preterm births, 35-million days of work absence, and 50 000 years lived with disability.

While the Draft IRP 2023 acknowledges the role of air pollution on human health, it avoids dealing with it, simply stating: "A balance will have to be found between energy security, the adverse health impacts of poor air quality, and the economic cost associated with these plants shutting down."

OUTA is deeply concerned about noncompliance of Eskom's coal-fired power stations with South Africa's environmental legislation, regulations and minimum emission standards. The negative health impacts of air pollution in the power generation sector of South Africa cannot be ignored or deferred indefinitely.

The argument that you need to choose between energy availability and air quality is not valid or appropriate. A pathway that continues with coal must take account of constitutional and legal requirements, and factor in the costs of meeting emissions standards in the modelling of the Draft IRP 2023, otherwise the Final IRP 2023 risks being overturned by the courts.

11. Comments on alignment of Draft IRP 2023 with other government policy initiatives

It is beyond the scope of this response from OUTA to discuss details of the alignment or misalignment of the Draft IRP 2023 with a number of other approved and/or published legislation, regulations, policy positions, initiatives, white papers and reports by Government, the Cabinet and various Government agencies, including:

- The work of the Presidential Climate Commission (PCC)
- South Africa's Just Energy Transition Plan (JETP)
- South Africa's Just Energy Transition Investment Plan (JETIP)
- South Africa's JET IP Implementation Plan
- The work of the National Planning Commission (NPC)
- The National Infrastructure Plan (NIP 2050)
- South African Renewable Energy Masterplan (SAREM)
- The work of the National Energy Crisis Committee (NECOM)
- The 2023 Eskom Medium Term System Adequacy Outlook (MTSAO)
- The Eskom Transmission Development Plan TDP 2023

However, it does need to be stated that there is indeed significant misalignment with some of the above that requires careful further analysis, clarification and alignment

END