Prospects for LNG and Hydrogen Export from Sub-Saharan Africa to the EU

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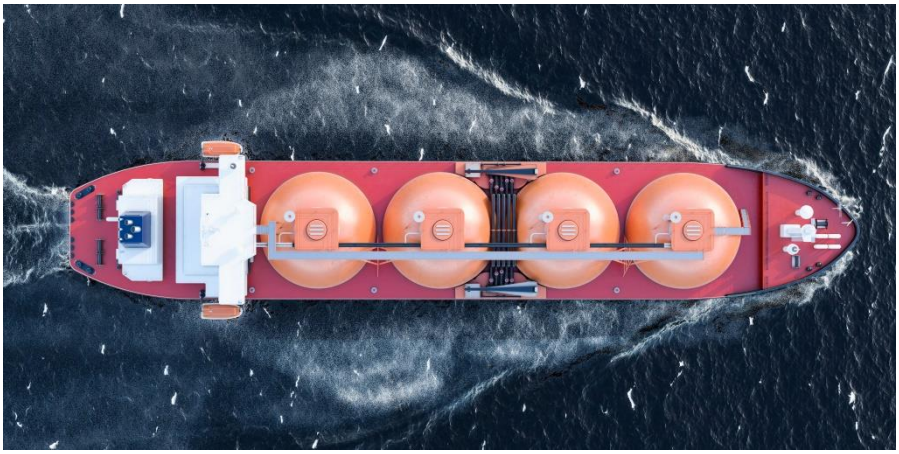
Prospects for LNG and Hydrogen Export from Sub-Saharan Africa to the EU

Dirk Kohnert [1]

EU to boost African LNG and hydrogen links



Source: cartoon © alexlmx / Adobe Stock, Komminoth, 2022

Abstract: Since Russia's war in Ukraine, many European countries have been scrambling to find alternative energy sources. One of the answers was to increase imports of liquefied natural gas (LNG). By bypassing the use of pipelines from the East by building LNG terminals, the EU opened up a wider variety of potential suppliers. The Europe-Africa Energy and Climate Partnership provides a framework for a win-win alliance. African countries will be key players in the future, including sub-Saharan countries such as Nigeria, Senegal, Mozambique and Angola. According to the REPowerEU plan, hydrogen partnerships in Africa will enable the import of 10 million tons of hydrogen by 2030, replacing about 18 billion cubic meters of imported Russian gas. Algeria, Niger and Nigeria recently agreed to build a 4,128-kilometer trans-Saharan gas pipeline that would run through the three countries to Europe. Once completed, the pipeline will transport 30 billion cubic meters of gas per year. The African Coalition for Trade and Investment (ACTING) estimates potential sub-Saharan LNG export capacity at 134 million tonnes of LNG (approximately 175 billion m3) by 2030. Sub-Saharan Africa is also expected to become the main producer of green hydrogen by 2050. However, this market remains to be developed and requires significant expansion of renewable production and water availability. However, the EU countries and companies involved would be well advised to take note of the adoption of much stricter EU greenhouse gas reduction targets for 2030 and the publication of the European Commission's methane strategy. That being said, the EU could risk having more than half of Europe's LNG infrastructure idle by 2030, as European LNG capacity in 2030 exceeds total forecast gas demand, including LNG and pipeline gas. Regardless, it should not be forgotten that African countries want and need to develop their domestic gas markets as a priority, and that export potential depends on this domestic development. In the long term, a global energy mix would be needed to accelerate change driven by new resources, new technologies and climate commitments. These changes in the use and availability of energy resources would also affect the use of fossil fuels. Regardless of this, in addition to the LNG supply, the EU must also take care of increasing its own storage capacities to be able to guarantee a cost-efficient response to a natural gas supply bottleneck. However, LNG alone is not enough to ensure the resilience of the system in the event of a supply failure. Alternative energy resources and energy saving remain essential.

