

Accelerating South Africa's energy transition

with gas power and renewables

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Building a world that works



Executive Summary

South Africa's leaders must work urgently with international counterparts to reduce the impact of climate change.

Although Africa contributes ~5 percent to global carbon dioxide (CO₂) emissions, the African Development Bank (AfDB) expects the costs of climate change on the continent could rise to \$50bn each year by 2040, with a further 3 percent decline each year in GDP by 2050.¹

South Africa, which generated 86 percent of its electricity from coal in 2020, sees addressing climate change as an urgent priority. Addressing this priority requires strong commitments and, consistent policy and regulatory frameworks.

The country has made progress. The 2019 Integrated Resource Plan, the Green Transport Strategy which enhanced energy-efficiency Programmes, and the recently implemented carbon tax are examples of the government's commitment to emissions reduction. The Nationally Determined Contribution is South Africa's commitment in terms of the United Nations Framework Convention on Climate Change (UNFCCC) and its Paris Agreement (PA) to contribute to the global climate change effort.²

In April 2021, the country announced it aims to reduce its annual greenhouse gas (GHG) emissions to 398–440mn tonnes per year (tpy) by 2030, 28 percent less than its 2015-set targets with the launch of an updated draft of the Nationally Determined Contribution (NDC).

Renewables are the fastest growing source of new power generation capacity and electricity. Research shows South Africa's energy mix will evolve to include greater amounts of renewables, even as coal remains the dominant fuel beyond 2040.

Executive Summary

(Continued)

South Africa's energy needs are urgent. Access to affordable, reliable, and sustainable energy is needed to transform the country's economic development. As the country increases access to—and demand for electricity—renewables and gas provide a powerful combination to address the CO₂ emissions challenge.

The complementary nature of renewables and gas power offers a compelling solution to change the near-term trajectory on emissions reduction.

GE believes gas will not just be a backup fuel but also the new baseload capacity for the Coal Repurposing Programme for many reasons. The focus of this whitepaper is to elevate the emphasis on renewables and gas power as the urgently needed solution to reduce carbon emissions in the near term.³

Gas-fired power is a lower-carbon alternative to coal-fired generation, and its operational flexibility can help integrate variable renewables into the energy system.

With large gas reserves in Mozambique, Angola, and other parts of the region (see

Figure 1), gas power can serve as an enabler for greater renewables penetration and, accelerate the retirement of coal assets, both of which will have significant positive impact on overall emissions. The near-term impact of coal-to-gas switching could represent a fast and effective win for emissions reduction in South Africa. The government and key stakeholders continue to deliberate on the social impact of a transition from its current high emission economy to a low-carbon climate resilient economy.

With the country's unemployment rate sitting at a record high of over 30 percent, large infrastructure projects could play a role in spurring economic growth and creating opportunities for jobs, new skills and industrialization.

While there is no universal blueprint for implementing a coal-to-gas transition, many case studies exist from countries like Poland, China and India that provide applicable references on the socioeconomic impact of transitioning to a greener economy.⁴

Beyond recognition of the importance of infrastructure roll out for economic growth, other crucial considerations for South Africa as it embarks on its Gas Programme include, building partnerships between private and public sectors, finding sustainable

solutions to funding shortfalls, and the effective implementation of projects from beginning to end.⁵

Through proper coordination between all participants, South Africa's Gas Programme could be the inclusive approach which brings along workers and communities historically reliant on the country's vast coal sector.

GE believes that the accelerated deployment of renewables together with gas power can change the trajectory for climate change, enabling substantive reductions in emissions quickly, while in parallel continuing to advance the technologies for low or near zero-carbon power generation.

It's not an either/or proposition between renewables and gas, but rather a multi-pronged approach to reducing carbon emissions with renewables and gas power at its core.⁶

GE is uniquely positioned to play a leading role helping customers navigate the energy transition through its scale, breadth, and technological depth.

Key SSA Countries with Largest Gas Reserves (2020)

