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The Role of Natural Gas in the South African Energy Mix

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Natural gas is acknowledged as the fuel for the 21st century, it is the cleanest fossil fuel. Natural gas is the fastest growing energy source, it will dominate the energy sector for the next 30 years (i.e. 2050). The world proven reserves in 2018 were 196.9 × 10^{12} m^3, if we take 2018 gas consumption, this gas will take us another 51 years. The world natural gas reserves increased from 130.8 × 10^{12} m^3 in 1998, to 170.2 × 10^{12} m^3 in 2008, to 196.9 × 10^{12} m^3 in 2018. The world gas reserves will keep increasing for both conventional and non-conventional gas (i.e. shale gas).
The world electricity production by source in 2018 was dominated by coal (38 %) and natural gas (23 %), while in South Africa more than 90 % of electricity is produced from coal. South Africa's coal consumption was the highest in the world (70.7 %), even higher than China (58.2 %) and India (55.9 %), both of them the biggest consumer of coal in volumes, while South Africa natural gas consumption is very low (3 %). The South African government's international climate change and carbon reduction commitments can be satisfied by increasing natural gas in the energy mix and reducing the coal and oil consumptions in the transition phase. The two sectors that natural gas can play a role in the energy mix are electricity production (i.e. gas to power) and transportation (i.e. GTL, CNG and LNG). This paper will discuss in detail how South Africa can substitute coal and oil with natural gas, particularly, electricity production and transportation to satisfy decarbonisation.

1. Introduction

Natural gas, although a fossil fuel, was very recently considered a source of green energy through gas fired power plants by the European Commission in addition to nuclear. According to the International Energy Agency, the burning of coal accounts for 45 % of the world's total carbon emissions from fuel combustion, ahead of oil (35 %) and natural gas (20 %) (Tordoir, 2022). In the Paris Agreement, many nations set ambitious global goals to stabilize and reduce carbon emissions to mitigate climate change. A large share of these emissions is caused by electricity generation. Pressure to reduce coal use has been increasing worldwide. Germany and France have decided to phase-out coal, while China is investing heavily in renewable sources to reach carbon neutrality by 2060 (Tordoir, 2022). According to International Energy Agency coal-to-gas switching reduces emissions by 50 % when producing electricity and by 33 % when providing heat (IEA, 2019). The global reduction of power sector CO_2 emissions in 2019 was driven by shifting from coal to natural gas (Tordoir, 2022). Natural gas might help the energy transition by reducing emissions compared to coal. However long-term implications of investing in natural gas might crowd out investments in renewable alternatives (Gursan and de Gooyert, 2021).
The world natural gas reserves increased from 130.8 × 10^{12} m^3 in 1998, to 170.2 × 10^{12} m^3 in 2008, to 196.9 × 10^{12} m^3 in 2018 (BP. 2019). The world gas reserves will keep increasing for both conventional and non-conventional gas (i.e. shale gas). Russia was the first in the world *vis a vis* reserves in 2018, with 38.9 × 10^{12} m^3, followed by Iran with 31.9 × 10^{12} m^3. The third in the world was Qatar with 24.7 × 10^{12} m^3, followed by Turkmenistan, USA, Venezuela, China, United Arab Emirate and Saudi Arabia. Nigeria was the first in Africa (10th in the world) with 5.3 × 10^{12} m^3, followed by Algeria (11th in the world) with 4.3 × 10^{12} m^3. Egypt was the 3rd in Africa (16th in the world) with 2.1 × 10^{12} m^3, and Libya was the 4th in Africa (21st in the world) with 1.4 × 10^{12} m^3. USA was the biggest consumer of natural gas with 817.1 × 10^9 m^3 in 2018, followed by Russia, China, Iran, Japan, Canada, Saudi Arabia, Mexico, Germany and the UK (i.e. 78.9 × 10^9 m^3). South Africa consumed 4.3 × 10^9 m^3 in 2018, which is very low (BP, 2019).