Keywords: LNG, Hydrogen economy, e-fuels, LNG terminals, Natural gas, Energy security, Gas storage, Sub-Saharan Africa, EU, REPowerEU, Trans-Saharan gas pipeline, emerging markets, Sonatrach, European Green Deal, African Continental Free Trade Agreement, Eni, TotalEnergies, BP, Nigeria, Angola, Mozambique, Tanzania, Senegal, Cameroon, Equatorial Guinea, Namiba, African Studies

JEL-Code: E22, E23, F13, F18, F23, F35, F54, L71, L95, N57, N77, O13, Q35, Z13

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1. Introduction

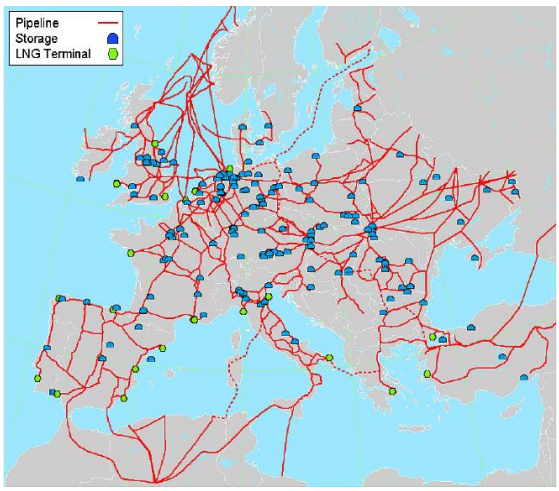
Cartoon 1: *Oil and gas frontier exploration pushes forward in Africa*

Source: © Gavin, 2023 ; African Business, 7 July 2023

Since the Russian invasion of Ukraine, many European countries have been scrambling to find alternative sources of energy (Armstrong, 2022). On 31 August 2022, Russia completely stopped natural gas supplies through the Nord Stream pipeline. However, gas imports from Russia to Eastern and Southern European countries continued through the Ukraine Transit (Druzhba pipeline), Yamal and Turkstream pipelines (Armstrong, 2022).

As a major energy-consuming region, the EU faced several challenges in meeting its future energy needs (Ratner & Belkin & Garding & Welt, 2021). Challenges included a rapidly growing global demand and competition for energy resources from countries such as China and India, tensions with Russia, efforts to integrate the EU's internal energy market, and a growing need to shift fuels in keeping with the EU's climate change policy goals. An important element of the EU's energy supply strategy has been to move towards a greater use of natural gas and renewables and to move away from nuclear (at least in Germany) and coal (Ratner & Belkin & Garding & Welt, 2021).

Graph 1: *European gas infrastructure (2007)*



Source: Lochner & Bothe, 2007:

In the following, the prospects, challenges, and potential benefits of exporting liquefied natural gas (LNG) and hydrogen from Sub-Saharan Africa (SSA) to the EU will be analysed on the base of the available literature. A detailed analysis of the role and the potential of SSA

fossil fuels and renewable energy will be followed by case studies of major African LNG and hydrogen countries exporting to the EU, namely Nigeria, Angola and Mozambique.

However, it has to be noted right at the beginning that the prospects for green hydrogen production and export on a larger scale are dim in the foreseeable future. Most Sub-Saharan African countries cannot afford to forego an entire stage of development in the development and use of liquefied gas just to produce climate-neutral green hydrogen in order not to further increase global warming. Even in large flatland countries with low population density like Namibia, where there are in principle ideal conditions for the production of green hydrogen, the current round of international production companies is for the foreseeable future aimed at developing the huge, promising gas reserves (Agyekum, 2023).

Oil- and gas-rich countries in sub-Saharan Africa (SSA) account for about 40% of global new gas discoveries in recent years (Nwankwo & Olaniyi & Morgan, 2023). Many countries in the Global North, including the EU, still rely on gas for energy security due to the intermittency of renewables and their inability to power some energy-intensive sectors such as cement and steel. However, there is a global call for a transition from fossil fuels to renewable energy to mitigate climate change, as, for example in the ongoing 2023 UN Climate Change Conference in Dubai, in the United Arab Emirates (UAE). While the Global North has built its economies on fossil fuels and continues to emit far more than the Global South, the latter is often asked to bear the brunt of the burden, particularly in Sub-Saharan Africa. Yet SSA countries remain heavily dependent on fossil fuels for economic growth, and many SSA countries are energy-poor, hampering their ability to diversify their economies. To achieve a just transition, where the transition process is fair and does not cause unnecessary hardship to a population, the complexity of the process must be taken into account (Nwankwo & Olaniyi & Morgan, 2023). Europeans and Africans need each other to drive Europe's energy transition on the one hand, and to make decisive and rapid progress towards achieving the Sustainable Development Goals (SDGs). Key priorities for action in the global North include debt restructuring, enhanced financing, de-risking investments in Sustainable Development Goals (SDG) sectors, new priorities for the energy and mining sectors, and fostering private investment (Eylm, 2023).