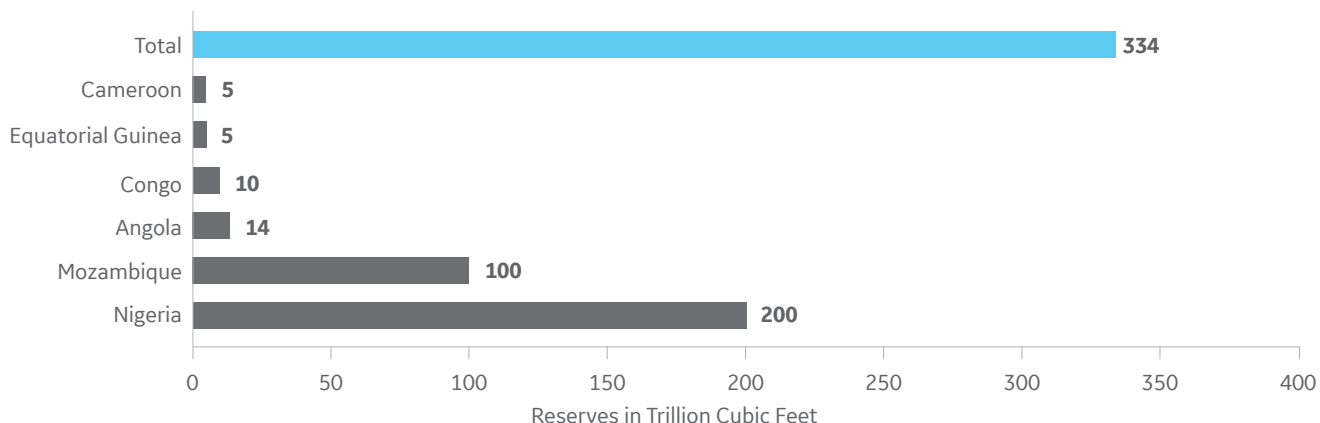


FIGURE 1 Source: Statista 2021

Introduction

THE SOUTH AFRICA CONTEXT

In October 2020, South African President Cyril Ramaphosa launched the Economic Reconstruction and Recovery Plan to drive investment in infrastructure, local production of goods, employment stimulus implementation and development of the power sector.⁷ Affordable, reliable, and sustainable electricity is South Africa's most urgent need. The country seeks 4–6 GW of power in the near-term to ease current constraints.⁸

According to the Council for Scientific and Industrial Research (CSIR), South Africa lost between R60 billion and R120 billion in 2019 due to load shedding. Thus, to transform the South African economy, spur re-industrialization and contribute to increased regional trade, a stable and reliable power supply is required.⁹

With ongoing technical and commercial reforms at the state utility, Eskom, the government expects new variable capacity, including 2.6 GW of solar and wind to be added in accordance with the fifth round of the Renewable Energy IPP Procurement Programme (REIPPP).

The South African government understands the over-reliance on coal poses a risk to climate change and its Climate Change Commission is working to ensure COP21 commitments are met.

Currently, coal accounts for 86 percent of the country's energy mix and its ageing coal-fired fleet presents an opportunity for diversification.¹⁰ The country's Just Transition plan will ensure the move to a low-carbon energy future creates more opportunities for the communities that are likely to be impacted the most.

The Department of Mineral Resources and Energy (DMRE) on 18 March 2021, announced eight preferred bidders for the Risk Mitigation IPP Procurement Programme (RMIPP), which aims to procure 2 GW of power to bridge



a looming supply gap. The announcement coincided with the release of a request for proposals (RfP) for the procurement of 2,600 MW under the Renewable Energy IPP Procurement Programme's (REIPPP) bid window 5, comprising 1,600 MW of onshore wind and 1,000 MW of solar PV.

The Risk Mitigation IPP Procurement Programme (RMIPP) presents a first—its technology agnostic approach could mean thermal, renewable and storage solutions will combine to meet a specific grid need, making the procurement for gas an even more attractive option for the future of energy.

But South Africa's energy needs go beyond the short-term.

The unbundling of Eskom's generation, transmission and distribution entities will enable a competitive energy system that promotes increased investor participation.

Reliable power supply is a prerequisite for economic development and many industries are deeply affected by power sector inefficiencies. South Africa's energy sector problems need urgent solutions.

The changing energy landscape

The continent's energy needs are critical. According to the World Economic Forum, electricity demand will triple by 2040 as incomes rise, populations grow, and governments push their industrialization drive. Financing for lower carbon gas-fired fossil projects is necessary to support the industrialization efforts and reduce energy costs for the poorest in society.

South Africa's revised Integrated Resource Plan targets a decommissioning of 10 GW of its coal-fired power capacity by 2030 with plans to supply 20 GW of the additional power needed with renewables and gas.¹¹

KEY DRIVERS FOR CHANGE

Addressing climate change is an urgent global priority—and the situation is no different in South Africa. The country has seen an increased drive for alternate energy sources in the last few

years with the launch of the Renewable Energy Independent Power Producer Procurement (REIPPP) Programme.

Renewables are the fastest growing source of new power generation capacity and electricity. This is driven by public awareness and greater concern for the environment, lower associated costs for renewable power generation, and policies that incentivize the adoption of renewable technologies. The International Energy Agency reports more than half of the global renewable capacity added in 2019 achieved lower power costs than the cheapest newer coal plants.

In South Africa and parts of the region with large gas reserves gas power can be an enabler for broader renewables adoption hence contributing significantly to the reduction of CO₂ emissions.

GAS AS A CLEANER ENERGY SOURCE

While renewables are the fastest growing source of new power generation, South Africa and the rest of the region cannot rely solely on renewables to