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2. South Africa energy mix

The energy mix of selected countries, including the BRICS countries, are summarized in Table 1. The South African energy consumption in 2018 was 121.6 × 10^6 t oil equivalent. The coal contribution to the South African energy mix was 70.7 %, followed by oil (21.6 %). Natural gas, renewable and nuclear contributed by 3.1 %, 2.3 % and 2.1 % respectively. The South African coal consumption is the highest in the world (70.7 %), even higher than China (58.2 %) and India (55.9 %). China and India are the biggest consumer of coal in volumes. South African natural gas consumption is one of the lowest in the world, covering only 3.1 %.

Table 1: Energy consumption by country in 2018 (10^6 t oil equivalent) (BP, 2019)

Country	Natural Gas	Coal	Oil	Nuclear	Hydro	Renewable	Total
China	243.3	1,906.7	641.2	66.6	272.1	143.5	3,273.4
USA	702.6	317.0	919.7	192.2	65.3	103.6	2,300.6
India	49.9	452.2	239.1	8.8	31.6	27.5	809.1
Russia	390.8	88.0	152.3	46.3	43.0	0.3	720.7
Japan	99.5	117.5	182.4	11.1	18.3	25.4	454.2
Germany	75.9	66.4	113.2	17.2	3.8	47.3	323.8
South Korea	48.1	88.2	128.9	30.2	0.7	5.0	301.1
Brazil	30.9	15.9	135.9	3.5	87.7	23.6	297.5
France	36.7	8.4	78.9	93.5	14.5	10.6	242.6
UK	67.8	7.6	77.0	14.7	1.2	23.9	192.2
Italy	59.5	8.9	60.8	0.0	10.4	14.9	154.5
South Africa	3.7	86.0	26.3	2.6	0.2	2.8	121.6

South Africa's indigenous energy-resource base continuous to be dominated by coal and the country's dependency on coal-based energy is unlikely to change significantly in the next two decades (Ratshomo and Nembahe, 2021). Globally, South Africa was the 7th biggest consumer of coal in 2018, with 86 × 10^6 t oil equivalent, while in 2008, South Africa consumed 93.3 × 10^6 t oil equivalent. South African coal reserves ranked 12th in 2018, with reserves of 9,893 × 10^6 t. China was the biggest consumer of coal in 2018, with 1,906.7 × 10^6 t oil equivalent, followed by India with a consumption of 452.2 × 10^6 t oil equivalent (BP, 2019).

South Africa has the 3rd largest oil refining capacity in Africa amounting to 3,451.8 m^3/h. By adding synthetic fuels production, including 990 m^3/h Sasol CTL (Coal To Liquids) plants and 297 m^3/h PetroSA GTL (Gas To Liquids) plant, South Africa will be the second largest refiner in Africa (SAPIA, 2019). Owing to the lack of reserves, South Africa imports all its crude oil. In 2018, Saudi Arabia supplied 43 % of South African crude oil requirements, followed by Nigeria (33 %) and Angola (12 %). Ghana and United Arab Emirates supplied 5 % each, while Togo supplied 1 % (Ratshomo and Nembahe, 2021).

In 2018, natural gas made up 3 % of the total energy supply in South Africa. Natural gas domestic production amounted to 12 % in 2018, whilst import amounted to 88 % (Ratshomo and Nembahe, 2021). The only South African gas productions are from offshore Bredasdrop basin own by PetroSA. The F-A and satellites, E-M and F-O gas fields secured nearly 39 × 10^9 m^3 gas and 6.2 × 10^9 m^3 condensate for the GTL plant (SAGMP, 2021). 90 % of South Africa's existing natural gas demand is supplied by a single entity, namely Sasol Gas. The gas is imported from Temane and Pande gas fields in onshore Mozambique, with a combine reserves of 73 × 10^9 m^3, via ROMPCO 865 km pipeline commissioned in 2004. Sasol Gas imports approximately 3.9 × 10^9 m^3 of natural gas annually, of which 2.8 × 10^9 m^3 is used by Sasol in the GTL and chemicals plant at Secunda, while the balance is distributed to commercial and industrial customers via a pipeline network covering more than 2,000 km in the Free State, Gauteng, Mpumalanga and KwaZulu-Natal (Ratshomo and Nembahe, 2021). The Sasol Secunda CTL plant produces close to 0.5 × 10^9 m^3 methane rich gas annually. Tetra4's existing CNG plant in Virginia in the North West Province, can produce up to 0.0028 × 10^9 m^3 annually from one well.

