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Mozambique Domgas

Gas in Road Transport: Driving us forward

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We have already introduced two of the use cases for the natural gas that will be produced in the north of Mozambique. The third potential use is for land-based road and rail transport.

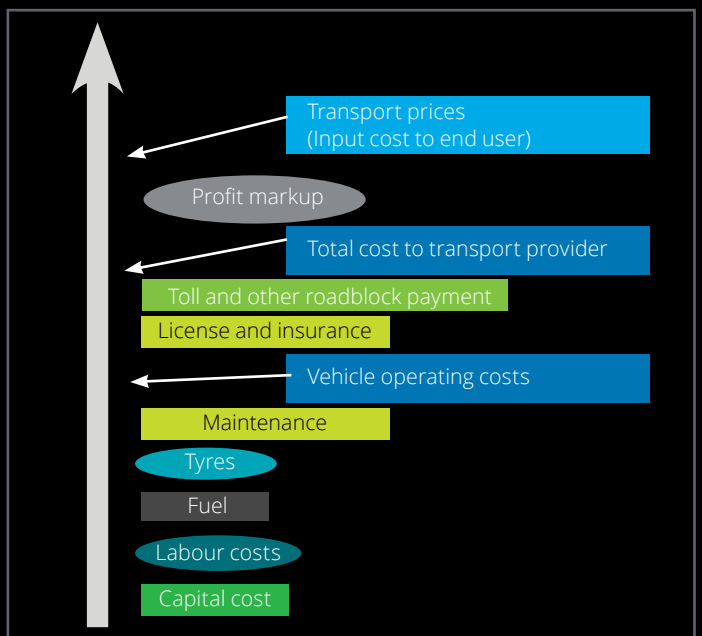
Natural gas will be the backbone of regional economic integration among the Southern African Development Community (SADC) member countries[1]. The adoption of natural gas in road transport has been slow, primarily due to limited uptake in demand and the lack of a readily available supply of Compressed Natural Gas (CNG) and Liquefied Natural Gas (LNG) (which presents a much stronger business case). Uptake has also been slow as a result of the high upfront capital costs associated with converting vehicle technology (upwards of $10,000 USD per vehicle), the lack of an enabling environment to encourage investment and the limited availability of natural gas. These concerns continue to contribute to the increased resistance to moving forward with this change.

However, the case for the adoption of Natural Gas Vehicles (NGVs) regionally is looking promising, specifically for high mileage commercial trucking fleets, as barriers such as incentivised policy, lack of infrastructure, limited model variants and high added vehicle costs are being addressed to increase the penetration of NGVs. The use of natural gas as a fuel (CNG/LNG) for transportation has been associated with several environmental benefits including less emissions of air pollutants, less emissions of greenhouse gases and lower noise pollution[2].

The regional gas supply situation is strong with abundant supplies currently accessible as well as in the future together with low, stable prices[3] - natural gas is not as prone to the price fluctuations seen by crude oil products. However, regional governments have provided limited incentives to encourage development in the sector. Almost all countries successful in promoting NGVs have had some kind of incentive and created favourable conditions in the initial period to push the technology and continue to pull demand with policy instruments. These include market-based (such as tax breaks) and regulatory-based (such as stringent emission control) policies[4].

The impact of fuel taxes on transport costs and prices in the SADC region is substantial. At least 20 percent (and up to 40 percent) of Vehicle Operating Costs (VOCs) are the result of fiscal policy[5]. South Africa, for example, has introduced a new tax incentive to penalise high CO_2 emissions. The tax is set to rise at two percent above inflation, currently at 4.5%, until 2022 and in line with inflation thereafter. This has directly affected fuel prices, and more increases are in the pipeline[6].

Various definitions related to transport



1. Transport prices are the rates charged by a transport company or a freight forwarder to the shipper or importer. Normally transport prices = TC's + operators overhead and profit margin
2. Transport costs (TC's) = VOCs + other indirect costs, such as license, insurance, road toll and roadblocks payment.
3. Vehicle operating costs (VOCs) include various direct costs to operate a given vehicle, notably maintenance, tyres, fuel, labour and capital costs.

There are significant costs associated with value added tax (VAT) and duties for importing this NGV technology, which is simply passed on to the end-consumer. Import tariffs should be addressed as these have a major influence on the appetite of decision makers to import green vehicles and parts. The tariff on truck imports is usually a proportion of the truck price. It is recommended that tariffs are set as a fixed lump sum, independent of the truck price, which would have the effect of favouring the import of newer trucks (as long as the trucking industry is deregulated in order to give an incentive to the most efficient companies to invest in new trucks). Addressing the tax structure can then be geared to reward those who operate more modern vehicles. Utilising them more intensively will encourage adoption[7].

