

Oil and Gas Exploration in the Context of Global Transition: The South African Case

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Abstract

The Operation Phakisa: Oceans Economy Oil and Gas Lab advocates the exploration of marine oil and gas reserves as a means of using marine resources to fast-track the South African economy. While the lab recognises that the direct employment impacts would not be substantial, the indirect economic impacts of oil and gas exploration were desirable, especially at a time when the South African energy grid was becoming increasingly reliant on imported crude oil and gas for power. The dependence of the South African energy grid upon coal has been an area of concern, especially in an era when the transition from fossil fuels to renewable energy is required by the Paris Agreement on Climate Change for the control of escalating global warming. This paper discusses the feasibility of South Africa's oil and gas exploration goals in a time when the country is being called upon to reduce the greenhouse gas (GHG) emission intensity of her energy sector. Central to the discussion is the concept of sustainable development which is entrenched by the South African Constitution, legislation, and case law. In the light of South Africa's GHG reduction emissions, the increasing importance of the adoption of the precautionary principle, the availability of cheap renewable energy substitutes and the growing wave energy sector, oil and gas exploration is no longer a feasible choice, especially as emerging markets and advanced developing economies increasingly shoulder the burden and responsibility of carrying the costs of the energy transition.

Keywords

Oil and Gas, Sustainable Development, Marine Energy, Greenhouse Gas Emissions

1. Introduction

The oceans have long been a valuable food source for the global community. With

the advent of modern commercial shipping, they have been a critical part of international trade supply and value chains. Despite their significance, it has only been in the last few decades that African nations have developed strategic plans for the exploitation of the ocean's resources for economic development¹ (United Nations, 1982: p. 43). South Africa's initial maritime strategy, Operation Phakisa: Oceans Economy Lab² (Department of Planning, Monitoring and Evaluation, 2014a) sought to fast track the development of the South African economy through the development of strategic maritime industries. The oil and gas lab were introduced for the exploration of potential marine oil and gas reserves. The vision for the lab was to create an environment which promoted exploration, with 30 wells drilled by 2024 in the hope that the potential 9 billion barrels of oil could be found and the value-added potential of these oil and gas finds unlocked (Department of Planning, Monitoring and Evaluation, 2014b: p. 1 and p. 18). Exploration would cost between US\$150 and \$200 million per well at a 15 to 20 percent success rate. If the exploration produced the expected yields, government anticipated that a period of between five and ten years would be required for permitting and licensing. Production would therefore begin in 2030 or 2035. As a mass importer of oil and gas, mineral products were South Africa's biggest import in 2023, accounting for 21 percent of South Africa's imports or US\$ 22.5 billion (Workman, 2024). The discovery of oil and gas reserves is seen as a means of ensuring energy security for the country, and removing its reliance on foreign energy, thus improving South Africa's energy profile (Hersov, 2023).

The adoption of the Operation Phakisa oil and gas lab coincided with South Africa's adoption of the Paris Agreement on Climate Change of 2015³ (Gov.Za, 2016). The Agreement was a response to the growing concern about the impacts of anthropomorphic greenhouse gas (GHG) emissions on the surface atmospheric temperature and the corresponding escalating negative climate change impacts (UNFCCC, 2015). The Conference of Parties (COP) based its conclusions and the resultant climate change reduction targets on the scientific findings of the AR 5 and AR4 Assessment Reports of the Intergovernmental Panel on Climate Change (IPCC, 2024) with parties undertaking to respond to the latest scientific findings on Climate Change (UNFCCC, 2015: pp. 4-7). Based on findings from the AR5 Synthesis Report, parties realised that the escalating climate change impacts needed to be curtailed and only by ensuring that the surface atmospheric temperature was kept well below 2°C, with efforts being made to limit temperature increase to 1.5°C

¹As per Article 56 of the United Nations Convention on the Law of the Sea of 1982, which came into force on the 16 November 1994, coastal states have a right to explore, exploit, conserve and manage the natural resources, living and non-living, within its exclusive economic zone and, by inference, its territorial sea. These rights include the seabed and its subsoil as well as the waters above the seabed. Activities allowed include activities for the economic exploitation and exploration of the zone, such as the production of hydro, current and wind energy. With the rights allocated to states so defined, parties to the Convention were free to implement national maritime strategies.

²Africa is situated amidst the Indian and the Atlantic oceans.

³Minister Molewa signed the Paris Agreement on Climate Change for South Africa on the 22 April 2016. And accepted by the National Assembly on the 1 November 2016.

above pre-industrial levels, would the worst outcomes be prevented.⁴ With the different development and capacity levels of the individual states, contracting parties would abide by the principles of equity and common but differentiated responsibilities and respective capabilities.⁵

Despite the lead role played by the developed countries in reducing global GHG emissions,⁶ developing countries were expected to increase their mitigating efforts, moving towards economy-wide emissions reductions, while pursuing sustainable development goals.⁷ Countries were also expected to prepare nationally determined contributions (NDCs) which become progressively more stringent, portraying the highest ambition of the individual countries, according to their individual capacities.⁸ They would be held responsible for the implementation of these NDCs.⁹ Parties were urged to apply the precautionary principle, with measures being taken to minimise, mitigate and prevent climate change impacts. Where there was a risk of serious, irreversible damage, the lack of full scientific certainty should not be seen as a reason for postponing adopting and implementing precautionary measures (UNFCCC, 1992: p. 4). While the Paris Agreement did not add more to the concept, the energy and development requirements of developing countries were raised in the United Nations Framework Convention on Climate Change¹⁰ (UNFCCC) which stipulated that Parties had a right to and should promote sustainable development. The interdependence of economic development and climate change mitigation measures was raised, with Parties being called to incorporate country specific climate mitigation policies into domestic legislation, being mindful of economic development goals. It is notable that the Convention did not adopt an either or approach.

While Parties to the COP 16 were aware of the escalating climate change impacts, the results of the IPCC 6th Assessment Report of 2023 showed that the current mitigation trajectory would be insufficient for the meeting of mitigation goals, with many tipping points already being reached (IPCC, 2023; Leahy, 2019). Global atmospheric temperature has also increased much faster than expected, with the temperature increases for 1850-1900 to 2013-2022 being 1.15 {1.00 to 1.25} °C for global surface temperatures, 1.65 {1.36 to 1.90} °C for land temperatures and 0.93 {0.73 to 1.04} °C for ocean temperatures (IPCC, 2023: p. 42). Only deep, rapid, and sustained GHG reductions in the near term can prevent overshooting and ensure that the rapidly closing gap for adaptation and mitigation measures is maximised (IPCC, 2023: pp. 12-13). This paper discusses the feasibility of further oil and gas exploration within the rapidly changing climate change context. As the Operation Phakisa: Oceans economy strategy sought to maximise

⁴Article 2(a), The Paris Agreement on Climate Change, at p. 3.

⁵Article 2(2), The Paris Agreement on Climate Change, at p. 3.

⁶Article 4(4), The Paris Agreement on Climate Change, at p. 4.

⁷Article 6(4)(a), The Paris Agreement on Climate Change, at 7.

⁸Articles 4(2) and 4(3), The Paris Agreement on Climate Change, at p. 4.

⁹Article 4(13), The Paris Agreement on Climate Change, at p. 4.

¹⁰Preamble and Article 3(4), United Nations Framework Convention on Climate Change.

gains from the ocean economy, cleaner ocean energy solutions are investigated.

