



Advancing United Nations SDG7 Through Adaptation Of Liquefied Natural Gas

ABSTRACT

The seventh sustainable development goal aims to ensure universal access to affordable, reliable, sustainable and modern energy services by 2030. One of the resolutions during the Conference of Parties 26(COP26) held in Glasgow Scotland in 2021 on energy was transition to clean energy use. The Forests, Agriculture and Commodity Trade (FACT) Dialogue, a road map for the sustainable development and trade of agriculture commodities was launched. This means that there is a need to reconsider further sources of energy especially for household cooking and heating. China, Japan, South Korea and India are the world's leading importers of LNG. Despite the fact that they do not have any reserves of LNG, they are among the highest consumers of LNG in the world. For example, leading LNG importing company in the world, KOGAS of South Korea also has the largest storage capacity. 84% of household energy use in S. Korea is from LNG piped directly to homes. Tanzania is a sleeping giant as far as LNG is concerned. It has 57.54T of LNG both offshore and onshore yet it is estimated that more than 95% of households in Tanzania use firewood and charcoal as their source of energy for cooking and with electricity access at only 39.9%. Tanzania's estimated natural gas reserves, are enough to cover the country's domestic use and make Tanzania the next natural gas hub in Africa. The natural gas from Songo Songo was first commercialized in 2004 and the gas from Mnazi Bay in 2006. The commercialization of the two discoveries propelled further gas exploration in Tanzania both onshore and offshore. Investments efforts by the government are geared towards propelling Tanzania to the club of Liquefied Natural Gas (LNG) exporters. Russia's invasion of Ukraine has further accelerated this move considering that nations worldwide more so Europe have

Coal (anthracite)	228.6
Coal (bituminous)	205.7
Coal (lignite)	215.4
Coal (subbituminous)	214.3
Diesel fuel and heating oil (HFO)	161.3
Gasoline (without ethanol)	157.2
Propane	139.0
Natural gas	117.0

Key words: Natural gas, seventh sustainable development goal, clean energy, carbon emissions.

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shifted focus to looking for new energy sources. For East Africa there is a proposal for Tanzania – Uganda pipeline 1,800km; Tanzania – Kenya pipeline of 600km from Mtwara to Mombasa, an MOU between the two countries has been signed.

1.0 INTRODUCTION

Tanzania and the world at large have a number of international protocols that are driving them towards adoption of clean, safe and sustainable energy. The seventh Sustainable Development Goal aims to ensure access to affordable, reliable, sustainable and modern energy for all by 2030. One of the resolutions during the Conference of Parties 26 (COP26) held in Glasgow Scotland in 2021 on energy was transition to clean energy use. During this conference, 100 nations expressed that they intend to end sale of internal combustion engines in leading markets by the year 2035. Additionally, they purpose to end the sale of the engines worldwide by 2040 so as to progress towards the decarbonization process.

According to the National Census of 2012, about 70% of Tanzanians reside in rural areas. Whereas 69.8% of the urban Tanzanian population had access to electricity, in rural areas, households connected to electricity accounted for 24.5% in 2019/20 compared to 16.9% in 2016/17. Therefore, the Government of Tanzania plans to increase rural connection levels to 50% by 2025 and at least 75% by 2033. A point to note is that S. Korea does not have any Liquefied Natural Gas (LNG) reserves, yet it has the biggest LNG storage facility in the world. It has 77 storage tanks with a total capacity of 12.16million kl. 84% of household energy use is from LNG which is piped to the homes through pipeline networks with total length of 5,027km. Moreover, 25% of the electricity production comes from natural gas.