Graph 2: *Natural Gas proved reserves and production in Sub-Saharan Africa (Enerdata, 2020)*

Countries	Proved Reserves (in Mb)	Share of Global Reserves (%)	Production (in 000 bpd)	Share of Global Production (%)
Nigeria	5761	2.82	47.90	1.20
Mozambique	650	0.32	4.21	0.11
Angola	343	0.17	7.28	0.18
Congo-Brazzaville	284	0.14	0.70	0.02
Cameroon	179	0.09	2.38	0.06
Ghana	53	0.03	2.77	0.07
Senegal	52	0.03	0.01	0.00
Mauritania	50	0.02	-	-
Equatorial Guinea	39	0.02	6.19	0.15
Tanzania	35	0.02	0.88	0.02
Gabon	26	0.01	0.48	0.01
Sudan	25	0.01	-	-
Ivory Coast	12	0.01	2.28	0.06
SSA TOTAL	**7631**	**3.74**	**74.86**	**1.87**

Source: Nwankwo, & Olaniyi & Morgan, 2023

In 2015, the Paris Climate Agreement and the UN Sustainable Development Goals (SDGs) put the world on a fast track to achieving sustainability goals. To meet the decarbonization targets on time, energy use in the end-use sectors (transport, buildings and industry) must be included in addition to the energy sectors. If the Paris Agreement objectives are to be met, countries need to raise their ambitions to ensure that they stay on track. The launch of the

European Green Deal is a step in that direction, focusing not only on Europe but also on external cooperation with neighbouring regions (Bhagwat & Olczak, 2020).

Scientists predict that renewable, electricity-based fuels and chemicals will play an increasingly important role in future sustainable energy systems. South America, Sub-Saharan Africa, and the Middle East and North Africa are emerging as major exporters of e-fuels and e-chemicals. The EU, notably Germany and Italy emerge as the largest importers of LNG, while Russia, Norway and Special categories rank highest in terms of export quantity. Spain, Italy, and France are identified as key nodes with advantageous positions within the gas trade networks (Trajanov et al., 2023).

It is estimated that the role of e-fuels and e-chemicals in a global energy system transformation from 2030 to 2050 will increase significantly. About 23-32% of the total demand will be traded, depending on the type of e-fuels and e-chemicals. The risk of supply disruptions to importers can be mitigated with diversified portfolio strategies combining different exporting regions (Galimova, et al., 2023).

Graph 3: *Trade preference of e-LNG (top left), e-FTL fuels (top right), e-ammonia (bottom left) and e-methanol (bottom right) in 2030*