Africa accounts for less than 3 % of the world's installed renewables-based electricity generation capacity (IRENA, 2021a). Nevertheless, in the last decade (2010-2020), the renewables-based generation capacity on the continent has grown by 7 % (IRENA and AfDB, 2022). Regionally, Southern Africa led total renewable generation capacity in 2020 with 17 GW, or around a third of Africa's total, followed by North Africa's total (IRENA, 2021). Solar and wind contributed the most to the African installed renewable-based electricity generation capacity. Solar energy is now the fastest-growing renewable energy source in Africa. South Africa and Egypt are Africa's two largest solar producers, accounting for over three-quarters of installed solar capacity in 2020 (IRENA and AfDB, 2022). Africa's installed solar generation capacity in 2020 was 1,0431 MW. South Africa contributed 57 %, while Egypt contributed 16 % (IRENA, 2021). Wind resources remain highly underexploited in Africa. At the end of 2020, wind generation capacity in Africa amounted to 6.5 GW, of which

some 0.7 GW was added in 2020 (IRENA and AfDB, 2022). Africa's installed wind generation capacity in 2020 was 6,479 MW. South Africa contributed 41 %, Morocco contributed 22 % and Egypt contributed 21 % (IRENA, 2021).

3. South African electricity generation

Between 2010 and 2018, total installed generation capacity in Africa increased from around 155 GW to almost 245 GW (IEA, 2019). Natural gas used for electricity generation in 2019 in Africa amounted to 42.6 %, mainly in North Africa, followed by coal (28.1 %), then hydropower (17.4 %) (IRENA and AfDB, 2022). South Africa accounts for 85 % of the almost 50 GW of coal fired capacity on the African continent (IEA, 2019).
South Africa's electricity generation depends largely to coal. Coal fired power plants amounted to 83 % in 2019, a decrease from 2018 (90 %) (Eskom, 2019). Eskom operated 15 coal fired power plants with a total capacity of 43,256 MW as March 2021 (Eskom, 2021). All the coal fired power plants are concentrated in Mpumalanga Province, except Lethabo in Free State and Matinba/Medupi in Limpopo. According to Merven et al. (2021), there are 6 coal fired power plants that will be decommissioned by 2030 with a total capacity of 10,711 MW. All the 6 plants are regrouped in the same region in Mpumalanga.
Currently, there are six open cycle gas turbine (OCGT) peaking plants in South Africa, utilising diesel as fuel source. Four of these plants are operated by Eskom and two by International Power, with a total capacity of 3,763 MW. All these six plants are located at the coast, three in the Western Cape, two in the Eastern Cape and one in KwaZulu Natal.
There is only one nuclear power plant in Africa, located 30 km north of Cape Town in the Western Cape and operated by Eskom. Nuclear energy contributed 2.6 % of the total South African energy supply. Koeberg nuclear power plant contains two 970 MW uranium pressurized water reactors, with a total capacity of 1,940 MW. Eskom is running a long-term operation (LTO) project that will extend the life of Koeberg for an additional 20 years to 2045 (Eskom, 2021). Eskom operated three peaking pumped storage schemes, namely Drakensberg (1,000 MW), Ingula (1,332 MW) and Palmiet (400 MW). Also, Eskom operated two hydroelectric stations, namely Gariep (360 MW) and Vanderkloof (240 MW).
Despite that South Africa is leading Africa in solar energy generation (57 %) with a total capacity of 5,945 MW, and wind energy generation (41 %) with a total capacity of 2,656 MW (IRENA, 2021), the contribution of the renewable energy to the energy mix is low (i.e. 2.8 %) (BP, 2019). The South African renewable energy is based on solar and wind. The onshore wind power contributed in 2020 with 52 % of the total renewable energy capacity, which represent 0.2 % of maximum generation capacity mix, followed by photovoltaic power with 36 % and concentrated solar power with 9 %, and the balance is covered by biomass, landfill gas and small hydro-technologies (Ratshomo and Nembahe, 2021). There are 25 onshore wind farms in South Africa with different capacity. The biggest wind farm is Khobab with 140 MW, 10 farms over 100 MW, 9 plants between 50 and 100 MW and 6 plants between 20 and 50 MW (Akinbami et al., 2021). There are 22 solar PV plants in South Africa. Aries Solar is the biggest solar PV with 97 MW, followed by Jasper (96 MW), 18 plants more than 50 MW and the smallest plant is Greefspan (10 MW). There are 6 concentrated solar power (CSP) plants, 4 with 100 MW capacity and two with 50 MW each (Akinbami et al., 2021).