2. Problem Statement

Parties to the United Nations Framework Convention on Climate Change acknowledged that the energy needs of developing countries will need to grow as they strive to meet their economic goals,¹¹ with peaking of GHG emission levels by developing countries occurring later.¹² It would be inferred from the above that developing economies would have greater leeway to utilise fossil fuels in their economic strategies, as developed countries have undertaken to assist them financially with their adaptation and mitigation goals.¹³ With the escalating climate change impacts, the ARP 6 Synthesis suggested that, if global surface temperatures are to be kept at below 1.5°C, the remaining carbon budget, from 2020 is 500 GtCO₂ with a 50% likelihood of success, and to keep global surface atmospheric temperatures at below 2°C, a carbon budget of 1150 GtCO₂, with a 67% possible success rate (IPCC, 2023; p. 19). For every 1000 GtCO₂ emitted, it has been estimated that global surface atmospheric temperature will increase by 0.45°C (with a likely range of 0.27 to 0.63°C). Existing fossil fuel infrastructure, without additional reductions, is projected to exceed the remaining carbon budget for the 1.5°C limit. Mitigation actions required to keep global atmospheric temperatures below 2°C will result in stranded assets, with 80% of coal, 50% of gas, and 30% of oil reserves not being utilised. A greater portion of current fossil fuel reserves cannot be burnt if warming is to be limited to 1.5°C (IPCC, 2023; p. 57). The current global spare oil production capacity is already 6 million barrels a day (excluding Iran and Russia), with an expected shift towards a buyers' market for liquified natural gas (LNG) in the next few years and a high risk of over-investment as countries begin to meet their climate change reduction pledges (IEA, 2024b; p. 22). With the escalating climate change impacts and the call for the phasing out of fossil fuel usage,¹⁴ together with the existing carbon budget, it is questionable whether there is room for new fossil fuel exploration. With the 1.5°C ceiling required to prevent the reaching of more tipping points, a carbon budget of 500 GtCO₂ has been set¹⁵ (Liu et al., 2022).

For purposes of distributive justice, it has been understood that there needs to

¹¹Preamble, at p. 3.

¹²Article 4(1), Paris Agreement, at p. 4.

¹³Article 9(1), Paris Agreement, at p. 13. For most developing countries, transition cannot occur without outside assistance, leaving them with no other option but to continue with fossil fuel usage until they receive the financial and technological assistance required for them to transition. Many of these assumptions are based on a static understanding of change and do not take into consideration the escalating cost of fossil fuel and its impacts on developing economies.

¹⁴Provision 71, UNFCCC (2023).

¹⁵This figure is variable as it is based on probability, given that the impact of current emissions and the multiplier impact are uncertain. A few agencies estimate that the available carbon budget is closer to 400 Gt CO₂. Estimates, based on 2021 figures and the current emissions trajectory show that there is 67% likelihood that the remaining carbon budget will be consumed by 2031 and an 83% likelihood that it will be consumed by 2028.

be an equitable sharing of the remaining carbon budget with developing countries, who have contributed the least to climate change but are limited to the remaining carbon budget for their developmental requirements.¹⁶ While the various climate change related documents refer to the obligations of developed countries, not much has been said about the responsibilities of major developing country emitters. If there is to be an equitable distribution of the remaining budget, while nations adopt renewable energy and convert their energy systems to net zero emission systems, are all developing countries on an equal footing? Another question that arises is linked to the status of coal dependant economies like South Africa. South Africa is the most polluting country in Africa, (Statista, 2024) and accounts for 1.2% of global cumulative emissions. The total cumulative emissions for Africa for the same period was 3%. Based on 2021 figures, the burning of coal contributed towards 83 % of South Africa's emissions, oil accounted for 16.2% and natural gas 4.4 Mt CO₂ with electricity and heat producers accounting for 55% of the country's emissions. Unlike most heavy emitting countries, South Africa's emissions are not attributed to industry (at 12.5%), or economic development, as this sector tied with the transport sector, which was responsible for 12.3% of emissions¹⁷ (IEA, 2024a), (Salem & Thieman, 2022: pp. 142-185), (Bello & Nwaeke, 2023: pp. 189-200). The above facts exclude further oil and gas exploration. Within the South African case, an additional question is raised regarding the justification of replacing coal with fossil fuels like oil and gas.

3. Objectives of the Paper

- a) To determine the legal principles and the arguments pertaining to sustainable development applicable to the South African position and the responsibility of states within the context of the closing mitigation gap.
- b) To determine the South African government and industry position on the energy transition.
- c) To determine whether there are alternative maritime energy-related solutions.

4. Methodology

This paper is based on a mixed methodology, with primary and secondary data being used. Primary data was obtained from the attendance of an oil and gas Roundtable, in which representatives from the private sector, the oil and gas lobby, the banking sector, the Department on Minerals and Energy and the Presidents Commission

¹⁶Provision 39, at p. 6.

¹⁷The impacts of oil production on the environment, society and pollution have not been discussed because of the lack of understanding of the intricacies of the oil production process and the possible negative societal or criminal impacts. These include the toxins, by-products and heavy metals and oil residues that may be released into the oceans through produced water from oil production. The Nigerian experience has also shown how communities could be affected by the theft of oil from pipes carrying crude, leading to clean up costs. Spillage could also result in the burning of crude oil, leading to further GHG emissions.

on Renewable Energy presented on the role of oil and gas in the energy transition. Information was also sourced from the private sector industry body, Business Unity South Africa (BUSA) Climate Change lobby representative. Legislation and policy documents were sourced from the relevant government and global governing body online sites. Secondary data was sourced from reputable international sites for the latest quantitative country specific GHG emission statistics. These include the International Energy Agency, United Nations, UN Environment Programme (UNEP), and the IPCC, amongst others.¹⁸ Quantitative statistics were used to provide clarity on the current GHG emission status, which is foundational to the qualitative arguments presented in the document. Central to the discussion is the understanding of sustainable development and the development of sustainable development rhetoric. Thematic and content analysis methods are used to identify patterns and themes from the data, with qualitative data being analysed to identify the correlation between economies of scale and pricing of renewable energy as well as the responsiveness of prices of fossil fuels and renewable energy to increasing use. While the IPCC uses the most up-to-date climate science, there is still much which is not known. Regulation and policy cannot be static but need to respond to the latest climate science findings. On the other hand, without clear, fixed guiding principles, management of climate change would be unfeasible. These principles are themselves evolving, and the evolving nature of these principles is acknowledged, with the paper using an exploratory tone, based on multi-disciplinary inputs.

5. Literature Review

5.1. An International Policy Dimension

The first objective of this paper was to determine the legal principles and the arguments pertaining to sustainable development applicable to the South African position and the responsibility of states within the context of the closing mitigation gap. Our Common Future, the Report of the World Commission on Environment and Development (United Nations, 1987: p. 29) highlighted the fact that environmental degradation was caused by both poverty and industrial development but manifested differently. While economic development creates environmental stress through the increased demand for scarce resources and pollution generated by the increasing living standards of prospering nations, poverty also creates pollution. This degradation is created by impoverished people who destroy their surroundings to survive. Activities such as overgrazing, deforestation, overuse of marginal land and over congestion of cities were cited. The cumulative impacts of these activities were deemed sufficient to classify poverty as a major scourge. When dealing with sustainable development, the activities of populations

¹⁸While it is understood that there are many theories relating to the way in which GHG emissions and country specific data is collected, there is sufficient correlation between the data obtained from the different sites for the information to be used without concern. Data obtained from the International Energy Agency, Carbon Brief and Statista is consistent.

in developed and developing countries are therefore to be regulated, if future populations are to be protected from the harmful actions of the present generation (United Nations, 1987: pp. 16-18)¹⁹. Sustainable development therefore requires that humanity regulates its activities to meet present needs without compromising the ability of future generations to meet theirs. The process of achieving sustainable development requires that technological development, resource exploitation, investment decisions and institutional change are consistent with present and future needs.²⁰ The anticipation and prevention of environmental damage requires that the ecological dimensions be considered together with economic, trade, energy, agricultural and other dimensions.²¹

The principle of intergenerational equity requires that the present generation does not prosper at the expense of future generations and that the wellbeing of future generations does not diminish over time, due to the actions of the present generations. (Stoddart, 2011: pp. 34-35) The main component of this principle relates to the use of the earth's resources (natural/environmental resources, human resources and human-made resources like manufactured capital, machinery, infrastructure, buildings and goods). Sustainability requires that each generation has the same capital stock available to it, with each generation living off interest, not the capital. For development to be deemed sustainable, a country should, at the least, maintain a constant stock of aggregate capital over time. The choices made regarding the maintenance of capital stock depend on whether a country is on the path of weak or strong sustainability. With weak sustainability, a country substitutes its natural capital with human or human-made capital, depleting half of its natural capital for the creation of human-made capital. With strong sustainability natural capital is not substituted for any other form of capital. Renewable resources and natural sinks must be used sustainably, with the rate of harvesting or the discharge of emissions not exceeding their rate of regeneration or assimilative capacity. With non-renewable resources, sustainability requires the maintenance of utility over time, either by expanding reserves through recycling, exploration and efficiency gains or investing surpluses in alternative resources that can be used by future generations. Another element of intergenerational equity requires that development be kept within the earth's carrying capacity. This implies that development must not exceed the limits sets by the earth's renewal and recycling processes which ensure that the biosphere can provide renewable resources, other environmental goods and services and assimilate waste (UNEP, 1999: p.27). This also includes the earth's population growth and demand for resources (UNEP, 1999: p. 43). It implies the conservation of natural life-support systems, conserving the earth's biodiversity and using all renewable resources sustainably (UNEP, 1999: p. 47). This also implies that governments should apply the precautionary principle when dealing with pollution. Upper income countries should intensify

¹⁹Provision 27, at p. 16. This document is also known as the Brundtland Report.

