

P O L I C Y B R I E F

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Comparative practices of Just Energy Transition from coal to hydrogen energy in South Africa and Brazil

Executive summary

The climate imperative to leapfrog from coal to clean energy has been made clear over the past years at the various UN Climate Change conferences. In 2021, South Africa not only confirmed that hydrogen as a green energy is critical for decarbonising the planet, but announced the first Just Energy Transition Partnership (JETP) South Africa with its Western partners. However, successful implementation of South Africa's Just Energy Transition (JET) Framework raises key questions, such as its governance capacity to implement government policies, and its history of dysfunctional long-term planning as evidenced by load shedding, which is a result of poor foresight. Brazil serves as a relevant comparative to South Africa given that they are both emerging countries, both engaged in global coal production, and have both established an interest in hydrogen energy over a decade ago. However, unlike South Africa, Brazil is currently a fossil free nation and has effectively localised green energy. The purpose of this comparative analysis is to, therefore, examine Brazilian best practices of energy transition for consideration by the South African government.

Introduction

Internationally, coal is currently the most widely used primary fuel, accounting for 36% of total fuel consumption for electricity production. The global energy sector is undergoing a massive transformation, due to the growing pressure to reduce carbon emissions, and because of deep, and fast technological developments. The rush to achieve net zero is also driving massive global investments in *renewable energy*. Since committing to the first JETP at the 26th UN Climate Change Conference of the Parties (COP 26) in Glasgow, Scotland, South Africa has been promised billions in financing by various countries, such as France, Germany, Denmark, the United Kingdom, the United States, and the European Union (Kramer, 2022).

Hydrogen is predicted to play a leading role in just transition from minerals, such as coal, and is being increasingly promoted by governments worldwide. The International Labour Organization (ILO) defines JET as greening the economy in a way that is as fair and inclusive as possible to everyone concerned, creating decent work opportunities and leaving no one behind (United Nations Development Program, 2022). Suffice to say, implementing JET to renewable energy remains a major challenge for most emerging countries as it is not only an expensive process, which includes large-scale hydrogen production costs (Mason and Shalal, 2021), but is also fraught with geopolitics and economic inclusivity hiccups.

The JET process being unpacked in South Africa also begs the question as to whether the country should not focus on an energy transition first in order to achieve its end goal of inclusive energy for economic growth across the board. It is critical at this juncture to point out that there is a difference between JET and energy transition. According to the United Nations Development Program, energy transition is specifically a continuing process requiring long-term energy strategies and planning, with a country-tailored focus on applying appropriated energy technologies to reach net-zero emissions (United Nations Development Program, nd). Energy transition is technical with a focus on energy production and not necessarily entangled with issues, such as job creation and other societal factors.

As already established, South Africa has released some legislative documents on JET. In 2022, the country released its JET Framework, which sets out the actions that government and its social partners will take to achieve a just transition, and the outcomes to be realised in the short, medium, and long term. (Presidential Climate Change Commission, 2022). Another planning tool for achieving a just transition is set out in its Department of Science and Innovation (DSI) strategic document titled, Hydrogen Society Roadmap for South Africa 2021 (Department of Science and Technology, 2023), arguing that hydrogen energy will accelerate South Africa's just transition from coal to renewables and support workers and communities currently reliant on the coal value chain (Creamer, 2022). However, a review of the previously mentioned document demonstrates that except for coal miners, inclusiveness has arguably not been sufficiently addressed, which is problematic in achieving holistic socioeconomic growth.

As indicated earlier, this brief will, therefore, examine South Africa's prospects of JET from coal to hydrogen energy through a comparative process with Brazil. The Brazil comparative is relevant because like South Africa currently, it was once massively reliant on imports, such as solar for its energy resources, and energy transition, decades ago. Brazil has now become an energy exporter that produces more energy than it consumes after 35 years of policy development 'to promote domestic energy resources, such as hydro, biomass, and solar' (Ramluckun, Malumbazo and Ngubeyana, 2024). The methodology will be two pronged. First, the paper will provide some background information on coal production in both South Africa and Brazil. This will be followed by a discussion of challenges and prospects of hydrogen energy governance practices on executing hydrogen energy legislation in both countries. Analysis of the aforementioned governance practices is critical in unpacking possible policy implementation fault lines that South Africa should take note of.