Gas in Rail Transport

Mozambique Domgas gives rail operators in the SADC region the opportunity to reduce their operational costs and emissions, particularly in areas where the costs and logistics of establishing an electrification infrastructure are challenging. Natural gas-powered locomotives consume 30% less fuel, emit 20% less carbon dioxide (CO_2) and 70% less sulfur dioxide (SO_2), and will make it possible to reduce the environmental burden and to save energy resources by 24% a year[1].

European locomotive manufacturers have introduced new technology which allows them to retrofit diesel engines with CNG/LNG reservoirs, substituting up to 80% diesel with natural gas without compromising engine performance[2]. These hybrid engines contain enough fuel for 1,400 kms of heavy freight haulage, at speeds up to 100 km/h, which is sufficient for the round-trip journey with contingency for idling time and delays[3]. The new locomotives are also capable of hauling freight wagons weighing up to 8,200 tonnes.

Rail transport can accelerate and intensify trade and economic development in the SADC region. As a result of its energy efficiency, reduced greenhouse gas emissions and lower cost per ton kilometre, it is expected to continue to play an increasingly important role in the conveyance of freight over long distances. Studies show that transporting one tonne of goods on railways for 100 kilometres consumes a quarter of the fuel that transporting it on roads would[4]. The implementation of natural gas locomotives has the potential increase that gap further.

[1,2,5]Estonia develops its first LNG-powered locomotive https://www.railtech.com/rolling-stock/2019/10/21/estonia-develops-its-first-lng-powered-locomotive/?gdpr=accept&gdpr=accept

[3]LNG as a rail fuel. That sounds like a novel new idea https://www.rivieramm.com/opinion/opinion/lng-as-a-rail-fuel-that-sounds-like-a-novel-new-idea-24951

[4]Sinara Group assembles new type of LNG-powered locomotive https://www.railtech.com/rolling-stock/2019/07/16/sinara-group-assembles-new-type-of-lng-powered-locomotive/

Mozambique LNG/CNG landscape:

Mozambique currently has around 2,500 converted NGVs, between passenger cars, vans, city buses and freight transport. These vehicles utilise CNG. There are currently six CNG refuelling stations in the southern region (Maputo and Matola), primarily as a result of the limited availability of gas. These stations utilise natural gas from Inhambane province (Pande and Temane fields), made available to Maputo via the ROMPCO pipeline. These stations are property of a Mozambican company (a public, private partnership) focused on the entire value chain: from the the distribution and sale of natural gas for vehicles, to the conversion of vehicles from conventional fuels to gas. New players are now starting to enter the market to provide these services, which may contribute to further market growth. In the next ten years, the number of NGVs is expected to grow at an average rate of 10% per annum with a corresponding increase in the number of refuelling stations from the current 6 to 70, including the central and north regions. These stations will primarily be centred around the major logistics corridors: EN4 to South Africa and the EN1 which cuts north across the entire country.

Mozambique's vehicles market is expected to grow 10% year-on-year. The Rovuma Basin LNG domestic supply quota can ensure the necessary cost-effective supply of CNG/LNG to refuelling stations across the country, which in turn will drive the feasibility for potential clients to invest in long-distance heavy road vehicles. The government should also consider the establishment of an initial investment fund to kickstart the development of CNG/LNG refuelling stations, similar to what it did to establish the current footprint of petrol/diesel refuelling stations across the country (even though there was no immediate business case). This will drive the necessary supply, while demand, in turn, catches up.

Policy implementation is needed to protect investors that build the network of refuelling stations, who typically only expect to see a return after 15 years. They will need protection mechanisms to ensure they see a return if they are to make the investment. These refuelling stations can cost up to $1 million USD per station. As such, more effective financing mechanisms are needed if investors are expected to take the plunge. Policy makers are encouraged to leverage the private sector's initiative to grow the use of natural gas (and reduce their carbon footprint) in the region by working with financiers to make development and project finance available at attractive rates[8]. Natural gas infrastructure development (i.e. pipelines, forecourts, compressed high pressure cylinders, etc) will aid the region's industrial expansion efforts/ambitions as current industrial output has slowed the growth of the commercial road freight sector[9]. The likelihood and timing of these infrastructure investments will have a direct impact on the business appetite to make the conversion to NGVs.