4. South African transportation sector

South Africa produces liquid fuels from oil, covering 54.4 % of the total fuel demand, while coal covered 42.3 % of the total demand via Sasol coal to liquids (CTL) plant. Natural gas produced 3.2 % of liquid fuels by PetroSA, in its Mossel Bay gas to liquids (GTL) plant (Ratshomo and Nembahe, 2021). According to the 2018 Energy Balances, 66 % of the total petroleum products supply was produced locally, imports amounted to 23 % and exports amounted to 11 % (Ratshomo and Nembahe, 2021). South Africa produced 4,738.8 m^3/h fuels by four crude oil refineries, one CTL synthetic plant, and one GTL synthetic plant.

5. Natural gas in Southern Africa

Nigeria (5.3×10^{12} m^3), Algeria (4.3×10^{12} m^3) and Egypt (2.1×10^{12} m^3) are among the world's 20 largest producers of natural gas. Major new natural gas developments in Egypt, Mauritania, Mozambique, Senegal and Tanzania, accounting for over 40 % of global gas discoveries between 2011 and 2018 (EIA, 2019). Mozambique has the largest gas discovery among the new discoveries in Africa, which holds over 2.8×10^{12} m^3 of proven reserves. The Rovuma basin is an offshore gas field bordering Tanzania. Area 1 has an estimated reserve of 1.8×10^{12} m^3, while Area 4 has an estimated reserve of 2.4×10^{12} m^3.
An onshore LNG (liquified natural gas) facility, Mozambique LNG, will be built in Carbo Delgado in Area 1 with a capacity of 12.88×10^6 t/y by Total, while Coral FLNG (Floating liquified natural gas) facility will be built offshore in Area 4 with a capacity of 3.4×10^6 t/y by Eni. The second onshore facility, Rovuma LNG, will be built by

ExxonMobil-Eni-CNPC with a total capacity of 15.20 × 10^6 t/y. Tanzania's natural gas reserve is estimated at 1.6 × 10^{12} m^3 in three fields, Songo Songo, Mnazi Bay and Kiliwani North. TLNGP (Tanzania Liquified Natural Gas Project) is the only LNG export terminal in Tanzania. The project is located in the town of Lindi on the Indian ocean coast. The construction of the onshore LNG export terminal is expected to start in 2022 and will be concluded in 2028. The LNG plant will have capacity to produce 10 × 10^6 t/y of liquified natural gas by a consortium led by Equinor, along side Royal Dutch Shell, ExxonMobil, Ophir Energy and Pavilion Energy.