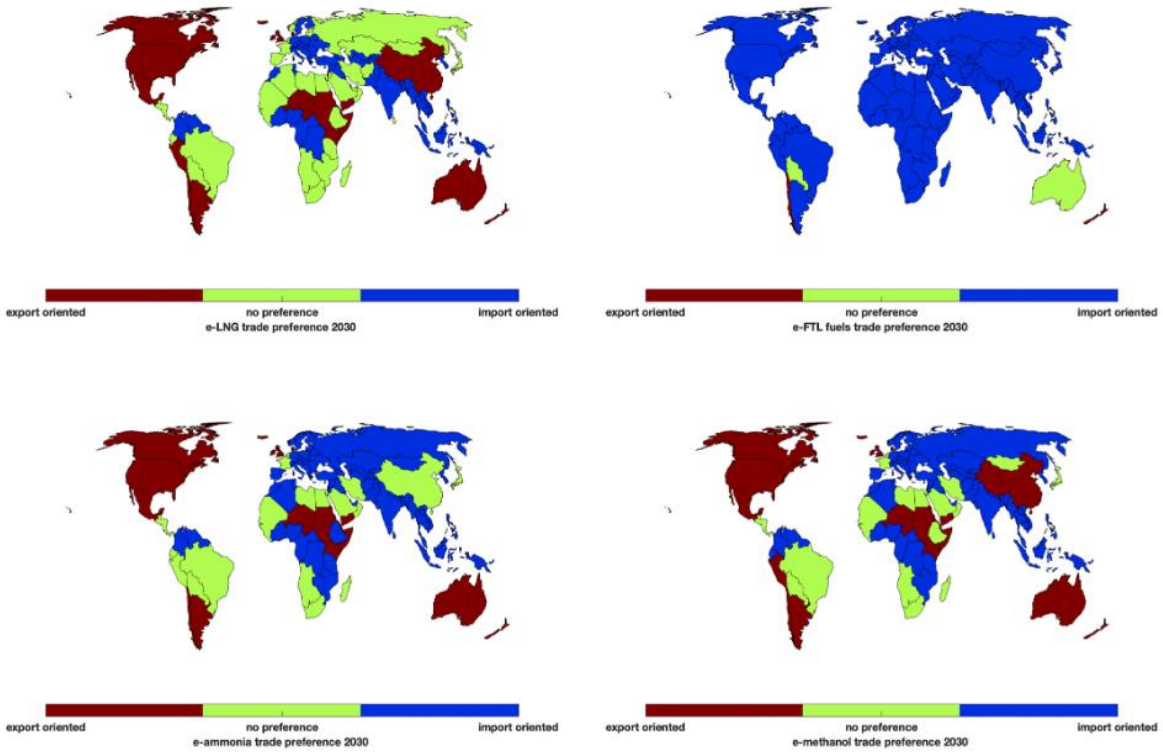


Fig. 3. Trade preference of e-LNG (top left), e-FTL fuels (top right), e-ammonia (bottom left) and e-methanol (bottom right) in 2030.

Source: Galimova, Tansu et al., 2023

The EU plans to become independent of Russian fossil fuels before 2030 and is calling for a renewed dialogue with African producers of LNG and hydrogen. Its REPowerEU plan, commissioned by the European Council in 2022, is increasingly looking south for alternative partners. African countries will be key players. The African Coalition for Trade and Investment (ACTING) estimated possible sub-Saharan LNG export capacity at 134 million tonnes of LNG (around 175 billion m3) by 2030 (Lohmann, 2022).

In addition to the major SSA producers, Nigeria, Mozambique and Angola, LNG terminals have been operating in Equatorial Guinea since 2007 and in Cameroon since 2018 (Lohmann, 2022). In the border region of Senegal and Mauritania, an FLNG terminal is expected to be operational in 2023 in the waters bordering Senegal and Mauritania, based on gas reserves in the Greater Tortue Ahemyim (GTA) field discovered in 2015. They are located 120 km offshore at a water depth of 2,850 meters, making it one of the deepest subsea projects in Africa. Both countries have agreed to share them equally. The recoverable reserves amount to about 400 billion m3. The British company BP has a 61% stake in the project. The commissioning of the terminal was delayed due to the corona pandemic. It is now expected to be operational end of 2023. However, when it comes to export potential, one should never forget that African countries want and need to develop their domestic gas markets first and foremost, and that export potential depends on this domestic development (Lohmann, 2022).

Besides restarting the energy dialogue with Algeria the EU is considering the untapped LNG potential of Sub-Saharan African countries such as Nigeria, Senegal, Mozambique and Angola. Four key areas for Africa-EU hydrogen cooperation have been identified. First, increased foreign direct investment (FDI), including de-risking through off-take mechanisms and public-private partnerships. Second, flagship projects, as envisaged by the Agenda 2063 adopted in 2015 by the African Union, serve as a model and incentive for others to follow. Third, large parts of the value chain should remain in Africa, and fourth, a wider 'democratization' and accessibility of the energy sector should be promoted (Kneebone, 2022).