²⁰Provision 30, at p. 17.

²¹Provision 38, at p. 18. This provision relates to the concept of intergenerational equity.

their efforts to clean-up existing emissions and lower income countries protect themselves from adopting polluting new industrial development which creates intolerable future outcomes (UNEP, 1999: p. 29). All countries should minimise, and where possible, prevent discharging harmful substances and ensure that products and processes are non-polluting.

While the principle of intergenerational equity works in theory, in practice, the question about how to determine the minimum level of capital stock remains.²² To answer this question, use of the precautionary principle has been proposed, with decision-makers being urged to err on the side of caution, even when all the scientific facts are not available, to ensure that sustainability limits are not breached (Stoddard, 2011: p. 35).²³ The crux of the precautionary principle (United Nations, 1992: p. 3).²⁴ is that where there is a threat of serious or irreversible environmental damage, the lack of full scientific certainty should not prevent the implementation of cost-effective measures required to prevent environmental degradation. The onus should be on the disputing parties to prove that the threat does not exist. (Bazurco-Pinto, 2020: p. 3). If they cannot disprove the threat, then national governments and the international community are obliged to accept that the threat does indeed exist (Stoddard, 2011: p. 25). Despite the lack of universal certainty regarding the elements of the precautionary principle, a 2002 study (Stewart, 2002: p. 76) on the nature of the precautionary principle ascribed four essential components to it. These are:

a) Non-preclusion precautionary principle: Lack of scientific certainty should not prevent the regulation of activities that pose significant harm.

b) Margin of safety precautionary principle: Regulatory controls should include a margin of safety which limits activities to a level at which no adverse effects have been or can be observed.

c) Best available technology precautionary principle: Where there is uncertainty about the environmental risks posed by an activity the best available technology should be used when conducting the activity, unless it can be shown that the activity does not pose any appreciable risk of harm.

d) Prohibition precautionary principle: where the risk of harm from activities is uncertain, these activities should be prohibited unless it can be shown that the activity holds no risk of appreciable harm. The onus of proof rest with the party

²²In the context of climate change, given the level of damage already being done globally and the tipping points that are already being reached, together with species loss, it is doubtful that there are any countries that can practice strong sustainability, although developing countries may still could protect their natural resources from overexploitation.

²³Due to incomplete information and the escalating climate change crisis, with surface atmospheric temperature rise being negatively impacted by factors such as permafrost and unprecedented ice melt within the north and south pole, which have resulted in increased levels of GHG emission discharge, rising sea levels and decreasing surface cooling, natural resources that are available would need to extend to external factors such as common resources such as the earths ability to cool itself and the levels of ice and permafrost available. While these factors were previously overlooked, their importance is fast becoming evident. The speed at which we can manage the current crisis will impact on the number of resources left for future generations.

²⁴Principle 15 of the Rio Declaration of 1992.

seeking to promote the activity.

While the role and significance of the precautionary principle as a *bona fides* principle of international law has been questioned, its use in climate change policy and emerging case law has solidified its significance. In the *Urgenda Case*²⁵, the Supreme Court dealt with the decision of the lower court regarding the Dutch government's reduction of its NDC target. The urgency of the climate change crisis was discussed together with the decreasing mitigation gap and the GHG threshold.²⁶ The courts raised the issue of the duty of care of the Dutch nation, given the severity of the climate change crisis and the danger of it escalating to dangerous climate change if mitigating measures are not taken. This duty is not decreased by the fact that the Dutch contribution to GHG emissions is minor.²⁷ In addition, if a government knows that there is a real and imminent threat, it must take precautionary measures to prevent infringement as far as possible. Indeed, "the mere existence of a sufficient genuine possibility that a risk will materialise means that suitable measures must be taken."²⁸ In the context of climate change, with the escalating risk of dangerous climate change, the precautionary principle requires that "more far-reaching measures should be taken to reduce GHG emissions rather than less far-reaching measures."²⁹ Referring to the Preamble to the UNFCCC, the court raised the applicability of the no harm principle, stating that countries must not harm other states and could be held responsible for the duty arising from this principle. In the context of GHG emissions, states can be held responsible for their GHG emissions. Justifying the partial responsibility approach each country is responsible for its part and can be called to account in this respect.³⁰ In view of the grave consequences of dangerous climate change, a defence that a state should not have to take responsibility because other countries are non-compliant cannot be accepted. The assertion that a country's share of global GHG emissions is small and that reducing emissions from its territory would make slight difference on a global scale, is also not an acceptable defence as these defences enable a country to evade its partial responsibility by pointing out other countries or its own small share. Where these defences are ruled out, each country can be effectively called to account for its share of emissions, thus maximising the chances of countries contributing.³¹

When determining the responsibility of states for global environmental degradation, Principle 7 of the Rio Declaration ([United Nations, 1992](#): p. 2) provided that, as nations are not equally responsible for global environmental degradation, they have common but differentiated responsibilities. Developed countries acknowledged the responsibility which they have in this regard, given the pressure

²⁵The State of the Netherlands vs Stichting Urgenda; 20 December 2019, No 19/00135, ECLI:NL:HR:2019:2007

²⁶Urgenda Case, at pp. 9 to 13.

²⁷Urgenda Case, at p. 15.

²⁸Urgenda Case, at p. 26.

²⁹Urgenda Case, at p. 35.

³⁰Urgenda Case, at p. 28.

³¹Urgenda Case, at p. 29.

which their populations have placed on the global environment and the finances and technology resources they possess. States are required to contribute towards the identification, evaluation, and subsequent action on issues of sustainable development that transcend national borders and cannot be resolved unilaterally (Stoddart, 2011: p. 29). Each nation's role is differentiated based on its economic and technical capacity as well as its historic contribution towards environmental degradation. The principle was adopted by the **United Nations Framework Convention on Climate Change (1992: p. 5)**³² in which climate change was deemed a common concern of mankind.³³ The main responsibility for historical and current GHG emissions was attributable to developed economies who were called to take the lead in combating climate change and the adverse effects thereof.³⁴ Weight is now being placed on current GHG emissions, with more responsibility being placed on economies in transition (Stoddart, 2011: p. 29). While other emerging market and developing economies (EMDE) outside of China account for only 15% of global clean energy investment (IEA, 2024b: pp. 8 and 16)³⁵, China is the biggest investor in clean energy, with a 33% share in global clean energy, ahead of Europe (20%) and the USA (16%) (IEA, 2024b: p. 196).³⁶ In contrast, Africa only had a 2% share of global clean energy, with its 2023 share of global investment in fossil fuels (1.8%) being more than its global clean energy investment share (0.5%) (IEA, 2024b: p. 190). Unlike other developing countries, China has not sought aid to pursue its green transition but has taken the lead in the renewable energy market. In addition, China has committed to peak carbon emissions by 2030 and carbon neutrality by 2060 (IEA, 2024b: p. 197). Despite the limited investment by EMDEs in green energy, their combined investment is almost the same of that of the USA (IEA, 2024b: pp. 199-208).³⁷ Together with China, the EMDEs have a combined 48 % share of global green energy investment, which is substantial. In contrast, Europe, and the USA (advanced economies) are at a disadvantage, with only 36 % of the global clean energy investment share. These figures also indicate the commitment of EMDEs to the clean energy transition, with these economies taking responsibility for change and the energy needs of their growing economies. While literature acknowledges the increasing responsibility of EMDEs, the responsibility of other developing country polluters and their role in the fast-closing mitigating gap remains uncertain. Whereas the UNFCCC acknowledged that they would still require fossil fuels to promote economic development within their countries, this

³²Article 4(1).