6. Natural gas import to South Africa

The international climate change and carbon reduction commitments made by the South African government can be satisfied by integrating natural gas in the South Africa's future energy mix diversification. The Integrated Resource Plan 2019 aim to increase natural gas in the energy mix from 3.1 % to 15.7 % by 2030. The utilization options for natural gas in South Africa are electricity generation, industrial, transportation and commercial/residential sectors, while electricity generation is the biggest immediate demand for natural gas. Gas to power and coal to gas switching programs are the ideal solutions to solve the outdated coal to power infrastructure, reduce cyclical energy shortfalls (electricity load shedding), reducing CO_2 emissions, enhancing energy security by adding generating capacity and supporting industrial development.

The two options for importing natural gas to South Africa are pipeline and LNG. The closest significant natural gas reserves are in Mozambique for large scale pipeline capacity. Sasol's Pande and Temane gas supply to South Africa via ROMPCO pipeline is expected to decline by September 2023 (SAGMP, 2021). A new 2,600 km pipeline is planned to tap natural gas from Rovuma field in Northern Mozambique to Gauteng, South Africa. A cooperation agreement has been signed between ENH, Profin Consulting, SacOil and China Petroleum Pipeline Bureau. The existing South Africa gas pipeline extended from Pande and Temane gas fields to Secunda via 865 km ROMPCO pipeline with an annual capacity of 5.3 × 10^9 m^3, the Sasol Gas 1,080 km distribution pipeline from Secunda, to Pretoria, Johannesburg and Sasolburg, as well as the Secunda-Witbank-Middelburg distribution pipeline in Mpumalanga Province. Sasol Gas has an annual transmission capacity of nearly 4.5 × 10^9 m^3. The methane rich gas (MRG), produced and supplied by Sasol Synfuels from Secunda CTL plant, is connected to Durban via 573 km Transnet 's Lilly pipeline, which passes Richards Bay with an annual capacity of 0.56 × 10^9 m^3.

An LNG import terminal is comprised of an LNG storage tanks and re-gasification unit, which must be at the coast. The obvious export countries closer to South Africa are Nigeria (23.5 × 10^6 t/y), Angola (5.2 × 10^6 t/y), Algeria (32.3 × 10^6 t/y) and Qatar (77.4 × 10^6 t/y). When the new LNG export terminals in Mozambique and Tanzania come on stream, these will be the ideal suppliers of LNG to South Africa, due to the proximity. There are three harbors that can be used as LNG import terminals, namely, Richards Bay in KwaZulu Natal, Coega in the Eastern Cape, and Saldanha Bay in the Western Cape. Richards Bay is by far the harbor of choice, because it is the closest to Mozambique. Furthermore, the Lilly pipeline can provide natural gas northwards to Gauteng, as well as southwards to Durban. An LNG import terminal in Richards Bay is favored over a pipeline from Mozambique, because of the instability in the northern Mozambique, which already delayed the LNG plants. The LNG import terminal has another advantage over a pipeline. The LNG import terminal can be onshore, but for fast use of the gas, the LNG terminal can be a floating storage and regasification unit (FSRU) which can be rented from the international market.

7. The role of natural gas in electricity production

The global demand for natural gas is expected to grow, mainly for power generation. Furthermore, the trend of switching coal to gas in power generation is endorsed by most countries in particular the USA and Europe. Since South Africa's electricity generation relies heavily on coal, natural gas switching can play a vital role in providing reliable electricity. Furthermore, gas fired power plant can add the much-needed electricity capacity to the grid. Converting mothballed coal fired power plants to run on natural gas can save substantial time and capital expenditure when compared with building new generation facilities. There are six coal fired power plants reaching end of life cycle by 2030, with a total capacity of 10,711 MW. These plants can have complete conversion to natural gas, in particular they are in the same region in Mpumalanga, and also they have access to Sasol Gas distribution network Secunda-Witbank-Middelburg. The new pipeline from Mozambique Rovuma field can supply gas to these plants. There are six OCGT plants, with a total capacity of 3,763 MW, currently utilizing diesel as fuel source. These OCGT plants could be powered by natural gas. There is only one OCGT plant (i.e., Avon, KwaZulu Natal), which have access to Transnet's Lilly pipeline. Delta Natural Gas (DNG) Energy is busy constructing a 125,000 m^3 floating LNG storage unit in the port of Coega in the Eastern Cape. This unit could supply Dedisa and peaking power plant with natural gas. A similar approach can be applied to the other OCGT plants, such as importing LNG in Saldanha Bay could supply Ankerling and Acacia peaking