2.0 LIQUIFIED NATURAL GAS

Liquefied Natural Gas is a natural gas that has been cooled to a liquid state, at about -162° centigrade, for shipping and storage. The volume of natural gas in its liquid state is about 600 times smaller than its volume in its gaseous state. In short, natural gas is converted into LNG for the main purpose of transporting large energy from natural gas in a containment (in liquid state) that is relatively smaller compared to when would have been transported in its gaseous state. LNG is purely composed of natural gas which is mainly methane. LNG is considered to be environmentally friendly due to its low carbon emission as compared to other fossil fuels. Natural gas, coal, diesel fuels emit different amounts of carbon dioxide. According to the U.S. Energy Information Administration, natural gas emits approximately 50% less CO₂ than coal. Likewise, different types of coal produce different amounts of CO₂ while burning are illustrated in table 1.

Table 1: Pounds of CO₂ emitted per million British thermal units (Btu) of energy for various fuels:

Source: www.eia.gov

3.0 NATURAL GAS RESERVES, PRODUCTION AND CONSUMPTION

3.1 Worldmeter

Natural gas is one of the mainstays of global energy. Worldwide consumption is rising rapidly and in 2018 gas accounted for almost half of the growth in total global energy demand. Gas plays many different roles in the energy sector and, where it replaces more polluting fuels, it also reduces air pollution and limits emissions of carbon dioxide. A report from the IEA's World Energy Outlook team provides an evidence base for this important discussion. It finds that switching to natural gas has already helped to limit the rise in global emissions since 2010, alongside the deployment of renewables and nuclear energy and improvements in energy efficiency (BiroL, 2022).

The report further shows that the contribution of gas to energy transitions varies widely across regions, between sectors and over time. Table 2 gives information on global position of world reserves, percentage world share, export and consumption positions.

Table 2: List of countries by natural gas reserves, export and consumption

Country	Leading gas reserve		Position as exporter	Position as consumer
	Position	% world share		
Russia	1	24.3	1	2
Iran	2	17.3	16	4
Qatar	3	12.5	3	22
United State	4	5.3	2	1
Saudi Arabia	5	4.2	None	7
Unite Arab Emirate	7	3.1	25	10
Nigeria	9	2.6	10	38
China	10	2.4	28	3
Algeria	11	2.3	9	26
Tanzania	82	0.003	None	91
Mozambique	14	1.4	None	82

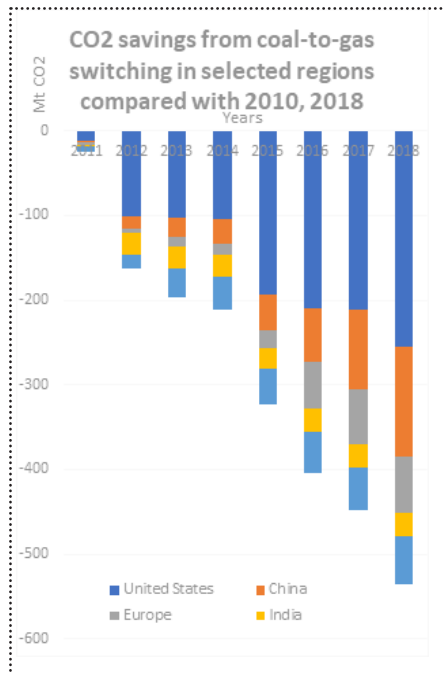
The contribution of gas to energy transitions varies widely across regions, between sectors and over time. Gas cannot, of course, do it all to bring down environmental emissions.

According to BiroL (2022), the four countries and regions chosen for in-depth analysis in the report – the United States, Europe, China and India – display a wide range of market and policy dynamics, which affects the ways in which coal and gas compete. In the United States, the shale revolution has had a dramatic effect on gas supply and prices. Alongside some state-level as well as federal-level environmental policies this has pushed gas into the energy mix while pushing out coal. Since 2010, the market share of gas has increased more than any other energy source. In China, gas demand has risen very quickly in recent years because of a major policy push to improve air quality. There has been relatively less switching in Europe since 2010, with the notable exception of the United

Kingdom. However, today's combination of low gas prices and higher CO₂ prices in the European Union is giving this process renewed momentum. In India, gas currently has a small share of the energy mix. Large-scale switching has been held back by supply constraints and affordability issues, as well as a lack of infrastructure. Figure 1 shows the role of gas in today's energy transitions (IEA, 2019).