Background: Coal production in South Africa and Brazil

South Africa contributes about 3,5% of the world's coal resources. The country's production is around 3,3% of the world's annual total and exports approximately 6% of global exports (Ratshomo, 2022). Brazil holds 7 271 million tons (MMST) of proven coal reserves as of 2016, ranking 15th in the world and accounting for about 1% of the world's total coal reserves of 1 139 471 MMST (Worldmeter, nd). This section will provide background information on coal production in both South Africa and Brazil.

1. South Africa and coal production

South Africa currently produces the largest amount of coal in Africa and ranks seventh in the world on coal production (Worldmeter, nd). As of 2018, South Africa was the seventh largest producer and consumer of coal in the world (The Carbon Brief Profile, 2018). 25% of South Africa's production is exported internationally (Eskom, nd). Around 77% of South Africa's energy needs are directly derived from coal (Carbon Brief Profile, 2018). This is unlikely to change significantly in the next decade, due to the relative lack of suitable alternatives to coal as an energy source (Makgetla and Patel, 2021).

South African coal is located in 19 coalfields, mainly in KwaZulu-Natal, Mpumalanga, Limpopo and the Free State, with lesser amounts in Gauteng, the North West Province and the Eastern Cape (Jeffrey, 2005). This large industry, means that as of 2015 about 92 000 workers, or 0,5% of total employment, were from the coal industry (Jeffrey, 2005). State-run energy provider, Eskom, employs about 46 000 people and owns 12 coal-fired power stations in Mpumalanga, as well as two in Limpopo and one in the Free State (Harrisburg, 2020). Mpumalanga accounts for 83% of national coal production.

However, despite the high level of coal production in South Africa, the country over the past year, has been in the grip of its most severe energy crisis. Intermittent power cuts have progressively worsened, due to aging and an inadequately maintained fleet of coal power stations by its state energy plant, Eskom. Eskom is one of the country's polluting culprits as its ageing coal-fired power stations have contributed towards South Africa's environmental standing as the world's 14th biggest emitter of climate-warming gases. Eskom is a key feature in this paper because the \$8,5 billion deal from COP 28 was linked with the energy provider, which is tasked with repurposing its aging apartheid-era coal Komati power station to clean energy (Lo, 2022).

In 2021, the Centre for Research on Energy and Clean Air found that Eskom's 15 coal-fired power plants emitted 1,6 million tons of sulphur dioxide (SO₂) a year, making it the largest emitter of health-harming SO₂ globally (Van Dieman, 2023). Alongside the sulphur emissions, Eskom also pollutes the air with 804 000 tons of oxides of nitrogen, 71 tons of particulates (ash) and 206,8 million tons of carbon dioxide annually from all its power stations (Garland, 2021). All these aforementioned pollution variables are currently contributing to diseases, such as asthma, cancer, heart and lung ailments, to surrounding mining communities (Garland, 2021). It is important to note that apart from Eskom, major corporations are also the biggest polluters in the country. For example, Sasol, a major energy and chemicals company, is South Africa's second biggest greenhouse gas emitter. Its Secunda coal-to-liquid fuels plant in Limpopo is the biggest single point source of greenhouse gas pollution in the world (Paton, 2023).

2. Brazil and coal production

Coal mining in Brazil is the country's largest source of non-renewable energy and is an important part of Brazil's energy economy (Zancan, 2021). Unlike South Africa, Brazil has a long history with non-fossil fuels. To date, Brazil's electricity generation is dominated by hydro resources, which represent more than 60% of its electricity generation (Baker Institute, 2022). More than 80% of its electricity already comes from renewable sources, such as hydropower. Nonetheless, Brazil produces 7 721 681,55 tons of coal per year, ranking 27th in the world. Coal accounts for approximately 5,8% of the country's total primary energy supply (Baker Institute, 2022).