³³UNFCCC, at p. 2.

³⁴Article 3(1), UNFCCC, at p. 4.

³⁵Within the EMDE, 50 % of all clean energy investments come from government and state-owned enterprises (SOEs).

³⁶Based on 2023 figures.

³⁷India, Japan, and Korea (combined 10 % share of global clean energy investment) are amongst the EMDEs who have taken their GHG emissions reduction targets seriously, with India committing to achieve carbon neutrality by 2070 and Japan and Korea committing to reach carbon neutrality by 2050. These economies have all adopted ambitious decarbonisation goals and measures to accelerate corporate investment in clean energy.

decision was taken prior to the current scientific findings regarding the vastly diminished carbon budget and the escalation of climate change impacts as well as the breakthroughs made with renewable energy and the diminishing cost of renewable fuel.³⁸

The Brundtland report ([United Nations, 1987](#)) highlighted the interdependence of ecology and economics, pointing out that they are interdependent and cannot be dealt with in silos as they are linked in a “complex system of cause and effect.”³⁹ Environmental stressors and patterns of economic development are also connected. Energy policies have been responsible for GHG emissions, acidification, and deforestation in developing countries, creating environmental stressors that threaten economic development. To protect humanity and the environment and promote development, economics and ecology must be fully integrated in law-making and decision-making processes.⁴⁰ Economic development which increases vulnerability to future risks is unsustainable. Sustainable economic development must combine growth with reduced vulnerability to future risks.⁴¹ While this report was compiled prior to the collective understanding of the dangers of GHG emissions and the escalating climate change crisis, the principles⁴² provided have become the foundation of modern sustainable development rhetoric.

The Declaration of the United Nations Conference on the Human Environment ([UNEP, 1972](#): pp. 1-4)⁴³ provided the building blocks for the Brundtland Commission. At that juncture, the main emphasis was the curbing of pollution and the responsibility of States in this regard. Of relevance to this discussion was the call to halt the discharge of toxic substances or other substances or the discharge of heat, in such concentrations beyond the capacity of the environment to render them harmless, to prevent serious or irreversible damage to the environment.⁴⁴ It is the responsibility of all States to ensure that their environmental policies⁴⁵ enhance and do not adversely affect the developmental potential of developing countries. While States have the right to exploit resources within their jurisdiction according to their own environmental policies,⁴⁶ according to the United Nations Charter and principles of international law, there is a corresponding obligation to ensure

³⁸Efficiency and cost wise, renewable energy, especially solar PV energy is much cheaper than fossil fuel-based energy, without the GHG implications. This will be discussed later within the document.

³⁹Chapter 1(40), at p. 36.

⁴⁰Chapter 1(42), at p. 36.

⁴¹Chapter2(38), at p. 49.

⁴²The polluter pays principle and access to information, participation and justice are administrated at a domestic level and so will not be discussed in this paper. One element of the polluter pays principle which does stand out is how this principle can be administered at a global level in the case of responsibility for climate change impacts. Unfortunately, allocating damages is not clear cut as it would be difficult to determine which countries emissions are responsible for the greatest damage. The common and differentiated approach, which places responsibility on the developed economies to take the lead in combating climate change impacts and assisting developing economies, can be seen as a measure that addresses the issue of responsibility and recompense.

⁴³Also known as the Stockholm Declaration, [UNEP, \(1972\)](#).

⁴⁴Principle 6, Stockholm Declaration, at p. 2.

⁴⁵Principle 11, at p. 3.

⁴⁶Principle 2, at p. 1.

that these activities do not cause damage to the environment of other States or in areas beyond their national jurisdiction.⁴⁷

Both the Stockholm Declaration⁴⁸ and the Brundtland Report referred to the use of non-renewable resources in a manner which guards against their future exhaustion, to ensure that these resources were still available for future generations. In the context of fossil fuels for energy use, the Brundtland Report foresaw that, with global warming, the energy needs of developing countries would not be provided by non-renewable fossil fuel sources, which were deemed to be unsustainable.⁴⁹ Development would require a safe and sustainable energy pathway based on renewable energy sources.⁵⁰ Until sustainable renewable energy pathways are available to developing countries, who would require assistance with the transition, energy efficiency policies must be at the forefront of national energy strategies for sustainable development.⁵¹ Any country committed to sustainable development, according to the Report, should commit to transition from non-renewable unsustainable fossil fuel usage to renewable energy sources as soon as they could.

Despite the sustainability arguments, the inclusion of the environmental dimension into trade decisions was often deemed to increase costs and reduce competitiveness. This perceived increased cost element has resulted in a resistance to sustainable development, as the added environmental element has often been perceived with suspicion. This argument was disproved by Porter and Van der Linde (1995) who found that the push back against environmental regulation was due to a static view of environmental regulation. Intelligently designed environmental regulations can trigger innovations which lower costs and foster innovation. They also encourage business to find innovative, creative solutions which have been shown to revolutionize business processes and strategies. Badly drafted regulations do the opposite. They identified that pollution is an inefficiency, pointing to hidden costs, specifically wasted resources and efforts, buried along the product life cycle. Government regulation which promotes the elimination of pollution and resource waste fosters innovation as it forces companies to approach systemic inefficiencies creatively. They identified two innovative approaches to pollution. The first is new technologies and cost reduction approaches to minimise pollution that has occurred. The more significant innovation approach addresses the root causes of pollution by improving resource productivity. Innovations of this nature

⁴⁷Principle 21, at pl 4.

⁴⁸Principle 5, at pl 2.

⁴⁹At this point. There was a fear of the exhaustion of non-renewable resources, without any replacement. Drafters had not foreseen the possibility of GHG emissions making the use of fossil fuel sources of energy being unsustainable, without the exhaustion of these resources. Indeed, in the current reality, fossil fuels reserves are still abundant, with new fossil fuel deposits being found in the marine environment, although, as these are finite resources, there is uncertainty regarding how long they will last. This has added to the reluctance to change, with investors and energy companies seeking methods in which they can recoup their investments.

⁵⁰Provisions 58 to 60, at p. 20.

⁵¹Provisions 61 to 64, at p. 21.

have been found to improve process consistency, reduce downtime, and decrease costs. While companies could motivate for these changes, innovation positive environmental regulation was found to be the catalyst to these changes.

Within the context of climate change, the UNFCCC, Paris Agreement, and the subsequent COP undertakings have consistently pushed for renewable energy alternatives to fossil fuel. While renewable energy is the chosen pathway of the future, for developing economies, the cost of renewable energy transition is a critical factor. Fortunately, in the last decade, the price of renewable energy has decreased substantially, and is set to continue, with the cost of solar PV continuing to decrease at around 10% per year (Farmer & Lafond, 2016: pp. 658-659). The differences in the improvement of rates of competing technologies can be dramatic, with the under-dog which was initially the last to progress quickly becoming the forerunner. Green technologies were found to have such an improvement rate and were likely to overtake fossil fuels in 20 years, (2035). These technologies were found to follow Wrights Law, entering a virtuous cycle where increased production resulted in fast decreasing costs. There was also the additional benefit of learning curves and the relationship between experience and falling costs (Roser, 2020). The learning rate for solar PV modules is 20.2%. With each doubling of the installed cumulative capacity, the solar module prices decrease by 20.2%. This provides an added incentive to invest in solar technologies.

In a comparison of the prices of different energy types, from 2010 to 2019, there was a marked decrease in the prices of renewable energy, although nuclear energy prices did increase. **Table 1** provides a clear picture of how energy prices have shifted in the ten years from 2010 to 2019. Lines 1 to 4 in the Table refer to the different types of renewable energy while line 5 refers to fossil fuel pricing. In comparison to the clear price changes of the renewable energy and the correlation between lower prices and learning curve percentages, the price of coal remained relatively stable, with no visible learning curve impacts. Nuclear energy alone increased over the period, although there is now a transition towards micro nuclear power plants.