Cartoon 2: *Mozambique's Cabo Delgado gas field hit by Islamist terrorists*

Source: © Paresh Nath, courtesy of *politicalcartoons.com*, 31 March 2021

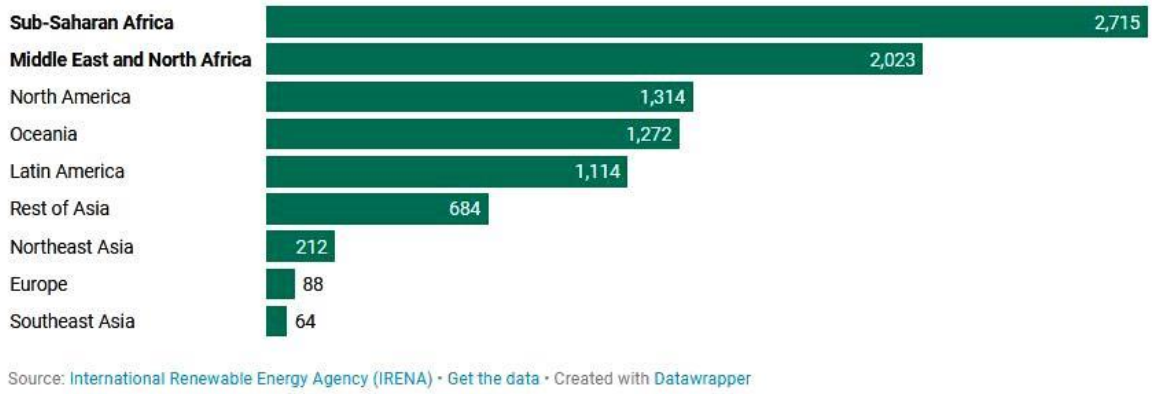
Eni, the Italian multinational energy company provides a first step. Eni's floating liquefied natural gas ship, *Coral-Sul*, flagged off Mozambique's northern coast at Cabo Delgado for its first shipment of liquefied natural gas, exports that could help ease Europe's energy crunch as Russia squeezes supplies. However, the region is infiltrated by Islamist terrorists and future deliveries are at risk (Hill & Nhamirre, 2022; see the following chapter Mozambique for more details).

Likewise, there is a growing concern in Nigeria that militants in the oil and gas-producing Niger Delta could be set to resume regular attacks on oil and gas infrastructure by the Reformed Niger Delta Avengers (RNDA), including attacks on oil and gas tankers in the Bight of Benin, similar to terrorism be the Movement for the Emancipation of the Niger Delta (MEND) in the decades before. Another problem is the theft of oil from pipelines through illegal connections (even submarine), common in Nigeria. For these reasons, Nigeria's largest LNG company is operating at 68% of capacity. The authorities are now hiring former Niger Delta rebels, who have been attacking this infrastructure since 2006, to protect it. The hope is

that this will increase security and production, but it is a risky, ad hoc strategy that does not guarantee lasting results (Czerep, 2022).

The REPowerEU plan foresees that hydrogen partnerships in Africa will facilitate the import of 10 million tons of hydrogen by 2030, replacing about 18 bcm of imported Russian gas. Sub-Saharan Africa is expected to be the main producer of green hydrogen by 2050: However, this market has yet to be developed and will require a significant expansion of renewable production and water availability globally (Komminoth, 2022).

Graph 4: *SSA is intended to be the main producer of green hydrogen by 2050*
Technical potential for producing green hydrogen by 2050, in Exajoule



Source: Komminoth, 2022

Moreover, Algeria, Niger and Nigeria agreed to build a 4,128-kilometer, multi-billion dollar trans-Saharan gas pipeline (TSGP) that will run through the three countries regarded as an opportunity to diversify the European Union's gas supplies (Fox, 2022). Niger, could thereby also export from its deposits (30 bcm) to Hassi R'Mel in Algeria (Czerep, 2022).

In July 2022, the three countries signed a Memorandum of understanding (MoU) for the implementation of the project. Once completed, the pipeline will transport 30 billion cubic meters of gas per year. Italy and Spain are also looking at how to increase their imports from Libya and Algeria and send the gas further into Europe. The EU is also promoting the projected EastMed pipeline, which will connect the European network to offshore gas fields in Cyprus, Israel and Egypt. The additional 2,000 km Trans-Mediterranean Pipeline from Algeria via Tunisia to Sicily and thence to mainland Italy, will be completed in 2027. Algeria is already Italy's second-largest gas supplier after Russia (Fox, 2022).

Africa has been identified as a potential key player in the production of green hydrogen not only for itself but also for other countries in Europe. Five key opportunities for the development of this resource have been identified, namely the export to EU markets (20.90%), availability of Renewable Energy (RE) resources (34.88%), youthful population (13.95%), Agenda 2063 (9.30%), and ammonia production (20.90%) (Agyekum, 2023). On the other hand, there were considerable barriers to this development such as the high cost of hydrogen (11.78%), dealing with the status quo (8.82%), corruption in the energy sector (4.52%), land and water availability issues (7.06%), political instabilities and insecurity in certain parts of the continent (11.76%), lack of the needed skills and education (11.76%), limited supporting infrastructure and financing (15.38%), and lack of the needed regulatory and legal framework (28.95%) (Agyekum, 2023). All of this makes it highly unlikely that the potential for hydrogen development in SSA will be fully realized in the foreseeable future.