The Brazilian coal reserves constitute 32 billion tons and are located in the south of the country, 90,1% of which are found in the state of Rio Grande do Sul, 9,6% in the state of Santa Catarina and 0,3% in the state of Paraná (da Silva, Muniz, Hoffmann and Lisbôa, 2018). Other small reserves are present in the states of Amazonas, Pará, Pernambuco, Maranhão and São Paulo (da Silva, Muniz, Hoffmann and Lisbôa, 2018). Coal mining activity in the area has had a large impact on the environment, especially in the areas directly surrounding the mines. These environmental problems are the result of over 120 years of unregulated mining activity, lack of accountability and enforcement in regard to waste disposal, lack of knowledge, and different economic priorities (Leffa, Carvalho, Mendonca, dos Santos, Bouffleur, Dias and Andrade, 2010).

It is important to note, however, that despite its limited reliance on coal, the industry has helped spur the regional economies in southern Brazil. But this has come at a high price. Severe environmental degradation has resulted from poor mining practices, improper waste disposal, poor regulation and lack of research. A number of health, social, economic and political concerns have arisen as a result of the mining industry (Oliveira, 2010). The environmental problems also translated into adverse effects for the mineworkers and those living in surrounding areas.

Consequently, the Brazilian government historically implemented legislation to address the environmental concerns related to coal mining activities decades ago. In 1980, for example, the Santa Catarina coal region was designated a 'Critical National Area for Pollution Control and Environmental Conservation', an early indication of effort on behalf of the government to recognise the problems in the region (Oliveira, 2010). Moreover, the Brazilians also took action over companies that did not abide by the environment obligations as remediation costs totalled from \$20 000 to \$40 000 per hectare according to the levels of degradation and intentions for future use (Gomes, Mendes and Costa, 2011). A technical advisory board was even created in 2006 to assist the Supreme federal court in addressing reclamation actions based on environmental indicators (Gomes, Mendes, and Costa, 2011).

In 2022, Brazil has unveiled an extension to its coal shift until 2040 under a new JET. Interestingly, the new JET Law 14.299 (Climate Laws, 2022) effectively delays Brazil's energy transition by 13 years, which contradicts the country's pledge to half its emissions under the United Nations climate policy by 2030 and become carbon neutral by 2050 (Climate Law, 2022). Suffice to say, under previous policies, Brazilian subsidies for thermal coal-powered plants were due to end by 2027 (Dajee, 2022). Brazilian civil societies, such as the ARAYARA International Institute, Rede Sustentabilidade and the Coal Observatory, have questioned the inconsistencies of the legislation regarding critical aspects that should support the energy transition in Santa Catarina (Instituto International Arayara, nd).

The civil society critics have focused on Law n° 18.330/22, proposed by the government of Santa Catarina, which institutes the State Policy of Just Energy Transition and the Pole of Just Energy Transition of the South of Santa Catarina state (Instituto International Arayara, nd). According to the environmentalists, the Santa Catarina legislation is on the opposite path of proposing migration to a clean and sustainable energy matrix, which they view is the essence of JET (Instituto International Arayara, nd). Given Brazil's track record on renewable energy for the country, the focus of the new

Federal JET Law 14.299, which effectively delays Brazil's just energy transition by 13 years could be viewed as a strategic method to provide more time for the coal region Santa Catarina to establish a sustainable economic balance between coal production and hydrogen energy production in order to eventually meet carbon emission targets (Instituto Internacional Arayara, nd).

Just Energy challenges and prospects

This section of the paper will examine South Africa's and Brazil's prospects using governance indicators to implement a successful JET process.

1. South Africa and Just Energy Transition

South Africa remains a prime example of how challenging it will be for the global south to transition to clean and renewable energy. South Africa's Just Transition is complicated by its unique legacies of apartheid, social unrest, poverty, unemployment and structural crisis in the energy sector, which dictate much of its political landscape. The Just Transition process is also complicated by Eskom's inability to provide sufficient electricity and dysfunctional energy plants, which are currently effecting the country's economy. Eskom *has* a total of 14 coal power *stations*, of which only three *have* total capacity below 2 000 MW (Moneyweb, 2023).