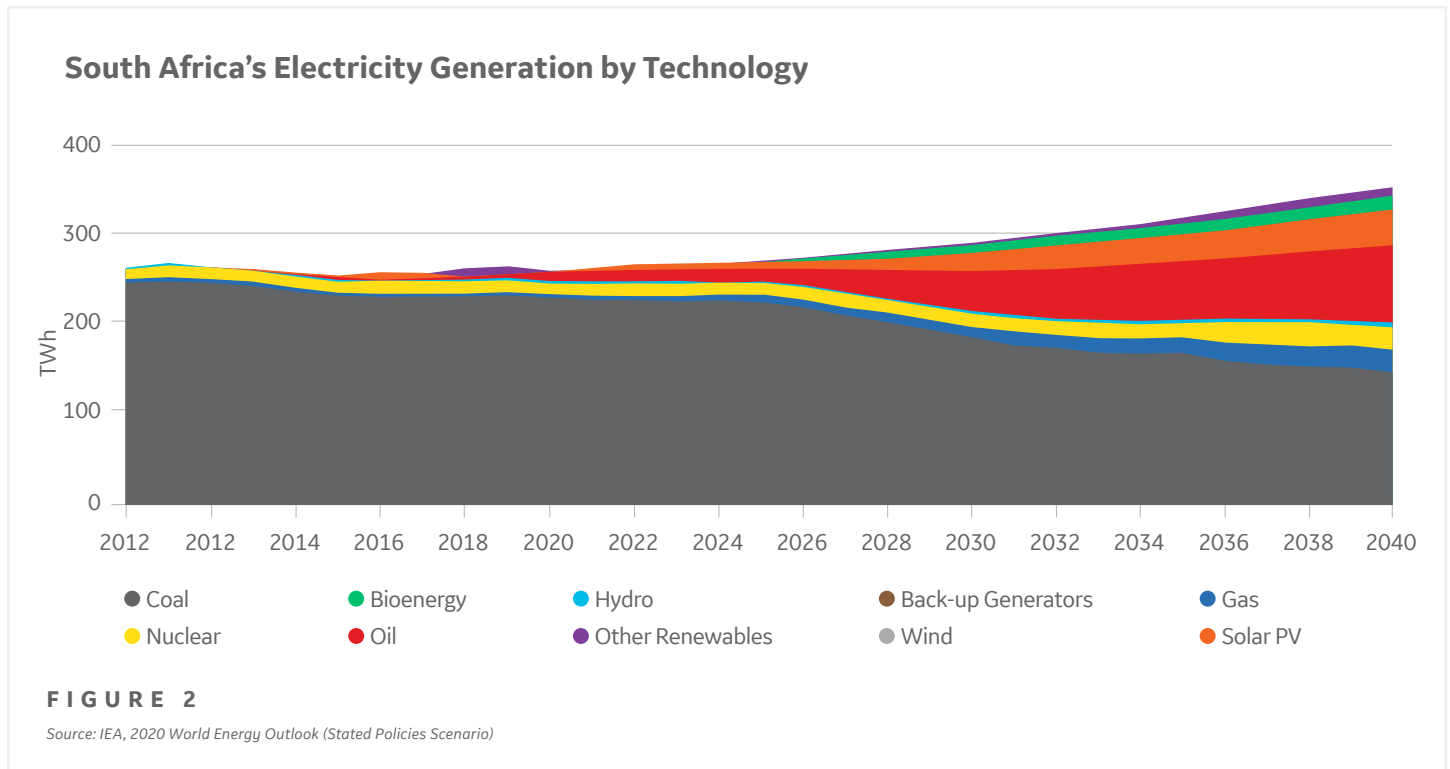
drive industrialization and economic growth, nor combat climate change.

Figure 2 below shows how South Africa's energy mix will evolve to include greater amounts of renewables, even as coal remains the dominant fuel beyond 2040 according to the International Energy Agency (IEA). An alternative to consider in the energy future narrative is a pairing of gas and renewables. Government will need to design transparent policies that support the large replacement of coal with gas and renewables.

Modern combined cycle gas-fired plants such as the H-class technology offer much lower CO₂ emissions (<320g/kWhr) than other fossil fuels (~1,000g/kWhr for coal), providing a lower-carbon alternative to coal-fired generation. Their operational flexibility can help integrate variable renewables into the energy system.

The H-class technology has higher power density. It can be deployed and be operational at scale in approximately 36 months and fits perfectly in existing coal plant's footprints, making it easier to accelerate decarbonization.*

*Decarbonization in this paper is intended to mean the reduction of carbon emission on a kilogram per megawatt hour basis.



High growth countries like China have been very deliberate about putting in place policy reforms focused on the coal-to-gas energy transition to accelerate decarbonization efforts while maintaining industrialization targets. They perhaps set an example that South Africa and other African nations may emulate. Today, China's energy policy reforms expect to reduce coal's share of electricity generation to less than 58 percent from 68 percent. In 2020, the Chinese state-owned power utility Guangdong Energy Group Co., Ltd ordered three 9HA.02 gas turbines—GE's largest and most efficient gas turbine—for the Dongguan Ningzhou combined cycle power plant in Guangdong province, in the Greater

Bay Area of China. Guangdong- Hong Kong- Macao Greater Bay Area (GBA) is a group of cities put forward by China to strengthen international cooperation and promote low-carbon, inclusive, coordinated and sustainable development projects. The plant will add more than 2 GW of highly efficient gas power to the Guangdong province in alignment with national goals to transition from coal-to-gas and further decarbonization.

Gas-fired generators have the lowest CO₂ emissions of all fossil power generation fuels—gas-fired combined cycle plants have less than 50 percent of the CO₂ emissions of a similarly sized coal plant, and lower emissions levels for other pollutants such as mercury,

NO_x, SO_x and particulate matter. In addition, GE's 9HA.02, our largest and most efficient gas turbine, can also provide a pathway to net-zero-carbon emissions through the use of low and zero-carbon fuels—including hydrogen—and carbon capture utilization and sequestration (CCUS) technologies.

The complementary nature of renewables and gas power is needed to change the near-term trajectory on emissions reduction.



Outlook for Gas

GAS SUPPLY DYNAMICS IN SOUTH AFRICA

Natural gas is seen as a destination fuel to aid South Africa’s ambitious renewable generation goals.