Table 1. Energy prices from 2010 to 2019. (Roser, 2020) (price per megawatt hour of electricity).

No	Energy Type and learning Curve percentage	2010 Price per MWh	2019 Price per MWh
1	Solar PV (36%)	\$378	\$68
2	Offshore wind (10%)	\$162	\$115
3	Nuclear Energy (0)	\$96	\$155
4	Onshore wind (23%)	\$86	\$53
5	Coal (0)	\$111	\$109

5.2. The South African Policy Dimension

In addition to the international component, the concept of sustainable development

is entrenched in South African legislation. With the guidance of international law, which is also used as a reference point, (Department of Justice, 1996: p. 120)⁵² the South African Constitution entrenched the protection of the environment in the Bill of rights⁵³. Together with the right to a healthy environment⁵⁴, it incorporates the concept of intergenerational equity⁵⁵, providing for the prevention of pollution and ecological degradation⁵⁶, promotion of conservation⁵⁷ and sustainable development.⁵⁸

In the case of *BP Southern Africa (Pty) Ltd v MEC for Agriculture, Conservation, Environment and Land Affairs 2004(5) SA124 WLD*, the Court provided that:

“The concept of ‘sustainable development’ is the fundamental building block around which environmental legal norms have been fashioned, both in South Africa, and globally, and is reflected in s 24(b)(iii) of the Constitution. ...Pure economic principles will no longer determine, in an unbridled fashion, whether a development is acceptable. Development, which may be regarded as economically and financially sound, will, in future, be balanced by its environmental impact, taking coherent cognisance of the principle of intergenerational equity and sustainable use of resources to arrive at an integrated management of the environment, sustainable development and socioeconomic concerns. By elevating the environment to a fundamental justiciable human right, South Africa has irreversibly embarked on a road, which will lead to the goal of attaining a protected environment by an integrated approach, which takes into consideration, inter alia, socioeconomic concerns and principles. (Glazewski, 2005)⁵⁹

This definition was further clarified in the Case of *Fuel Retailers Association of Southern Africa v Director-General: Environmental Management, Department of Agriculture, Conservation and Environment, Mpumalanga Province, and Others 2007 (6) SA 4 (CC)*.⁶⁰ Ngcobo J, on behalf of the Constitutional Court majority explained that sustainable development requires an appreciation that economic development cannot occur without environmental protection. In this regard he provided that;

⁵²The South African constitution provides for the acknowledgement of international legislation by all Courts, which are called to prefer a reasonable interpretation in line with international law as opposed to alternative treatments that are inconsistent with international law. Section 232, Constitution of the Republic of South Africa.

⁵³Chapter 2(24); at p. 9.

⁵⁴Chapter 2(24) (a) provides the right to an environment that is not harmful to health or wellbeing.

⁵⁵Chapter 2(24)(b) Intergenerational environmental protection should be pursued through reasonable legislation and other measures.

⁵⁶Chapter 2(24) (b) (i).

⁵⁷Chapter 2(24) (b) (ii).

⁵⁸Chapter 2 (24)(b) (iii). In this context, sustainable development and the promotion of justifiable economic and social development were separated, with the provision providing for the right to “secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development. This could be because the concept of sustainable development was still developing.

⁵⁹At p144 B-D.

⁶⁰At para 44.

“Development cannot subsist upon a deteriorating environmental base. Unlimited development is detrimental to the environment and the destruction of the environment is detrimental to development. Promotion of development requires the protection of the environment. Yet the environment cannot be protected if development does not pay attention to the costs of environmental destruction. The environment and development are thus inexorably linked.”

In the case of *Sustaining the Wild Coast NPC and Others v Minister of Mineral Resources and Energy and Others, Western Cape Division, Case No 3491/2021* the Court took into account Section 24(a)(vii) of the National Environmental Management Act, which provides that sustainable development requires the consideration of all relevant factors, including *“that a risk-averse and cautious approach is applied, which takes into account the limits of current knowledge about the consequences of decisions and actions”*⁶¹ The precautionary principle was thus deemed an essential element of sustainable development, and, according to the *Fuel Retailers Case*⁶² the approach adopted by NEMA is one of risk-aversion and caution, and entails *“taking into account the limitation on present knowledge about the consequences of an environmental decision”*. The precautionary principle is applicable *“where, due to unavailable scientific knowledge, there is uncertainty as to the future impact of the proposed development.”*⁶³

Within the *National Environmental Management Act, no 107 of 1998* (NEMA) (*Government Gazette, 1998*: p. 10) sustainable development is defined as.

“The integration of social, economic and environmental factors into planning, implementation, and decision-making so as to ensure that development serves present and future generations.”

With regards to renewable energy, Chapter 1, Section 2(4)(a) of NEMA (*Government Gazette, 1998*: pp. 11-12) provides that sustainable development requires the consideration of all relevant factors including the following:

“(v) that the use and exploitation of non-renewable natural resources is responsible and equitable and takes into account the consequences of the depletion of the resource.

(vi) that the development, use and exploitation of renewable resources and the ecosystems of which they are part do not exceed the level beyond which their integrity is jeopardised;

(vii) that a risk-averse and cautious approach is applied, which takes into account the limits of current knowledge about the consequences of decisions and actions; and

(viii) that negative impacts on the environment and on people’s environmental rights be anticipated and prevented, and where they cannot be altogether prevented, are minimised and remedied.”

⁶¹At para 70.

⁶²Cited in the text.

⁶³Fuel Retailers Case, para 81 and 98.

a) Within the mining context, *the Minerals and Petroleum Development Act No 28 of 2002* (*Government Gazette, 2002: p. 16*), defined sustainable development as: “*the integration of social, economic, and environmental factors into planning, implementation and decision making so as to ensure that mineral and petroleum resources development serves present and future generations.*”

The importance of this Act is that it refers to both minerals and petroleum and petroleum related by products, like gas, with petroleum being defined in Section 1 (*Government Gazette, 2002: p. 14*) as:

“any liquid, solid hydrocarbon or combustible gas existing in a natural condition in the earth’s crust and includes any such liquid or solid hydrocarbon or combustible gas, which gas has in any manner been returned to such natural condition, but does not include coal, bituminous shale or other stratified deposits from which oil can be obtained by destructive distillation of gas arising from a marsh or other surface deposit.”

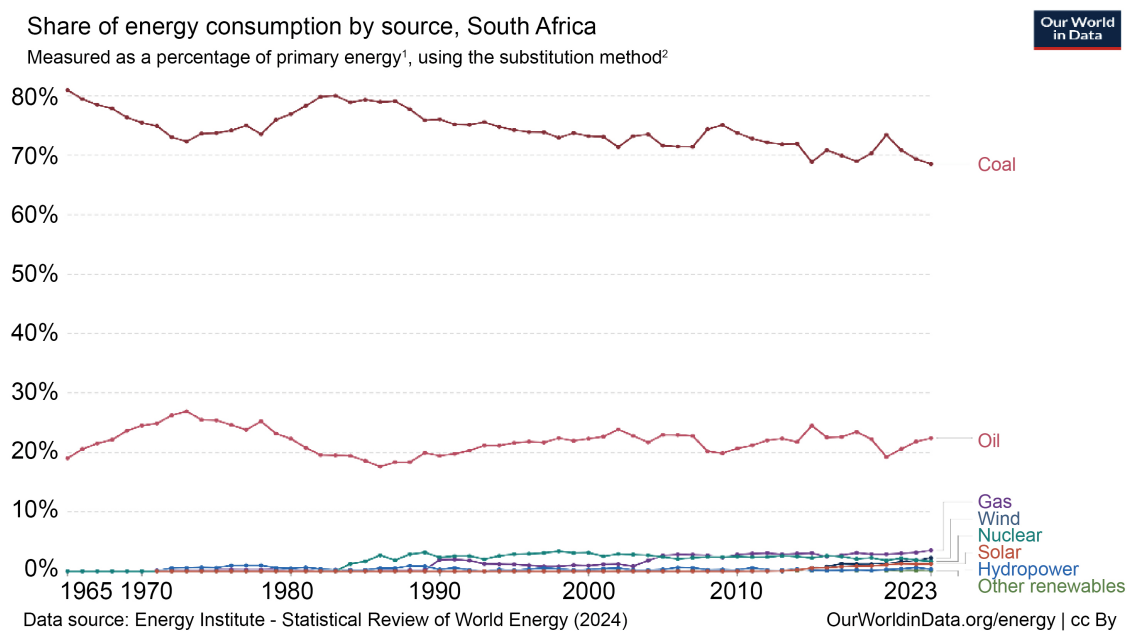
As the Act was adopted prior to the current knowledge about climate change and the escalating impacts of GHG emissions as well as the narrower, more focused definition of sustainable development, there is a need to rethink this definition. In addition, the intergenerational focus of fossil fuel impacts would have to be read in the context of the current understanding of sustainable development. This is, undoubtedly beyond the scope of the legislature’s intention, as, if the requirements of future generations are to be considered, this would require the phase out of fossil fuel usage and the transition to renewable fuels, as envisaged by the Brundtland Commission and current climate change literature.