power plants. Furthermore, the existing open cycle gas turbine (OCGT) plants could be converted to close cycle gas turbine (CCGT) plants.
An LNG import terminal is the best option for South Africa to accelerate the penetration of natural gas in the energy mix. Furthermore, gas to power can add new generation capacity to South Africa. These new generating capacities can be as follows: a 3,000 MW gas fired power plant in Richards Bay, also two gas fired power plants at Coega and Saldanha Bay can be built with 1,600 MW capacity each. Furthermore, natural gas will be available in Johannesburg, then a 1,600 MW gas fired power plant can be built. These new capacities totaling 7,800 MW can cover the actual shortage and also gas fired power plants are more reliable than renewable energy, because of the storage capacity.

8. The role of natural gas in transportation

Total demand for petroleum products in South Africa reached 35×10^9 L in 2019, where 78 % is locally produce and 22 % is imported. South Africa imported 39.2 % of diesel supply and 11.2 % of petrol supply. The South African liquid fuels demand is as follows: 43 % diesel, 36 % petrol, 10 % jet fuel/kerosene, 7 % fuel oil, 3 % LPG, and 2 % others. The petroleum products demand is concentrated mainly in three provinces, Gauteng 31 %, KwaZulu Natal 20 % and the Western Cape 16 % (SAPIA, 2019). Sasol Synfuel is producing 21 % of South Africa petroleum products via its Secunda CTL plant (990 m^3/h), while 57 % of petroleum products are produced in oil refineries (3,451.8 m^3/h), which relies on imported crude oil (SAPIA, 2019).
PetroSA GTL plant is covering 6 % of South Africa petroleum products. The design capacity of PetroSA plant is 297 m^3/h oil equivalent, but because of the shortage of gas, the plant is running of 1/3 of the design capacity. Furthermore, the gas at PetroSA South Coast gas fields will be depleted by 2029. Importing LNG can extend the life of PetroSA GTL plant, in particular there is an LNG tank farm. Furthermore, Shell and Sasol did feasibility studies on a GTL plant in Mozambique. Sasol conducted a feasibility study for a large scale GTL plant, which is based on gas from Rovuma basin in northern Mozambique. This study was conducted in conjunction with ENH and Eni. The Afungi GTL project is the second proposed GTL project tapping Rovuma basin. The Afungi GTL project is led by Shell to produce 250.8 m^3/h of liquid fuels. PetroSA had talks with the Mozambique government to build 264 m^3/h GTL plant in Mozambique. All the proposed GTL plants will provide liquid fuels, in particular ultra clean diesel with very low sulphur and aromatics, to the country and SADC countries, in particular South Africa.
Natural gas can be used directly as alternative clean fuel (i.e. petrol and diesel), as CNG (compressed natural gas) or LNG. LNG is more economically attractive for long haul applications, as well as shipping fuel, but LNG require significant more capital compared to CNG. Public transport fleets are the best end user of gas as alternative to diesel and petrol. However, infrastructure, high capital costs and storage issues presents barriers which may be addressed by concentrating on dedicated fleets in specific areas and providing financial support for conversion cost, possibly recouped through taxation on the natural gas supply (SAGMP, 2021). The taxi industry is the most important part of South Africa's public transport system, where 11.4 million commuters per day use it, representing 80.2 % of all public transport, an increase from 67.6 % in 2013 (SABOA, 2021). There are approximately 250,000 minibus taxis currently doing business in South Africa. Most of these taxis are operating in Gauteng, followed by KwaZulu Natal, Mpumalanga and the Western Cape. The dedicated taxi fleets can be converted to gas as alternative fuel, in fact there are over 1,200 taxis already converted to gas, which leave a huge potential for gas to be leveraged (SAGMP, 2021). According to SABOA (South African Bus Operators Association), there are approximately 25,000 busses in South Africa, of which 19,000 are involved in public transport. The bus industry has about 16.6 % of the market share in 2020 with 2.1 million users, a decline from 19.5 % in 2013 (SABOA, 2021). The city of Johannesburg was one of the first cities in Sub-Saharan Africa to run a fleet on CNG converted busses with a fleet of 180 busses. The City of Tshwane has 80 CNG busses, while the Free State has 10 CNG busses (SAGMP, 2021).