Figure 1: The Role of Gas in Today's Energy Transitions | IEA 2019. All rights reserved.



Gas prices - The shale revolution in the United States has in general brought down gas prices, and the growth of destination-flexible, hub-priced LNG exports from the United States is providing a catalyst for a more liquid global gas market. However, even though global gas markets are becoming more interconnected, there is still no global gas price. The lower energy density of gas compared to oil or coal means that transportation by pipeline or as LNG takes a relatively high share of the delivered cost, making geographical proximity to resource-rich areas an important determining factor for affordability.

3.2 Africa meter

Africa is a continent richly endowed with natural resources with almost half of its 55 countries known to have proven natural gas reserves. Across the entire continent,

natural gas reserves amount to a total of more than 800 trillion cubic feet, with BP predicting that the production of natural gas in the continent will expand by 80% by 2035, contributing to rising Gross Domestic Profit (GDP), the emergence of middle-class consumers and increased market value. As a major source of wealth and energy in Africa, the development of oil and gas resources proves critical for economic growth and revenue expansion. The following list comprises the Top Ten Natural Gas Reserves in Africa by country:

Table 2: Top 10 African Countries Sitting on the Most Natural Gas

Position	Country	Reserves in TCF	Position as exporter
1	Nigeria	206.53	10
2	Algeria	159.1	9
3	Senegal	120	none
4	Mozambique	100	none
5	Egypt	77.2	27
6	Tanzania	57.54	None
7	Libya	53.1	30
8	Angola	13.5	none
9	Congo	10.1	none
10	Equatorial Guinea	5	Exports*

Source: Energy Capital Power, 2021 (TCF – Trillion Cubic Feet)

*** Export position not stated**

Gas prices - Transportation of natural gas by pipeline or as LNG takes a relatively high share of the delivered cost, making geographical proximity to resource-rich areas an important determining factor for affordability. African countries should take advantage of availability of the large NG in the continent to implement SDG7. More so the countries with the reserves.

4.0 ENERGY USE IN EAST AFRICA

4.1 Access to electricity

Electricity is considered as one of the main source of clean energy especially if produced from renewable energy or NG. Access to electricity is fairly low in East Africa compared to the world. Figures 2 and 3 illustrates the share of electricity in East Africa with Mozambique included because of its large reserves of NG and proximity to EA. Share of the population with access to electricity – TZ is presented in Figures 4 and 5. Figure 6. Illustrates Percentage of the population that has access to clean energy in EA Incl. Mozambique.



Electricity access

Share of the population with access to electricity. The definition used in international statistics adopts a very low cutoff for what it means to 'have access to electricity'. It is defined as having an electricity source that can provide very basic lighting, and charge a phone or power a radio for 4 hours per day.