The use of natural gas in vehicle applications reduces dependence on petroleum and can reduce greenhouse gas emissions. Direct emissions from the transport sector account for 91.2% – mainly from the combustion of petrol and diesel[10]. Heavy Duty Vehicles (HDVs) emit a range of pollutants including nitrogen oxides (NOx) and particulate matter (PM), which account for the most air pollution damage. The claimed tailpipe emissions reduction benefits of NGVs over diesel and petrol vehicles include reduced CO_2 emissions by 23% to 35%, almost zero particulate matter (PM) emissions, 87 to 90% reduced NOx emissions and 67 to 76% reduced hydrocarbon emissions at comparable fuel economy[11]. The analysis of 12 heavy duty NGVs and 16 heavy duty diesel vehicles showed that NGVs emit 34% less carbon monoxide (CO), 24% less NOx, and 79% less PM than their counterpart HD diesel vehicles[12]. Original equipment manufacturers (OEMs) report a lowering of GHG emission of up to 10%.

HDVs are available on the market as OEM vehicles or as retrofit vehicles –aftermarket conversions to dual-fuel vehicles, which are no longer challenging due to evolved technology[13]. There are four primary natural gas engine types used for heavy-duty vehicles: stoichiometric spark-ignited engines (SIS), dual-fuel engines (DF), spark-ignited lean burn (SILB) and high-pressure direct injection (HPDI)[14]. Dedicated Dual-fuel (DDF) indirect injection uses a pilot diesel to initiate ignition instead of a spark plug. Once ignition starts, the engine continues to burn gas injected into the inlet of each cylinder.

A natural gas pioneer in South Africa is in the construction phase of South Africa's first commercial LNG plant in partnership with a global LNG player which has opened its second CNG forecourt, supplying a fleet of 15 dual diesel fuel (DDF) vehicles. The actual diesel substitution rate is, on average, 50% to 60%[15]. DDF vehicles have reduced running costs and substantially lower greenhouse gas emissions compared to vehicles running on diesel alone, with the benefit being able to run on diesel again should natural gas refilling not be available. NGVs offer benefits such as good fuel efficiency with a high energy content and excellent price/kilojoule ratio, as some OEMs report up to 15% reduction in fuel consumption and a competitive price that can deliver 20% to 40% cost savings over petrol and diesel[16]. Considering that fuel costs amount to at least 40% of total VOCs, adopting NGVs to high mileage commercial trucking fleets will considerably reduce the high cost of transportation in the region.

Large businesses are often unable to justify additional large capital outlays given that they are yet to realize their paybacks on previous legacy technologies (diesel & gasoline). Additionally, these businesses need to do long-term planning and produce cost-benefit assessments to justify these investments. The business cases could even justify waiting for the proliferation of LNG infrastructure as opposed to betting on the current CNG, given its improved economic potential. The purchase of an NGV currently represents an additional cost to vehicle Total Cost of Ownership (TCO) of roughly 30% for a truck and 7% for a light commercial vehicle (LCV). Generally, vehicle owners attribute a lower residual value to their NGVs than diesel vehicles; therefore, the difference between the price of natural gas and diesel is an essential factor to reach a TCO that is better than or equal to the TCO of a diesel vehicle[17]. To benefit from this price differential, companies investing in a fleet of NGVs should plan to use their vehicles for at least five years and use them in high mileage applications[18].

This is encouraging as trucking companies in the region cover approximately 100,000–120,000 kilometres annually[19]. Studies show the operation of NGVs was found to be financially feasible for high mileage vehicles for many years, and if the natural gas fuel can be purchased at a discount of at least 15% relative to the existing retail price of diesel on an energy-equivalent basis[20], the profitability and cost savings look promising for freight companies.

Natural gas (LNG/CNG) as an alternative fuel to diesel in the transportation sector is gaining rapid acceptance worldwide. There are currently over 26 million NGVs and over 31,000 refuelling stations across the world, with over 50% of these vehicles in China, Iran and India[21]. Southern Africa is endowed with large gas reserves which can reduce the dependence on importing refined products from other regions. The potential socio-economic benefits of using natural gas in transport include diversity in the transportation fuel mix, fuel cost-savings and lower GHG emissions.

Addressing barriers such as incentivised policy, lack of infrastructure, limited model variants and high added vehicle costs, will encourage the adoption of natural gas, as international energy companies and the private sector recognise the potential of a natural gas to enhance the regional economy—and companies have already started to position themselves to leverage this opportunity.

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