6. South Africa’s Climate Change and Energy Undertakings

With the energy sector being the biggest consumer of fossil fuels and hence the greatest contributor towards GHG emissions, it is reasonable to assume that the sooner the sector transitions towards a more sustainable energy sector, the sooner South Africa can meet its Net Zero undertakings. Although South Africa has committed to the goals of the Paris Convention, as of 2023, its energy mix was still composed of coal (68.52%), oil (22.38%), gas (3.52%), wind (2.23%), nuclear (1.65%), solar (1.23%), hydropower (0.32%) and other renewables (0.10%) (*Richie & Roser, 2024*). The share of primary energy from fossil fuels in 2023 was 94.42%. There was minor change from the 2022 figures, in which South Africa’s primary energy mix was made up of coal (69.23%), oil (21.82%), gas (3.16%), wind (1.87%), solar (1.19%), hydropower (0.60%) and other renewables (0.10%). Despite the slow change, from the above figures, it is evident that the transition from coal is being met by renewable and non-renewable energy sources, with an increase in the consumption of oil and gas. Renewable energy usage is also increasing, although there has been a decrease in the use of hydropower. Nuclear energy, solar and wind energy usage increased in 2023, with nuclear energy showing the biggest

increase, followed by wind and solar.⁶⁴

Figures 1(a)-(b) provide a snapshot of South Africa's energy usage in terawatt-hours⁶⁵ from 1965 to 2023. It is evident that in the last 40 years, South Africa's consumption of coal tripled, peaking around 2010, as South Africa incorporated more oil and gas into its energy mix. The incorporation of renewables began after 2010. Despite the slow start, after 2020 there has been a slight decrease in fossil fuel usage, which is encouraging. The decrease, as it coincides with the period of Covid-19, can also be attributed to the slow-down in the South African economy and hence, decreased demand for fuel (during the lock-down and after, with more companies adopting a work from home approach) and energy from industry. South Africa's slow economic recovery and increased loadshedding can also be contributing factors. For a growing economy, decreased energy demand is not a positive indicator, unless it reflects improved energy efficiencies and less pressure on the main energy grid as more households and businesses move off-grid.



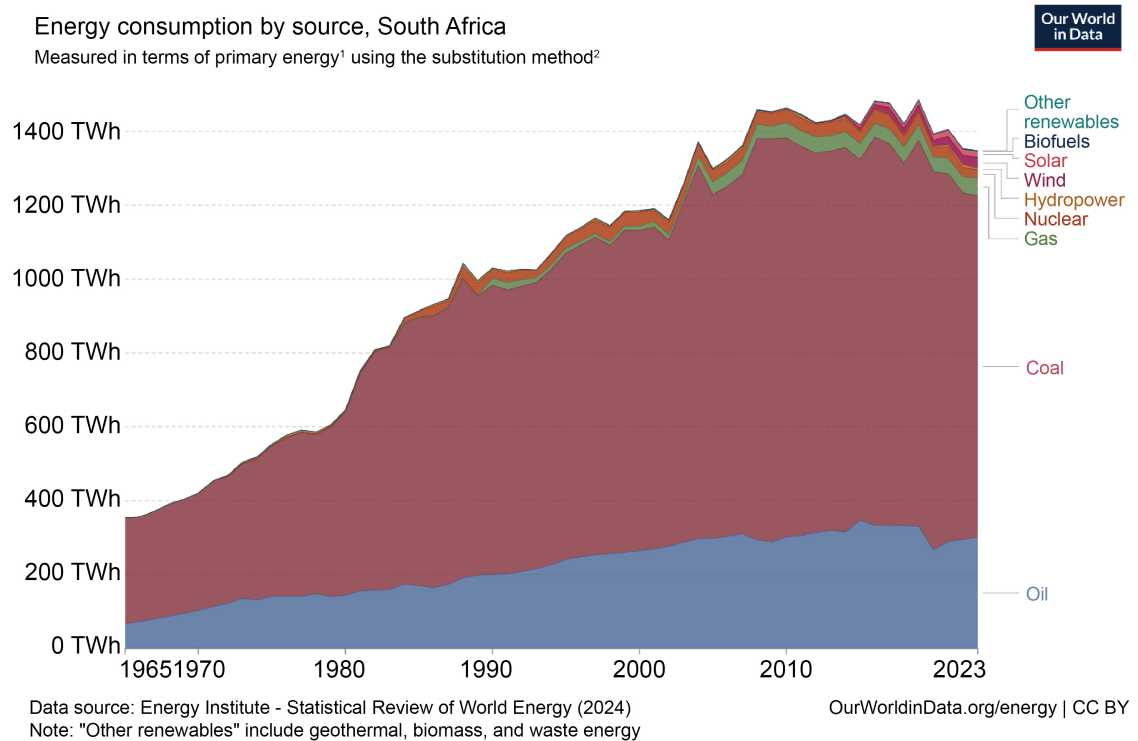
1. Primary energy: Primary energy is the energy available as resources - such as the fuels burnt in power plants - before it has been transformed. This relates to the coal before it has been burned, the uranium, or the barrels of oil. Primary energy includes energy that the end user needs, in the form of electricity, transport and heating, plus inefficiencies and energy that is lost when raw resources are transformed into a usable form. You can read more on the different ways of measuring energy in our article.

2. Substitution method: The 'substitution method' is used by researchers to correct primary energy consumption for efficiency losses experienced by fossil fuels. It tries to adjust non-fossil energy sources to the inputs that would be needed if it was generated from fossil fuels. It assumes that wind and solar electricity is as inefficient as coal or gas. To do this, energy generation from non-fossil sources are divided by a standard 'thermal efficiency factor'- typically around 0.4. Nuclear power is also adjusted despite it also experiencing thermal losses in a power plant. Since it's reported in terms of electricity output, we need to do this adjustment to calculate its equivalent input value. You can read more about this adjustment in our article.

(a)

⁶⁴There is no consensus regarding the rate of renewable energy increase across the different statistical and research platforms. Irena and Statista all report different figures, although they do not have the 2023 figures. These discrepancies may be due to the means of calculating these increases and the formulae used.

⁶⁵The formula for TWh is 3.6×10^{15} joules.



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(b)

Figure 1. (a) South Africa's energy consumption by source. (Our World in data) [Richie and Roser \(2024\) South Africa: Energy Country Profile, Our world in Data, https://ourworldindata.org/energy/country/south-africa#citation](https://ourworldindata.org/energy/country/south-africa#citation); (b) South Africa's Energy consumption by source. (Our World in data) [Richie and Roser \(2024\) South Africa: Energy Country Profile, Our world in Data, https://ourworldindata.org/energy/country/south-africa#citation](https://ourworldindata.org/energy/country/south-africa#citation)⁶⁶

Despite the increasing use of coal and oil in the energy mix, the percentage of fossil fuel usage within the energy mix has remained almost constant, with the percentage of coal decreasing slightly with the introduction of renewable energy. The role of oil has also remained almost constant, peaking in the period between 1970 and 1980 and rising again after the Covid-Pandemic.