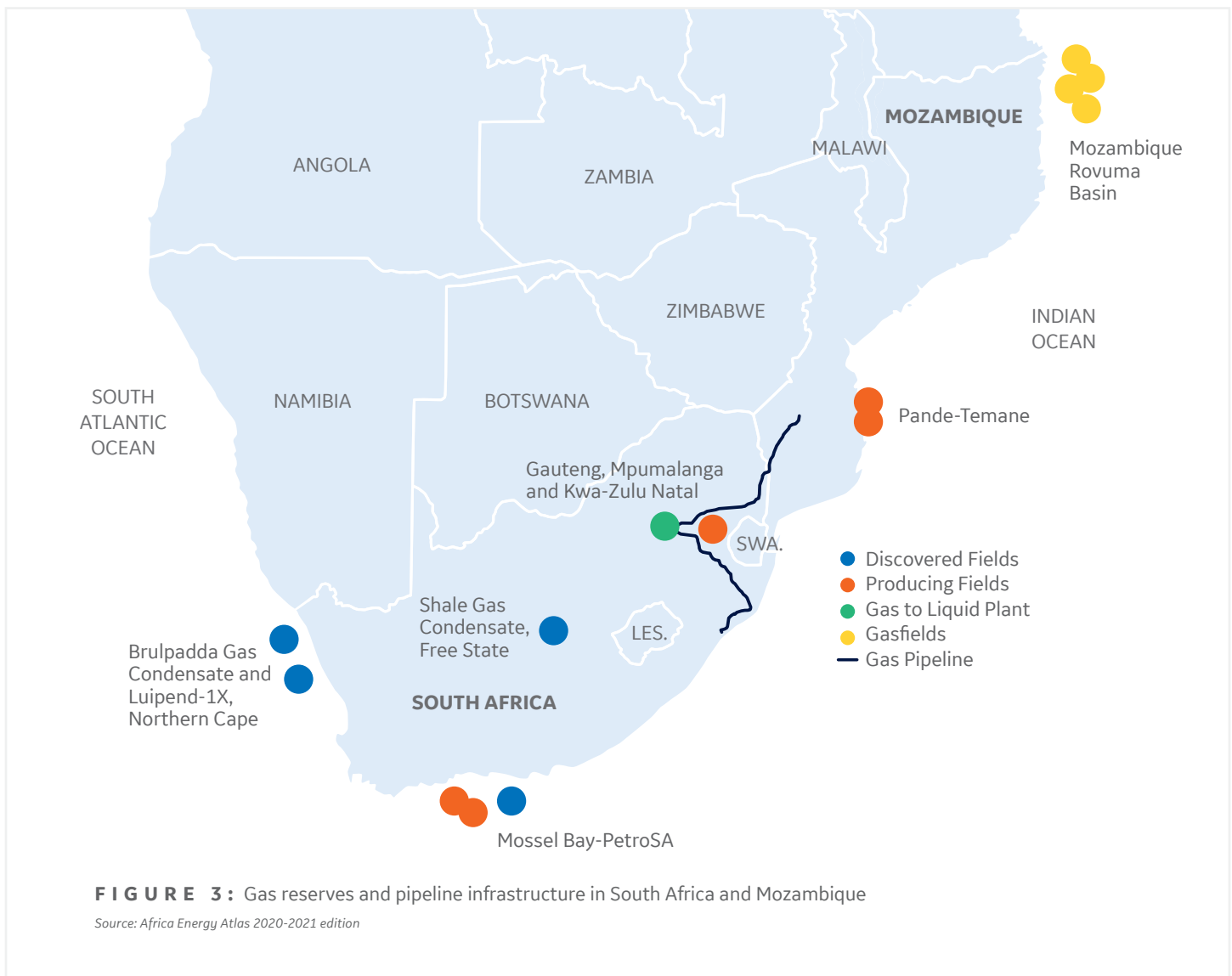
GE believes natural gas will not just be a backup fuel but also the new baseload capacity for the Coal Repurposing Programme. Natural gas-fired combined cycle power plants have the lowest emissions impact compared to other fossil fuels power plants. Their deployment, accompanied by CCUS and/or hydrogen, would represent a meaningful and long lasting reduction

of CO₂ emissions. The introduction of new LNG supply is a critical first step. The current offshore gas supply to PetroSA and Sasol from Pande-Temane fields are on the decline and have raised questions about the Gas Programme focused on power plants as the main consumer.

Recent discoveries from offshore exploration (Brulpadda gas condensate and Luipend-1X well) coupled with shale gas reserves and other marginal fields discoveries provide alternatives to gas supply. See Figure 3 below. However, commercialization from these fields are far from reality with a lot of development milestones and regulatory barriers yet to be crossed. The alternative source of gas from the Mozambique Rovuma Basin presents major challenges that need to be resolved before molecules can reach South Africa:

- High capital cost for the construction of approximately 2,600 km gas pipeline connecting the gas reserves to supply market in Gauteng, Mpumalanga and Kwa-Zulu Natal
- Operational and political risks to be mitigated for the cross country pipeline
- Current offshore Rovuma Basin Area 1 and 4 development focused on LNG liquefaction and sale

These challenges limit gas supply to South Africa as short or medium-term opportunities coupled with reticulation of gas infrastructure to be developed. LNG is seen as the quickest way of bringing gas to South Africa and being used as the basis in developing the Gas Master Plan.





LNG has become a fuel of choice for decarbonization in countries without adequate commercial gas reserves due to its competitiveness and bankability either as a bridge or destination fuel.