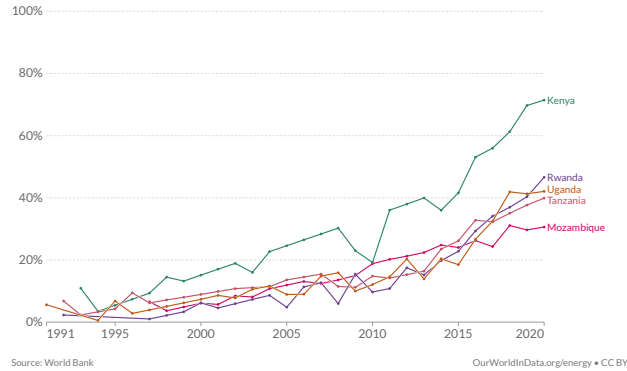


Figure 2: Share of population with access to electricity in EA, Mozambique incl

Electricity access

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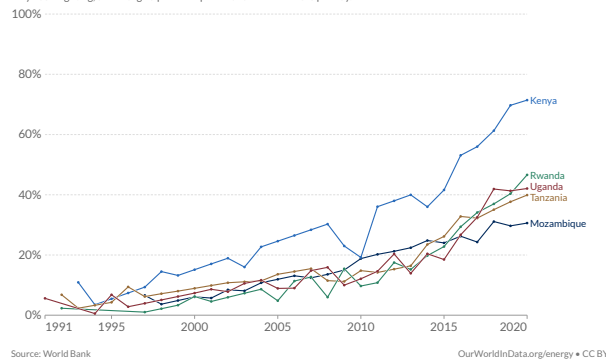


Figure 3: Share of population with access to electricity in EA, Mozambique incl. with percentages

Access to electricity, urban (% of urban population) – Tanzania

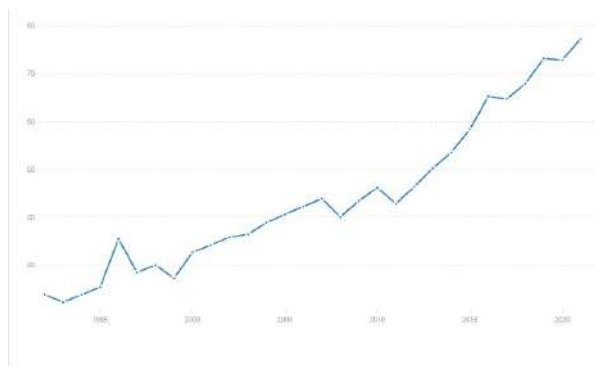


Figure 4: Percentage urban population with access to electricity in Tanzania

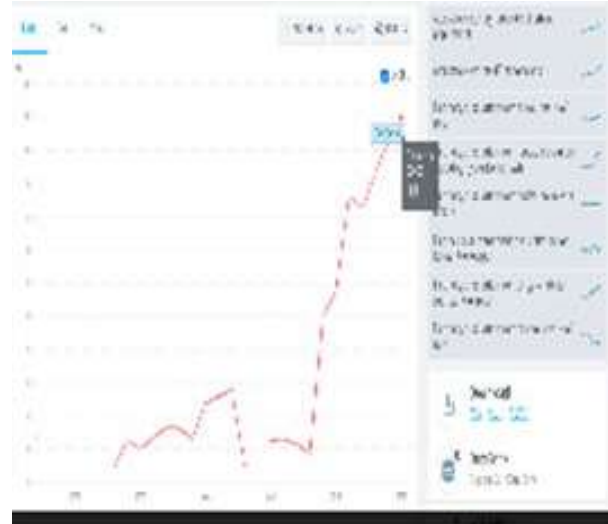


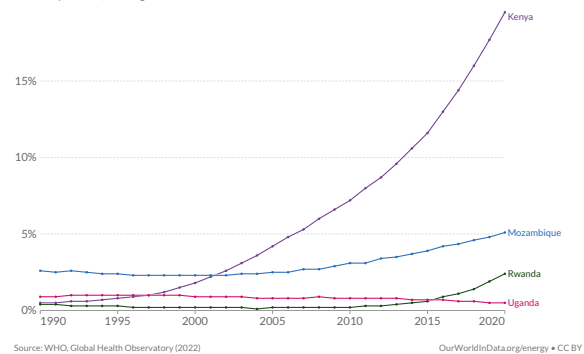
Figure 5: Percentage of rural population with access to electricity in Tanzania

4.2 Access to clean energy

The graph below indicates share of the population with access to clean energy for cooking in East Africa incl. Mozambique

Share of the population with access to clean fuels for cooking

Access to clean fuels or technologies¹ such as natural gas, electricity, and clean cookstoves reduce exposure to indoor air pollutants, a leading cause of death in low-income households.