The 2019 South African Energy Sector Report stated that the South African energy mix was dominated by coal (69%) with crude oil (14%), renewables (11%), natural gas (3%) and nuclear energy (3%), according to the 2016 figures (Department of Energy, 2019: p. 8). Given that fossil fuels still made-up 94.42% of the 2023 primary energy mix, these figures are highly unlikely, especially the reference

⁶⁶The Data source is cited in the chart.

to renewable energy, which together with nuclear energy, were less than six percent of the 2023 primary energy mix, as shown in **Figure 1(a)**. According to the Integrated Resource Plan of 2019, (**Government Gazette, 2019**) coal (with carbon capture, utilisation, and storage {CCUS}), gas and nuclear energy will remain a part of South Africa's energy strategy, with renewable energy like Solar PV, wind, and concentrated solar power (CSP), hydropower and energy storage providing an opportunity to diversify the energy grid (**Government Gazette, 2019**: pp. 11-13).⁶⁷ The use of crude oil was not mentioned. Renewable energy, specifically solar power was seen as a means of addressing the need for energy within remote areas, while creating jobs (**Government Gazette, 2019**: p. 19). Other than hydropower, other forms of marine renewable energy sources were not mentioned. For the purposes of minimizing risk and job losses, the IRP envisages the continued usage of coal and an extension of the useful life of the nuclear station, Koeberg Power Station, for 20 more years, after its current license ends in 2024 (**Government Gazette, 2019**: p. 12). The drafters acknowledged that in South Africa the energy sector contributes almost 80 percent towards total emissions with 50 percent being from electricity generation and liquid fuel production alone. In keeping with the ILO guidelines, the timing of the transition to a low carbon economy must be done in a manner that is socially just and sensitive to the potential impacts on jobs and local economies. It is for this reason and in this context that engagements at global forums such as the G20 refer to "Energy Transitions" rather than "Energy Transition". The usage of the plural acknowledges that countries are different, and their energy transition paths will also be different due to varying local conditions (**Government Gazette, 2019**: p. 14).

The IRP provides that carbon capture and storage, underground coal gasification, and other clean coal technologies are critical considerations that facilitate the continued use of coal resources in an environmentally responsible way. Air quality regulations under the National Environmental Management Act: Air Quality Act No. 39 of 2004 prescribe that Eskom's coal power plants meet the minimum emission standard (MES) by a certain time, or they would need to shut down (**Government Gazette, 2019**: pp. 14-15). In addressing the potential non-compliance, government must balance energy security, the adverse health impacts of poor air quality and the economic cost associated with shutting down the coal plants (**Government Gazette, 2019**: p. 15). While the long-term goal is the use of renewable energy in compliance with South Africa's undertaking under the Paris Agreement (**Government Gazette, 2019**: p. 86)⁶⁸, in the period of transition, the IRP has made provision for increased dependence on the use of natural gas, with emphasis being placed on the accelerated exploration of the Brulpadda gas resource discovery in the Outeniqua Basin of South Africa, piped natural gas from Mozambique

⁶⁷Government Gazette, op cit note 118 at pp. 11 to 13.

⁶⁸The IRP long term scenario was left open, as it is dependent on the availability of a stable renewable energy supply that can compensate for the removal of the coal element. Despite this uncertainty, drafter hoped that coal would contribute less than 30% to the primary energy mix in 2040 and less than 20% by 2050, with emissions peaking around 2025/2026.

(Rovuma Basin), indigenous gas like coal-bed methane and ultimately shale gas, forming a central part of South Africa's strategy for regional economic integration within the Southern African Development Community (SADC) (*Government Gazette, 2019*: p. 12).

South Africa's transition is a work in process, as renewable energy technology evolves, and the global picture becomes clearer. This can be observed in the strengthening of the South African position with time. South Africa's first updated NDC of 2021 provides more clarity on her decarbonisation commitments, with her second NDC being provided in 2025. Because the update was from four years ago, it is still not a true representation of South Africa's position and may be subject to change. With the exponential growth of technology and the fast-decreasing costs of renewable energy, the transition is not static but dynamic, with small gains impacting all areas. It is therefore possible that South Africa's second NDC may be adjusted to incorporate and reflect these exponential gains in renewable technology growth. The update represents a shift to a fixed level target range under the Paris Agreement. South Africa committed itself to a decrease in its annual GHG emissions for the period of 2021 to 2025 in the range from 398 - 510 Mt CO₂-eq. For the period 2026 to 2030 South Africa's commitment to GHG emissions in the range of 350 - 420 Mt CO₂-eq (*UNFCCC, 2021*: pp. 15-16). To meet these targets, South Africa has committed to implement a range of policies and measures, including the power sector investment plan contained in the IRP, the Green Transport Strategy, enhanced energy efficiency programs and carbon taxes.

The Industry Position

From logistics to fashion, energy is essential for the speedy development of nations. In addition to the availability of reliable energy, cheap sources of energy facilitate economic growth and development. This is even more important in an energy dependant technological age. Besides the usage of oil as crude oil, it is also used for petroleum and petroleum-based products, waxes, diesel fuel, jet fuel, heating oil, petrol, petrochemical feedstocks, lubricating oils, and asphalt. There are currently about 6000 petroleum-based products, including dresses, tyres, ammonia, perfumes, nail polish dyes, refrigerators, and phones (*Ranken Energy Corporation, 2020*). Within the economic context, the transition towards renewable energy does not only influence the energy sector but will have major impacts on fossil fuel reliant supply chains. Where nations could balance competing interests, such as the labour, employment, and sector protection, in the current global environment, environmental considerations must be the driving force behind all decisions relating to current and future energy production methodologies. The ready availability of renewable energy sources provides a ray of light in a darkened global landscape. The greatest challenge to change will be the abundance of fossil fuels in some nations, because, unlike countries who have been searching to alternatives to oil, coal, or gas, they have not had to struggle with access to these resources. An additional impediment to change will be the reluctance of these

nations to lose current and future revenues which they have enjoyed from the sale of these resources. It will therefore be natural for them to seek ways to extend the use of fossil fuels for as long as possible. These internal agendas, while providing short-term economic benefits, will not only delay the inevitable but may also contribute to the global environmental challenges in the short, medium, and long-term.

Industry has been clear about its position on the energy transition and its call to decarbonise the power sector, which it deems the most critical part of the transition (NBI, 2021: p. 34). In the context of South Africa's energy crisis, transition to a renewables-dominated energy system was deemed to be the key to addressing South Africa's power supply shortfalls in a fast and affordable way. The transition requires large-scale renewables deployment, with the corresponding grid investments. A delay in the roll-out of renewable energy capacity at scale will dramatically worsen South Africa's financial situation. Consequences of the delay include the increased cost of decarbonising the power system; decreased global competitiveness and decreased opportunities to diversify the economy. Existing bottlenecks include unsupportive policies, slow regulatory processes, and a lack of visible investible green projects. Trade support and concessional finance from developed countries are essential for stimulating new green industries and mitigating transition risk. They advocate for the following measures (NBI, 2021: p. 7).

a) For a rapid roll out of renewables, South Africa's power grid must be expanded by at least 30 GW by 2030, double what is currently planned, strengthened, and modernised.

b) Renewables need to be rolled out at the rate of 6 - 7 GW per year, more than ten times the current rate. An additional 6 - 12 GW of renewables need to be deployed per year to capture the green hydrogen opportunity.

c) South Africa must leverage its structural advantages and establish up to a 9.5 Mt p.a. green H₂ industry by 2050. This requires 170 - 200 GW of renewables for local demand and exports and could create approximately 2.5 million high-quality jobs.

7. Alternative Maritime Energy

Within the area of offshore marine energy research, there is much scope, beyond that of oil and gas exploration into wave and offshore wind energy. The AU maritime policy speaks directly into regional collaborations on marine and maritime issues (African Union, 2012: p. 27).⁶⁹ One of the seven missions of the African Union Commission (AUC) is to "promote regional economic cooperation as a foundation for irreversible integration in the Continent."⁷⁰ These seven missions are applicable to all major issues facing Africa, including energy exploitation,

⁶⁹Provision 83 of the Africa's Integrated Maritime (AIM) Strategy identified the development of renewable energy and maritime renewable energy sources as sources of economic development within the African Context, to be explored by the Strategic Foresight Marine Task Force (SFMTF).