9. Conclusions

Natural gas is the cleanest fossil fuel, emitting 50 % less CO_2 than coal, and around 32 % less than oil. South Africa's coal contribution to energy mix is 70.7 % and oil 21.6 %, while natural gas contributed 3.1 %. For South Africa's government decarbonisation commitment to climate change, substituting coal and oil with natural gas can satisfy the commitment to reduce CO_2 emissions by 2030 and beyond. The two sectors that natural gas can play an important role are electricity generation and transportation. Coal to gas switching in power plants is an approach widely used, in particular the USA and Europe. Coal fired power plant in South Africa generated 43,256 MW in 2021. There are six plants with total capacity of 10,711 MW will reach end of life by 2030. These coal fired power plants could be completely converted to natural gas, in particular they are regrouped in the same area in Mpumalanga Province, and have access to Sasol distribution networks. There are six open cycle

gas turbines (OCGT) with a total capacity of 3,763 MW and using diesel as fuel source. These OCGT plants can be converted to gas. Furthermore, the OCGT plants can be converted to close cycle gas turbines (CCGT). LNG to power is the most viable option for new generating capacities, such as 3,000 MW at Richards Bay, at Coega and Saldanha Bay with 1,600 MW capacity each. Furthermore, a 1,600 MW gas fired power plant can be built in Johannesburg, such as Kelvin, using LNG import at Richards Bay and reversing Lilly pipeline.

Natural gas can play a role in transportation sector in different ways, such as GTL, CNG and LNG. GTL is a process to convert natural gas to liquid fuels in particular ultra clean diesel with high cetane number and very low sulphur and aromatics. PetroSA's 297 m^3/h plant in Mossel Bay is running 1/3 of the design capacity and the gas will be depleted by 2029. Importing LNG will extend the life of this plant. Furthermore, GTL plants in Mozambique can supply liquid fuels to the country and the region in particular South Africa. Sasol, Shell and PetroSA, the world leaders in GTL technology, announced proposals to the Mozambique government. Natural gas can be used directly as fuel in transportation as CNG or as LNG. For natural gas to be widely used in transportation a dedicated fleets are required. Taxi minibuses are widely used in South Africa, covering 80.2 % of the business share, with 250,000 taxis and 11.4 million users. The bus industry has about 16.6 % of the market share in 2020, with 2.1 million users. There are 19,000 buses involved in public transport.

Furthermore, the other uses of natural gas are industrial, commercial and residential sectors. The industrial uses of natural gas can be to supply heat for processes in steel, paper, packaging, textile, etc. industries, as well as providing natural gas for petrochemical industry. For commercial and residential sectors, natural gas can be used for space heating, water heating and cooking, where an articulation network can be developed in niche areas.

Beyond 2060, South African energy mix will be dominated by solar, wind and green hydrogen. The introduction of natural gas in the energy transition will not only reduce carbon emission, but also will facilitate and accelerate the penetration of green hydrogen in the energy mix.

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