L N G M A R K E T

The LNG market in recent years has shifted from a typical long-term seller market to a buyer market, where spot and interruptible contracts are traded. The advancement in technology and increase in liquefaction projects will be the key drivers to achieve competitive and favorable LNG supply dynamics in the next two decades. Liquefaction projects

reaching final investment decisions in 2020 reached 70.4 Mtpa with the United States, Russia and Mozambique being the major financial contributors. Commercial operations of liquefaction facilities saw an increase of nearly 10 percent of global capacity (38.8 Mtpa) in 2019.¹²

Global LNG Trading is projected to double by 2040 with 130 Mtpa of regasification capacity under construction adding about 15 percent to global capacity when operational.¹³ GE projects that the timing is right for South Africa to implement its Gas-to-Power Programme and take advantage of the current LNG market dynamics. However, regulatory clarity on Transnet's role, Eskom's liquidity issues

and the country's economic struggles have raised a few potential issues on:

- Government's implementation approach; integrated Gas-to-Power Programme or decoupling the gas supply solution from the Power generation Programme
- The role of Transnet and the Central Energy Fund (CEF) in the construction and operation of an LNG infrastructure terminal and distribution pipelines
- The risk mitigation strategies for LNG Sales and Purchase Agreement (LNGSPA) for both the anchor consumer (IPP) and other industrial customers
- The Forex risk associated with switching from coal (SA Rand traded) to LNG (US Dollar traded)

These undoubtedly have created inertia in the gas market and have stymied the progress of consultation awaiting Government directives on its strategy.

The Energy market currently views the Gas-to-Power Programme as either an integrated approach or as decoupling Gas Supply Infrastructure from the Power Generation Programme. Either of the two presents its own risk profile and the government needs to make a call on its preferred approach.

THE GOVERNMENT'S IMPLEMENTATION APPROACH

Import infrastructure development will be quicker to implement in an integrated approach model than decoupling gas supply.

The current structure of Transnet presents a "hub and spoke model" with a Tolling arrangement. However, this creates:

1. market residual risk from aggregating demand
2. project-on-project risk
3. operational risk of Transnet's ability to meet the project timelines, and
4. operational requirements and volumetric risk of satisfying the required needs as defined by the IPP

Lenders will request the risk mitigation strategy for the gas supply to the IPP, and the role of Government is also linked with whether it can accept liabilities and if yes, whether it will meet its default obligations. However, a bundled approach allows the Gas-to-Power project consortium to manage project-on-project risk (LNG Terminal and Power Plant Infrastructure). The consortium also bears the liabilities for failure to dispatch power either because of Gas supply operations or power plant operations, hence ensuring all requirements of Lenders are met to facilitate project implementation.

ROLE OF TRANSNET AND THE CEF IN REGULATION

The market is concerned about the delay of the Gas-to-Power Programme coupled with three updates of the Integrated Resource Plan (IRP) draft since 2015. The role of key state-owned enterprises like Transnet and CEF in the Gas Programme is still being defined. The issue of a licensing regime for commodity import, infrastructure and pipeline operations still needs clarification. The commencement of the port infrastructure and pipelines (time lag item) and strategy on the Coegha and Richards Bay deployment are still lingering in the market. The IPPs, OEMs, gas suppliers and lenders await government's preferred implementation approach.

LNG SOURCING RISK MITIGATION STRATEGY

Whilst the integrated approach opens opportunities for long-term LNGSPA linked with PPA, the decoupled approach gives the option of spot buy and interruptible LNGSPA.

Lenders and gas suppliers prefer long-term supply contracts on a take-or-pay basis. Although a state entity like Transnet's role in the gas structure may reduce the take-or-pay obligation for the LNG supply, it creates counterparty risk in the Gas-to-Power Programme which will prejudice the integrity of the gas supply stream whilst adding a layer of cost to the gas supplied at the delivery point to the power plant. An integrated approach with Government taking an equity stake will deliver competitive LNG molecules.

FOREX RISK MITIGATION STRATEGY

Whilst the Consumer Price Index (CPI) of coal is linked to the South African Rand, that of LNG import is linked to the US dollar. Gas suppliers prefer payment of LNG delivered in US dollars whilst Government communication has been in SA Rand. The Risk Mitigation IPP Procurement Programme (RMIPP) provided some mitigation strategies and same is expected of the Integrated Resource Plan (IRP).

TRANSFORMING SOUTH AFRICA'S INDUSTRIES

South Africa's economy is driven mostly by its industries. The decline in economic activities in the country is partly attributed to power supply insecurities and continued tariff hikes by the utility to attain cost reflective tariffs, make it difficult to sustain operations and attract investors.

South Africa is a greenfield in the oil and gas industry.

It is imperative that extensive gas policies and developmental goals are established to ensure the country reaps all the benefits it comes with. Besides Gas-to-Power, developing the gas infrastructure will benefit the transportation, fertilizer and petrochemical industries. For instance, logistics companies switching from diesel to LNG for their long-haul trucks will see an estimated cost saving of between 15 percent and 25 percent.¹⁴

Policy frameworks will guide investment

DOES THE EXISTING POLICY AND REGULATORY FRAMEWORK SUPPORT REPLACING LARGE COAL WITH GAS AND RENEWABLES?