Graph 5: *Projected Trans-Saharan gas pipeline*

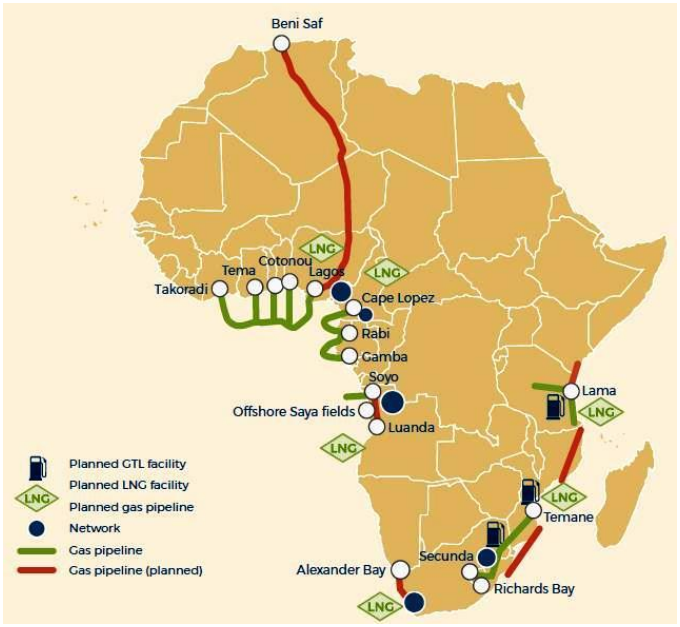
Source: © Sémhur, Wikimedia Commons

Nevertheless, in 2021, Germany and Namibia, for example, formed a partnership for green hydrogen production and export (BMZ 2021). The Federal Ministry of Education and Research (BMBF) is providing funding for the identification of suitable sites for green hydrogen production in Africa within the framework of the Potential Atlas for Green Hydrogen in Africa (H2-ATLAS-AFRICA), a joint initiative of the Institute for Energy and Climate Research (IEK, Jülich) with African partners from the sub-Saharan region. Germany will provide up to 40 million euros in funding from the economic stimulus package for cooperation within the framework of this partnership (BMZ 2021). Namibia has enormous potential for scaling up a green hydrogen industry, although being the most arid country in sub-Saharan Africa. It has a lot of vast unused space. High wind speeds in the country mean that the generation of wind power is particularly profitable. Solar power harbours an even greater potential thanks to over 3,500 hours of sunshine per year. This is almost twice as much as Germany has to offer. It was estimated that one kilogramme of hydrogen from Namibia will eventually cost between € 1.50 and € 2.00. This would be the most competitive price in the world which would be a huge locational advantage for hydrogen 'made in Namibia'. The National Hydrogen Council estimated that hydrogen demand of German industry alone (excluding refineries) would amount to 1.7 billion tons per year, a demand which was said to likely grow further. A feasibility study is planned to explore the potential of a green hydrogen industry, including innovative seawater desalination technologies (BMZ 2021). However, Namibia's plans to export green hydrogen as early as 2025 may be over-ambitious, sounding more like pious wishes.

That Africa is well positioned to become a major hub for global green hydrogen production has also been recognized by G20 members. Several African countries have begun to explore the potential for local production of green hydrogen, with feasibility studies underway and some projects in the preliminary stages. Africa should leverage its existing power pools, port and gas infrastructure, renewable energy potential and the African Continental Free Trade Agreement to fully integrate the green hydrogen value chain. SSA plans to set up six liquefied natural gas (LNG) facilities for LNG export and import, two new gas-to-liquid (GTL) facilities and two additional LNG trains at existing LNG facilities. Four ring networks

distributing gas within cities are expected to be set up, to establish domestic gas economies (Grobbelaar & Ngubevana, 2022).