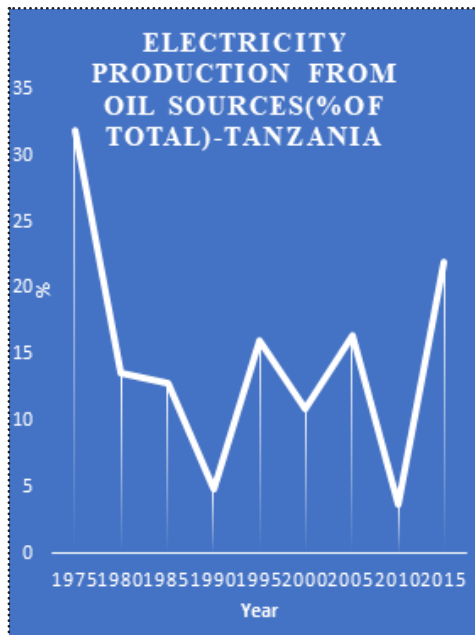
¹ Access to clean fuels for cooking: Clean cooking fuels are defined as those that, when burned, emit less than the World Health Organization (WHO) recommended amounts of air pollutants (specifically particulate matter). They reduce the burden of air pollution – and its health impacts – for households that use them. The following fuels are defined as 'clean': natural gas, biogas, liquefied petroleum gas (LPG), electricity, solar, and alcohol fuels including ethanol. Polluting 'non-clean' fuels include solid fuels such as unprocessed biomass (wood or dung), charcoal, coal, and kerosene. Learn more from the World Health Organization (WHO).

Figure 6: Percentage population access to clean energy in EA Incl. Mozambique



4.3 Sources of electricity production in Tanzania

The graph below shows the trend in electricity production in Tanzania using heavy fuel oil. It is encouraging to note that electricity generation in Tanzania using HFO has drastically reduced over the years from 1975 to date. Although the graph is indicative upto 2015. A comparison of Figure 7, with Figure 8 shows what necessitated the reduction. With reduction in the use of HFO, the use of natural gas in electricity production has gone up. Eventually becoming the leading fuel in electricity production in Tanzania.



Source: www.databank.org/indicator/EG.ELC.FOSL.ZS/Tz

FOSL.ZS/Tz

Figure7: Electricity production from oil sources (% of total)