South Africa's Integrated Resource Plan (IRP) sets out a power generation road map for the country and this has gone through a series of revisions mostly driven by change in assumptions and the need for cleaner energy. The 2018 IRP laid out a plan that will increase the energy mix of gas to 15.7 percent (11.9 GW) and wind and PV to 25.6 percent (19.4 GW) by 2030. However, in the latest IRP released in October 2019, the share of gas has reduced to 8 percent and that for solar and wind increased to 33 percent. See Figure 4. This clearly shows the shift from more gas to more decentralized renewable energy to replace coal.

GE cautions against policies which aim to predict the future, setting narrow pathways for technologies and energy sources. Energy policy framework needs to balance transparency with flexibility, ensuring it will send the right signals to markets for a cost effective energy transition.

With South Africa's unemployment rate sitting at a record high of over 30 percent, large infrastructure projects could play a role in spurring economic growth and creating opportunities for jobs, new skills, and industrialization.

IMPACT OF CHANGING FUEL MIX ON CO₂ EMISSIONS

South Africa is the 14th largest emitter of greenhouse gases in the world, emitting 467.5 million tons of CO₂ in 2018 and accounting for only 1.28 percent of global emissions.

However, the country has higher per capita emissions than China, India and the UK as shown in Figure 5.

Change in RE and Gas Target by 2030

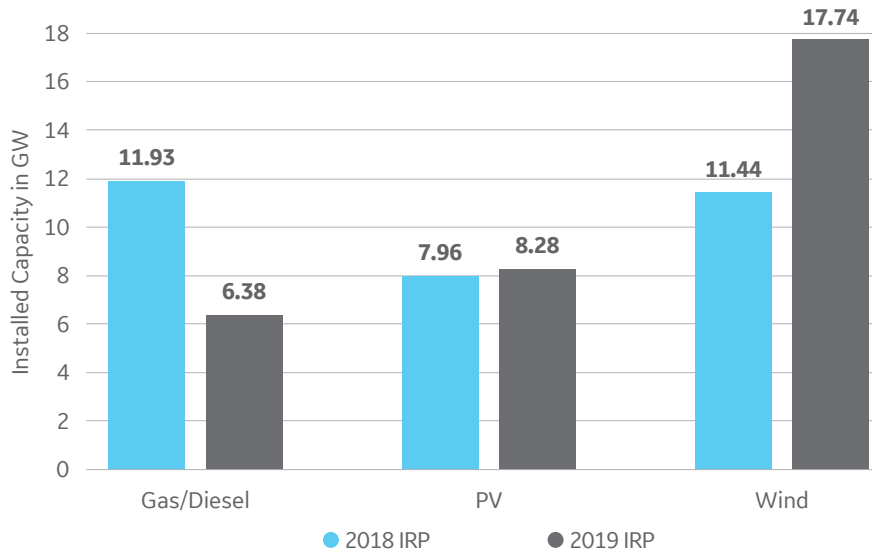


FIGURE 4: Wind and PV expected to contribute 33 percent of installed capacity according to the 2019 Integrated Resource Plan (IRP)

Per Capita CO₂ Emissions in South Africa, UK, India and China

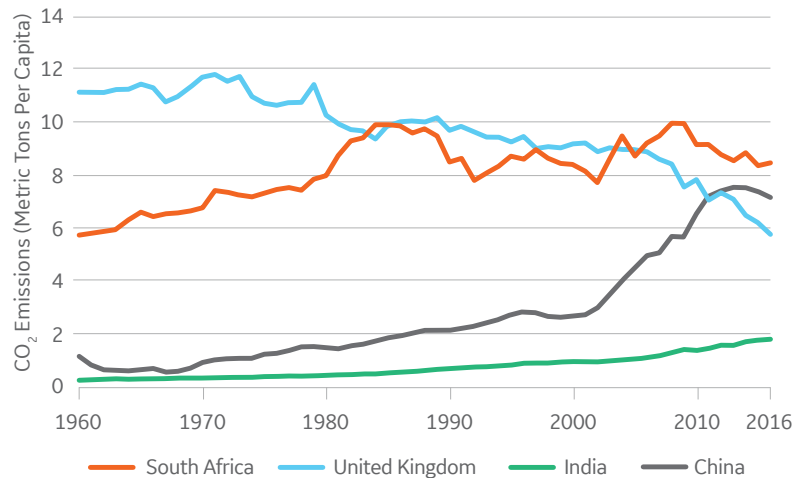


FIGURE 5
Source: The World Bank Data

The country's heavy reliance on coal is the major contributor, with coal-fired plants accounting for 84.5 percent of total CO₂ emissions.¹⁵

The move to a more diversified fuel mix will see a drastic reduction in the carbon footprint of the country. Gas produces 50 to 60 percent less CO₂ when combusted than a typical coal plant and 30 to 40 percent less

than a diesel plant.¹⁶ Hydrogen and carbon capture, storage and utilization (CCUS) are both viable pathways toward low to near-zero emissions from power. According to McCoy Power Reports, GE has over 35 years of experience and the largest installed fleet in terms of MW and unit count with H₂ and low BTU fuels. Our most efficient 9HA.02 gas turbine is capable of burning a 50/50 H₂/natural gas fuel blend by volume.



GOVERNMENT’S COMMITMENT TO EMISSIONS REDUCTION

South Africa signed the Paris agreement on 22 April 2016 and ratified it on 1 November 2016. In response to the Paris agreement’s call for countries to set out long term climate strategies, the country’s cabinet approved the goal to become a net zero economy by 2050.¹⁷

The 2019 Integrated Resource Plan (IRP) outlines how the power sector will be reformed to help meet their target.