Komati is an example of a coal mining community consisting of a 60-year-old Komati power plant in Mpumalanga, which was shut down for repowering and repurposing through global funding (Evans, 2022). Suffice to say, the Komati JET project is one of the largest coal-fired power plant decommissioning, repowering and repurposing projects that have been implemented to serve as a global reference on how to transition fossil-fuel assets (Eskom, 2022).

2. South Africa's governance

The South African government is considered the main actor as far as governance and promoting citizens' rights. However, poor performance of the public sector on national, provincial and local levels remain a cause for concern in South Africa and one which has cast the issues of governance in the country in a poor light. Given the litany of other social documents, such as the Mining Charter, ASGISSA, Social Labour Plans, Black Economic Empowerment (BEE), and the MPRDA Act of 2002, there are concerns that the JET Framework could join them by not making a dent in improving the lives of the marginalised in coal mining communities. This begs the question as to what will make implementation of the JET in successfully transitioning coal production to green energy given the government's track record.

As established earlier, Komati is a perfect example of Government's failure to promote economic justice. Despite the World Bank funding and documentation to guide the repurposing of Komati, the process has been marred with a lack of key JET implementation processes, such as stakeholder communication. This is demonstrated through a study, which found that no government funding has been provided to help workers and communities fund alternative livelihoods within the Mpumalanga areas ahead of coal plant closures in 2030 (Bloomberg, 2023). Moreover, according to a member of the South African Commission, the Climate Justice advocate most of the community members and stakeholders were not informed of the decommission in advance. Furthermore, job creation and skills training, which were supposed to have materialised before the Komati power plant shutdown also did not happen (Slater, 2022).

The Komati case highlights the lack of pre-planning for such a critical initiative, which begs the

question as to how the government will succeed if it cannot get strategic basics right. Corruption must be mentioned as it also plays a major role in affecting South Africa's governance capacity. South Africa lost R1,5 trillion through corruption between 2014 and 2019 while accountability still remains unabated (Buthelezi, 2021). Suffice to say, bad implementation of policies, such as the JET Framework, will remain a major obstacle despite the fact that the government insists that their policy frameworks are transparent and well-defined. Regrettably, the translation of policy into practice has become more complex than the stated judgments of government (Brauns, 2014).

3. Brazil and Just Energy Transition

Brazil established an interest in hydrogen development since 1975 with activities, such as the creation of the Hydrogen Laboratory. A few years later, the Roadmap for Structuring the Hydrogen Economy in Brazil was published, with targets for 20 years highlighting:

- a. the importance of the various technological paths in which Brazil could have a competitive edge
- b. the role of natural gas in the transition, until green hydrogen is predominant
- c. the expansion to distributed generation markets, isolated regions and urban buses (Camarg, Guedes and Araujo, 2022).

To date, the first signs of the birth of a hydrogen economy are extremely visible in Brazil. Projects, such as the Green Hydrogen Hub, Pecém – Ceará. In this context, Brazil has a competitive advantage, being one of the best-placed countries for producing green hydrogen to promote domestic energy resources, such as hydro, biomass and solar, etc. (Ramluckun, Malumbazo and Ngubeyana, 2024). Brazil also demonstrates the need for long term policy planning in green energy given its efforts over 35 years. One would argue that Brazil, through its current energy supply mix, which includes 85% of renewable sources, focused on energy transition instead of JET, which is key. By focusing specifically on energy transition, there were less distractions on issues of social inclusion with a focus on green energy infrastructure development instead.