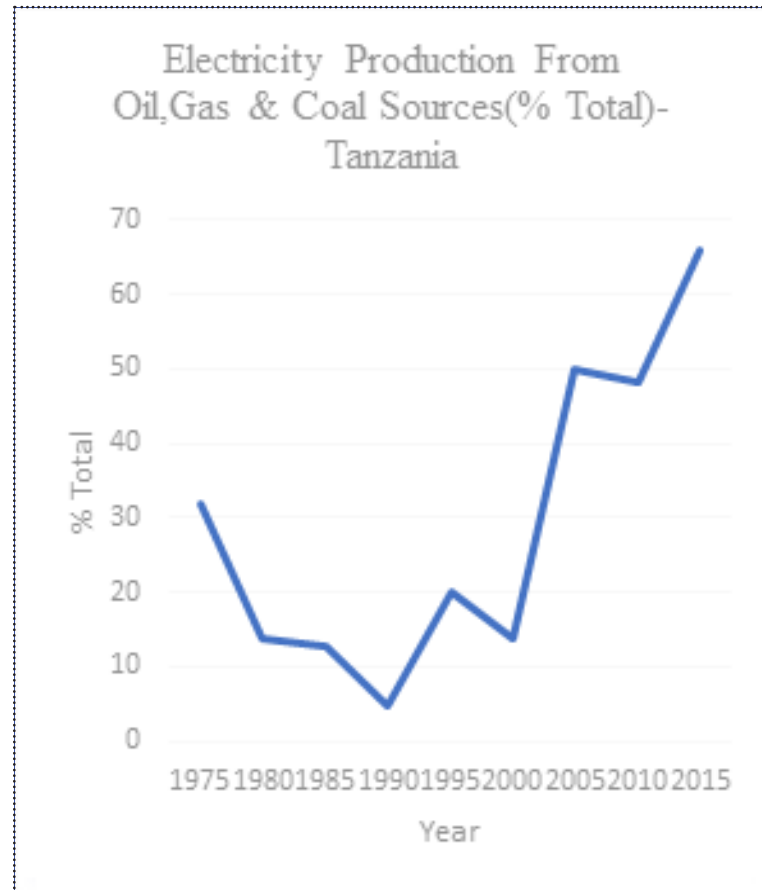


Figure 8: Electricity production from oil and gas sources

5.0 TANZANIA'S OPPORTUNITIES FOR LNG INVESTMENTS

5.1 Vast NG reserves at the coastal area both onshore and offshore

Tanzania's exploration for natural gas has taken more than 50 years with the first natural gas discovery made in 1974 on the Songo Songo Island (Lindi Region). The second discovery at the Mnazi Bay (Mtwara Region) in 1982. Natural gas was discovered both offshore and onshore at the Songo Songo Island, while the gas discovery at Mnazi Bay was only offshore. It's estimated that the total available gas is 57 trillion cubic feet with a total annual production of 110 billion cubic feet from three fields: Songo Songo, Mnazi Bay, and Kiliwani North.) Natural gas from Songo Songo was first commercialized in 2004 and the gas from Mnazi Bay was commercialized in 2006. The commercialization of the two discoveries propelled further gas exploration in Tanzania both onshore and offshore.

Investments efforts by the government are geared towards propelling Tanzania to the club of LNG exporters. Russia's invasion of Ukraine has further accelerated this move considering that nations worldwide, more so Europe, have shifted focus to looking for new energy sources. Therefore, Tanzania investments in LNG projects could reach \$40 billion. The strategy is to have shipment of LNG gas by the year 2030. This will be made possible by



negotiating for financing and technical support from foreign oil and gas companies.

In March 2020, the Kenya and Tanzania governments agreed to construct a 600 km Pipeline from Songo Songo Island to Mombasa at a cost of \$1.1 billion. At present it is envisaged to transport natural gas from Mtwara through Tanga (Tanzania) to Mombasa (Kenya). This is a more convenient means of transport due to its distance and the route is relatively cheap compared to other routes. The Tz/Ke gas pipeline deal is still at its infancy stage where members of Joint Technical Committee and Steering Committee have been appointed from both countries. If the Tz-Ke pipeline picks up, this will be the first NG export Tanzania will realize.

5.2 Vast NG reserves in the neighboring country of Mozambique

Mozambique holds roughly 100 trillion cubic feet of proven natural gas reserves, accounting for approximately 1% of the world's total. The country's proven gas reserves are able to meet 1,545.7 times its annual consumption, meaning the southern-African country has 1,500 years of gas left. Once the uptake infrastructure is in place, Tanzania ought to take advantage of that and link up to Mozambique with a view of becoming NG hub in East and Central Africa.

CONCLUSION

Tanzania and Mozambique – home to East Africa's largest natural gas reserves and with a combined capacity of nearly 157 trillion cubic feet (TCF) – must quicken their pace as the race for supply contracts accelerates. East Africa benefits from convenient geography, with the coastline acting as a springboard to market to rising demand in the Middle East, India, China, Southeast Asia and Northern Europe.

As earlier stated, transportation of NG by pipeline or as LNG takes a relatively high share of the delivered cost, making geographical proximity to resource-rich areas an important determining factor for affordability. Africa and East Africa in particular should take advantage of the vast NG reserves in Tanzania and Mozambique to make LNG their main source of fuel mainly in industry and domestic use as well as electricity production in the place of fossil fuel. This will see the region realize SDG7. To the benefit of the health of their populations as well as adaption of clean energy use towards de-carbonization.



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