The government is committing to decommission and repurpose coal plants, reducing the percentage of coal in the energy mix from ~90 percent to 45 percent by 2030 and 5 GW of coal still forecasted to be operating post 2050.

Achieving their emissions target and still having 5 GW coal plant operating means the country plans to invest in carbon capture and storage.¹⁸

The government understands that gas is crucial to enable the transition from coal to renewable energy.

South Africa’s favorable conditions for wind power and its solar potential will also be utilized to help meet the 2050 target.

A carbon tax was also introduced in February 2019 covering fossil fuel combustion emissions, industrial processes, product use emissions and fugitive emissions such as those from coal mining. The proposed carbon tax rate is R-120/tCO₂e (USD 8/tCO₂e). However, the first phase (2019–2022) will see parties benefiting up to 95 percent tax exemptions, resulting in an expected tax rate between R6–48/tCO₂e (USD 0.4–3/tCO₂e).^{19, 20}

This law will affect about 1,000 to 1,500 companies and 75 percent of national emissions. A leading Steel Company has estimated that, they could pay up to 600 million Rand (\$54.5 million) as carbon taxes a year at the current tax rate.²¹



FIGURE 6: Deepsea Stavanger Drill rig, arrived in Cape Town on 13 August 2020

According to the Climate Action Tracker, South Africa’s 2019 Integrated Resource Plan (IRP) will only enable the country to meet its 2030 Nationally Determined Contributions (NDC’s) target. However, more measures need to be implemented beyond the IRP to meet the Paris Agreement target of well below 2° C.

Partnering and Financing

While there is no universal blueprint for implementing a coal-to-gas transition, many case studies exist from countries like Poland, China, and India that provide applicable references on the socioeconomic impact of transitioning to a greener economy.²²

Beyond recognition of the importance of infrastructure roll out for economic growth, other crucial considerations for South Africa as it embarks on its Gas Programme include, building partnerships between private and public sectors, finding sustainable solutions to funding shortfalls and the effective implementation of projects from beginning to end.²³

Through proper co-ordination between all participants, South Africa's Gas Programme can be the inclusive approach which brings along workers and communities historically reliant on the country's vast coal sector.

FUNDING AVAILABLE FOR GAS PROJECTS

International financing is shifting to renewable energy as the push for clean energy advances. However, the World Bank and its private sector arm, the International Financial Corporations are still committed to ensuring that Africa gets the needed support to industrialize and grow its economy. Thus, it continues to offer funding for gas power projects.²⁴

POLICIES

TARIFF MODELS

A cost-reflective tariff is necessary in South Africa, considering the changes that have taken place in the energy sector.

The National Energy Regulator of South Africa (NERSA) in charge of the energy sector tariff regime has initiated steps to reform the methodology used for tariff determination to reflect recent energy dynamics.²⁵

POWER MARKET ATTRACTIVENESS

There are several factors that make South Africa's gas power market attractive. These include:

- Available demand for gas either as baseload or backup to Government's aggressive renewables goal;
- Progressive policy as evidenced in Government's commitments to the Paris Agreement, coal repurposing Programme and amplified interest in renewable energy;
- Gas availability in the region, international LNG availability and market innovation in pricing and infrastructure technology coupled with South Africa's gas discoveries;
- A track record of rolling out large infrastructure Programmes, i.e., the Renewable Energy IPP Procurement Programme (REIPPP) with 6000 MW procured from 2010 to date;
- Sound institutions, particularly the deep local lending capability.



GE's Blueprint for the Energy Transition

The most effective way to ensure power system reliability and energy security is through a mix of generation sources. No single form of power generation is optimal in every situation or economy. For example: wind and solar are variable but consume no fuel and emit no CO₂; gas-fueled generation emits CO₂ but is dispatchable (i.e., has output that can be readily controlled between maximum rated capacity or decreased to zero) to help balance supply and demand; hydro power often requires dedicating significant amounts of land area but is zero-carbon, renewable and dispatchable, and can provide long-term, low-cost energy storage.

GE believes in and promotes additional renewables capacity, augmented where needed with gas generation to provide system flexibility and dependable capacity, as the most effective near-term action to decarbonize the energy sector. Given the time it takes to deploy new renewables and to implement energy efficiency improvements, coal-to-gas switching represents a potential quick win for emissions reductions.

As a technology and service provider for the full length of the energy value chain, GE has a unique perspective on the energy transition and has a suite of complementary technology.

For South Africa however, GE's 9HA gas turbine is the best solution.

GE's HA gas turbine portfolio is the world's fastest-growing fleet with more than 100 units ordered by more than 40 customers across 20 countries. Our second-generation H-class fleet with HA technology, expects to achieve 1 million operating hours of commercial experience in the coming months. Weighing nearly 400 tons, as much as two big blue whales, GE's 9HA is the result of a US \$2 billion investment by GE Gas Power that offers more than 64 percent combined cycle efficiency, leading to the remarkably cost-effective conversion of fuel to electricity to help meet increasingly dynamic power demands.

This record-setting efficiency is delivered with the help of GE's Digital Power Plant capabilities, which help to unlock power that had previously been inaccessible.

Capabilities, including the digital control system, use real-time data to deliver better plant outcomes with stable and efficient operations, while providing valuable predictive insights for higher reliability and optimization.