Consequently by first focusing on energy transition, Brazil has not only become the third country in the world that most generates renewable energy, but succeeded in promoting economic inclusivity (Camarg, Guedes and Araujo, 2022) from a long-term perspective. Inclusivity is demonstrated through the fact that Brazil has not only localised its energy production, but is now the third country in the world that generates the most renewable energy for local usage (Ramluckun, Malumbazo, and Ngubeyana, 2024). Moreover, Brazil is also now the tenth-biggest producer of electricity globally and the eighth-leading world user of energy (Ramluckun, Malumbazo and Ngubeyana, 2024).

Brazil's governance

Legislative implementation in Brazil seems to be more successful as the renewable energy strategy has grown progressively over the years despite leadership changes, which is not always the case in African countries. Governance-wise, Brazil's energy policies measure up well against the world's most urgent energy challenges. This is not to allude that Brazil has had a perfect leadership process. According to the Organisation of Economic Cooperation and Development (OECD), Brazil has faced a crisis of trust in the wake of, among other factors, corruption scandals, institutional imbalances and problems in guaranteeing certain basic constitutional rights, which undermines citizens' trust in government and effectiveness of public services (OECD, 2022). However, there are highlights that demonstrate that the country began to promote accountability and oversight as demonstrated earlier how Brazil began taking action over companies that did not adhere to environmental obligations

through severe fines, including the establishment of technical boards to assist legislative institutions, such as the Supreme Federal Court.

The OECD has also argued that Brazil is in the right direction as the country has accomplished significant achievements, such as the entry into force of its corporate liability regime in 2014 (OECD, 2023). Last year, the OECD also emphasised how Brazil has emerged as a strategic leader for sound public governance at the regional and global level. For example, the Brazilian government has taken steps to safeguard public integrity. To date, 59% of Brazil's public sector workers have a tertiary education, compared to the global average of 47% (OECD, 2023). The fact is, a Just Energy transition from coal to hydrogen energy cannot succeed without a skilled workforce in both the private and public sector.

Needless to say, implementing legislation on JET is bound to remain challenging in any country including Brazil, which has been successful in energy transition. Suffice to say the various coal mine communities in Mpumalanga Province, such as Komati and cities in Santa Catarina state, where coal mines are still big employers of coal mining communities and are bound to be disproportionately impacted. It is, therefore, not surprising that transitioning coal to hydrogen in South Africa has become politicised as thousands of lives depend on it. Brazil chose the long-term planning approach in Santa Carina as its coal capital by promoting JET legislation that would not only assist the coal sector (Dajee, 2022), but create a practical balancing act to encompass its national and state political and economic policies.

Conclusion

South Africa's Hydrogen and Fuel Cell Technologies Research, Development and Innovation Strategy was approved by the Department of Science and Technology (DST) in May 2007, approximately 17 years ago (Department of Science and Higher Education, 2021). However, despite its green energy plans over the years, South Africa still remains fossil fuel-based. Through its comparative approach, this brief has attempted to demonstrate how South Africa's governance capacity may have derailed its attempt to implement green energy legislation adopted over a decade ago. The following key points are recommended Brazilian best practices that South Africa should consider for a successful JET process:

1. *Legislative Framework:* As in Brazil's Federal JET Law 14.299, South Africa's JET Framework should consider establishing a sustainable political and economic balance between coal and hydrogen production regarding zero carbon emission
2. *SA energy transition:* Brazil has demonstrated the need to establish a practical framework for implementation. South Africa and its international partners should consider first establishing an energy transition foundation, which will eventually feed into a JET matrix for coal to hydrogen.
3. *Long-term planning:* Brazil serves as a good example through its Law 14.299, demonstrating the need to be practical in terms of the time of the timeframe. Energy infrastructure development on its own without JET is not a short-term process, which can happen overnight.
4. *Governance capacity:* As in Brazil, South Africa needs to professionalise its workforce and curb corruption through its legal frameworks. Hopefully, the Government of National Unity (GNU) will promote necessary political will for *legislative* implementation.
5. *Legislative alignment:* South Africa has established many policies, such as the JET, which need to be aligned to existing socioeconomic policies. The culture of lack of implementation of policies has to be replaced with legislative accountability and cooperation with the courts.

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