⁷⁰Provision 6 (iv), AIM, at p. 9.

climate change, environmental protection and conservation and safety of life and property at sea”.⁷¹ Sustainable development was deemed central to the development of Africa’s Blue Economy.⁷² Because of the possible gains, it may be more economical and sounder for SADC nations to collaborate, economically and scientifically on maritime renewable clean energy projects which could benefit the region. The Cahora Bassa Dam in Mozambique, one of two major dams on the Zambezi River and the largest hydropower plant in southern Africa is such a collaboration, with most of the energy generated being sent to South Africa via a high voltage direct current line system (Goosen, 2021), (Belletti & McBride, 2020: p. 3).⁷³

While South Africa is not a country which has large internal water reserves, it has the characteristics required for harnessing and utilizing wave and wind energy (IRENA, 2014: p. 15) (Ramos-Marín & Soares, 2024: pp. 5-7). Unlike many other renewable energy sources, which are weather dependent and susceptible to climate change impacts, marine renewable energy has the potential of producing consistent returns. The best conditions for harnessing wave energy are in medium latitudes and deep waters greater than 40m deep. South Africa, together with Australia, Ireland, the USA, the UK, New Zealand and Chile were identified as countries with excellent wave resources with average power densities of 40 to 60 KW/m (IRENA, 2014: pp. 5-7). While these conditions are also conducive for offshore wind power development, the sector outside of China, has been hampered by increased investment costs, which are 20% higher now than a few years ago. Because of these increased costs, developers have cancelled or postponed 15% of offshore wind projects. (IEA, 2023). Research on wave energy is ongoing, with researchers seeking to improve efficiency and reduce the costs of tidal energy systems. The use of innovative turbine designs, such as horizontal axis turbines with adjustable pitch blades, to optimize energy capture across a range of tidal flow velocities is one area of development. Researchers are also developing more efficient and reliable wave energy converters (WECs). Point absorbers and attenuators, are being researched as ways to improve energy capture and lengthen the lifespan of WECs. Innovative control strategies, including resonance control and optimal power extraction algorithms, are also seen as a means of enhancing WEC performance (Thennakoon et al., 2023: pp. 97-98).

Technological advancements and innovation are making wave technology cheaper and more competitive. Improved device design, materials, and manufacturing processes have enhanced energy capture efficiency and reduced capital and operational costs. The economic potential of suitable ocean energy resources has been acknowledged, especially their role in the creation of green supply chains

⁷¹Provision 7(ii), loc cit.

⁷²Provision 9, loc cit.

⁷³Unfortunately, climate change has been responsible for both droughts and floods in the Susharan African region, with droughts contributing towards water shortages, which in turn, have negatively impacted hydroelectric power generation. It has therefore become necessary to seek stable sources of renewable power, to complement solar and wind power.

and job creation. The harvesting of ocean energy is just one of the ways in which capital can be adequately and efficiently utilized. Unlike fossil fuels, which are easily exported, ocean -based energy sources, which are still being researched, piloted and scaled up, are localized. As such, they do not have the allure of fossil -fuels. With the greening of supply chains, however, countries who have green sustainable energy grids may be able to create green energy business hubs.⁷⁴

8. Discussion

The transition from a fossil fuel-based energy grid to a renewable energy-based grid is critical for the placement of the South African economy in an increasing green world. Within the Operation Phakisa Ocean Economy context, it is questionable whether there is still room for oil and gas exploration, especially in the face of increasing global resistance, South Africa's climate change undertakings, the IRP 2019 Energy Transition strategy and the limited resources available for transition. While the IRP 2019 provides for the use of gas through the transition, the use of oil was not mentioned. Although South Africa's energy mix has become increasingly reliant on oil as a stop gap measure, in the medium to long term, this situation is not compatible with South Africa's sustainable development undertakings. Renewable energy transition undertakings should be South Africa's foremost concern. The IRP 2019, at the time of drafting, was based on limited knowledge about the speed of renewable energy development and the costs thereof. With the fast-decreasing costs of solar energy and the cost and efficiency gains related to wind energy, with other transition fuels becoming cheaper with increasing economies of scale, there is hope that the transition can be hastened, with clean energy replacing fossil fuel-based energy at much cheaper costs. Within the Operation Phakisa context, the question of harnessing ocean energy resources will take on a new meaning, if wave and offshore wind energy are explored as means of stabilizing renewable energy grids. While offshore wind exploration is an extension of onshore wind exploration, offshore exploration facilitates the use of ocean-based wind sources, which are more stable, and free land for food security.

Wave technology, on the other hand, enables nations to tap into a truly renewable, scalable marine energy source. While current challenges include the most efficient means of converting wave energy and the best approach for harnessing and transporting the raw wave power and final product, with sufficient research and technological knowhow, the scalability of wave energy is massive. The current estimates of potential wave energy within South African waters are based on wave sizes within the territorial waters. Research by IRENA shows that waters within South Africa's Exclusive Economic Zone (EEZ) may provide up to 110 kW/m. The area from South Africa's Western Cape coastline to Antarctica holds the greatest wave energy potential. While tidal wave energy may be the easiest to control, the

⁷⁴This will depend also on the availability of a skilled labour force, a conducive business and tax environment, stable political situation, recognition and protection of ownership rights, amongst others.

power of wave energy in the turbulent seas between Cape Town and Antarctica provides researchers with the opportunity to explore underwater and above water harvesting methods. Unlike the exploration of oil and gas, which requires large capital outputs with high risk, with wave energy technology, the returns are guaranteed. The only caveat would be the rate of returns in the pilot stages, as opposed to the returns upon the introduction of economies of scale. There is the added advantage of controlling the size of pilot studies, to prevent wasted resources.

The biggest challenge to South Africa's oil and gas exploration aspirations are both legal and ethical. As the largest polluter in Africa, is it ethical for South Africa to replace coal with oil and gas? Even if South Africa has been allocated its own portion of the existing carbon budget, according to the *Urgenda Case* judgement, nations have a duty to do all that they can to meet their climate change obligations and take the greatest measures possible, within their capability, regardless of how little or much others do. Given that the science regarding climate change is confirmed, nations have a duty to act with caution when dealing with matters or decisions pertaining to matters that may escalate GHG emissions. With sustainable development principles entrenched in South Africa's Constitution, legislation and the energy strategy, decisions made by South Africa must be guided by legislation and case law. As South African courts have already ruled that the precautionary principle is an essential element of sustainable development, not applying these principles is contrary to the growing body of international and domestic legislation which requires tighter controls when adopting measures which may escalate climate change impacts.

While the economic development status of South Africa has been gradually decreasing, with the example shown by the EMDE in proactively investing in research and development on renewables and actively growing these markets, the distinction between developing country and developed country commitments is fast decreasing, especially as China has chosen to grow the sector without seeing international assistance. This approach shows a deep commitment to change as well as a willingness to be responsible for her actions, even if China's contribution to GHG emissions is recent. The gains from trade enjoyed by China, together with the monopoly position which China holds in the sale of renewables like Solar PV and battery technologies indicates the advantage that can be enjoyed by early entrants into the sector. As the largest GHG contributor in Africa, despite the small percentage of Africa's cumulative emissions, it may be argued that South Africa should rise to the challenge and be an example to the remaining African nations.

9. Conclusion

Legislation and policy are not set in stone, but rather, with global and domestic developments, must align. With the transition to wave and offshore wind energy and the increased momentum towards renewable energy globally, late adopters will be at a distinct disadvantage. While South Africa's energy transition is contained in instruments like the IRP, South Africa's energy position is already out of

alignment with her transition strategy. The current reality is evident of short-term measures adopted to deal with the energy crisis and not a long-term functional approach. While Operation Phakisa Oceans Economy goals are meant to provide short-term economic solutions through the exploitation of marine and maritime resources, all development within South Africa should be sustainable. It is arguable whether further development of South Africa's fossil fuel exploration goals provides any long-term benefits for the country. In the light of legislative developments, possible economic impacts and the availability of cheaper renewable energy alternatives and the opportunity to explore genuine marine energy goals, this paper advocates for the amendment of Operation Phakisa oil and gas sector goals to the exploration and investment in marine energy alternatives.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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