GE's 9HA units deliver exceptionally low life cycle costs per megawatt-hour. The economies of scale created by this high-power density gas turbine are unprecedented. Moreover, the turbine offers industry-leading flexibility. It allows customers to maintain stable power production and to reliably accommodate grid variations through quick start up, rapid load changes and other features. It can reach from start to full load in less than 30 minutes. This enables the HA to deliver reliable and flexible operations not just for large power plants and utilities but also for captive power plants or small grids. It also enables the greater use of renewable energy by enabling quick responses to fluctuations in grid demand and weather changes.

GE's 9HA also accommodates both gas and liquid fuels with wide gas variability and has the capability to transition from gas to hydrogen, paving the way to a more decarbonized world. Its fuel flexibility is an ideal fit for South Africa.

AN INTEGRATED LNG TO POWER MODEL IN PORTO DO SERGIPE (1.5 GW), BRAZIL

The 1.5 GW Sergipe project²⁶ is the first Integrated LNG-to-Power project in Brazil and the largest and most efficient thermal power station in Latin America. The project was financed by a Goldman Sachs BRL 3.2 bn (USD 925 million) bond backed by the Swiss Export Credit Agency. Inter-American Investment Corporation (ICC) and The International Finance Corporation (IFC) provided the debt facility, which comprises USD 288 million and USD 200 million respectively.

The LNG infrastructure consists of:

- A dedicated new built Floating Storage and Regasification Unit (FSRU), Golar Nanook, with a storage capacity of 170,000 m³ and regasification capacity of 21 million cubic meters per day of gas
- A 6.5 km gas pipeline connecting the FSRU to the power facility
- Ocean LNG, a joint venture of Qatar Petroleum (70 percent) and ExxonMobil (30 percent), signed a long-term LNG Sales & Purchase Agreement with the CELSE (Project Company) to supply 1.3 Mtpa of LNG for the project.

The power plant infrastructure was built on 511,622 m² (51.16 ha) site consisting of:

- Three 7HA Gas turbines
- A steam turbine
- Three heat recovery steam generators (HRSG)
- 33 km transmission line and a sub station

GE, the major equipment OEM was also awarded the engineering, procurement, and construction (EPC) contract. GE also entered into a Contractual Service Agreement (CSA) and a long-term operations and maintenance (O&M) agreement for the project.

Under the terms of the PPAs, the project has guaranteed an annual capacity payment of approximately BRL 1.6 bn (USD 311.1 million), adjusted annually for local inflation, coupled with pass-through fuel and operating costs according to dispatch. The project provides cleaner, more reliable large-scale power for growing communities and helping facilitate Brazil's transition to lower-carbon energy.

GE believes the Sergipe LNG-to-Power Integrated approach can be replicated in South Africa under the Integrated Resource Plan (IRP) implementation.

The Path Forward: Recommendations

Access to affordable, reliable, sustainable energy is a basic human right and it's what's needed to transform South Africa and the rest of the continent's industries. Renewables and gas provide a powerful combination to addressing the CO₂ emissions challenge.

GE believes that accelerated and strategic deployment of renewables and gas power can change the trajectory for climate change, enabling substantive reductions in emissions quickly, while in parallel continuing to advance technologies for low or near zero-carbon power generation.

GE's 9HA gas turbine is at the heart of the world's most efficient combined cycle gas power technology and can provide affordable, reliable, and sustainable power. Replacing coal plants with efficient gas power plants is a major way to decarbonize. The 9HA technology also offers grid firming and load following capabilities to support the heavy renewables planned for the South African grid.

International Developers & IPPs, gas suppliers and lenders understand and are experienced in the Gas-to-Power Programme. Issues raised by market players need to be addressed to facilitate the implementation of the Integrated Resource Plan (IRP). This is the first of its kind in South Africa, and the market will implement international practices and precedent in developing the contractual and legal framework especially when the LNG to Power Programme is at its infancy in sub-Saharan Africa.

Concerns raised by the Industrial Gas User Association (IGUA-SA) that the Gas Programme is dependent on new power project whilst neglecting industrial consumers are legitimate, however, the only anchor demand available to accelerate the

implementation of the Gas Master Plan is a Gas Generation plant.²⁷ The Integrated approach reduces risk exposure and facilitates the LNG Supply infrastructure. The government's strong position of Transnet's role in import infrastructure is formidable. This can be achieved via equity participation in an import Terminal by Transnet whilst linking the LNG commodity Sales and Purchase Agreement with the Power Purchase Agreement (PPA).

To successfully implement the Integrated Resource Plan (IRP) Programme, GE believes the Government will need to adopt the bundle approach whilst acquiring an equity stake to ensure skills transfer over the course of the programme. New entry LNG market countries

have successfully implemented their Gas Programme through the bundled approach of Gas-to-Power (example is the 1.5 GW Sergipe LNG to Power Project in Brazil).

Addressing climate change will require government and consumer action. GE is uniquely positioned to play a key role through its scale, breadth, and technology depth.

We have been a key player in the power industry since its inception more than a century ago and have a suite of complementary technology including gas-fired power, onshore and offshore wind, hydro, small modular reactors, battery storage, hybrids, and grid solutions needed for the energy transformation.

We believe it is our responsibility to support this transition through our relationships with customers, policy makers, and consumers, collaborating to build an energy system that works for everyone.

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