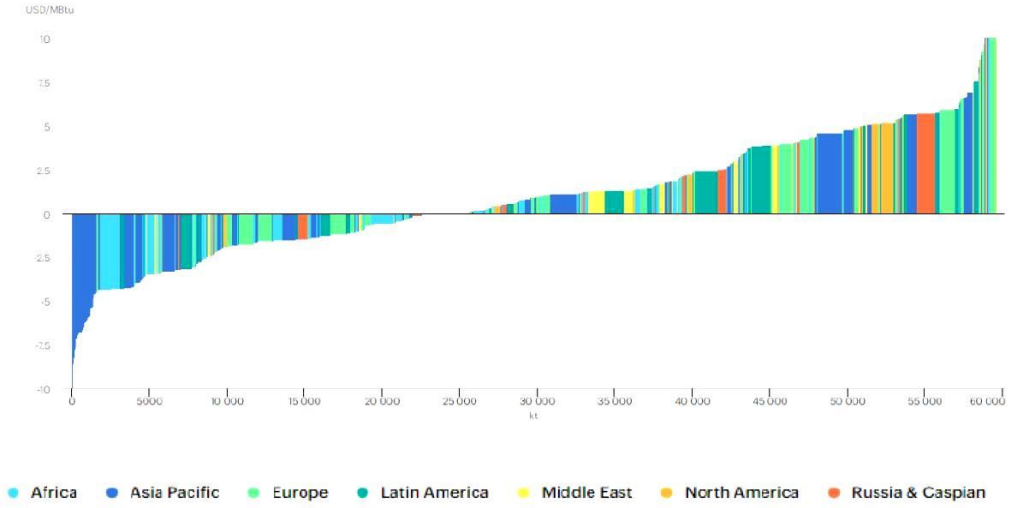
Graph 6: *Potential African natural gas infrastructure, 2015-2035*



Source: Grobbelaar & Ngubevana, 2022

Another controversial issue concerning climate change is the methane emissions from natural gas and LNG imports that become an increasingly urgent issue for the future of gas in Europe. According to the International Energy Agency's (iea, Paris) Methane Tracker, the negative costs of avoidance to limit damage are the highest in the Asia-Pacific and Africa regions. Apparently, this EU initiative has already attracted the attention of non-EU governments and companies involved in the global gas and LNG trade. First deliveries of 'carbon neutral' LNG cargoes to Asia have been realized (Stern, 2023). Other environmental impacts of the entire supply chain and the life cycle from producer to consumer were analyzed, as well as a risk assessment of recent innovations, using Mozambique as an example (Aczel, M.R. (2022).

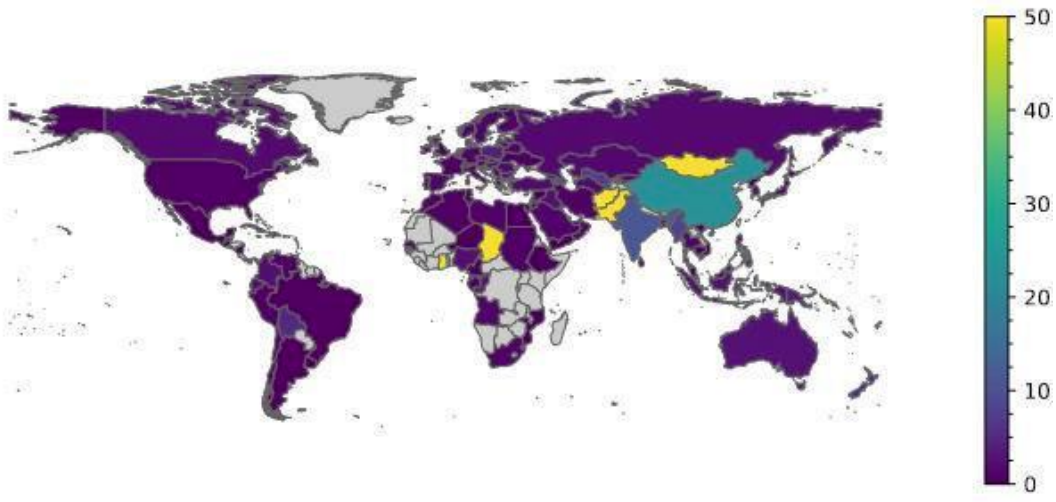
Graph 7: *Marginal abatement cost curve for global oil and gas methane emissions*



Source: https://www.iea.org/reports/methane-tracker-2020 , Stern, 2023

Adjustments in the use and availability of energy resources have affected global trade patterns in fossil fuels (coal, oil, and natural gas). Some economies are becoming less dependent on external energy sources, while others have increasingly relied on imports to meet their energy needs (Berdysheva, & Ikonnikova, 2021). The evolution of the international network of energy flows is revealing new patterns, including implications for energy security. For example, Canada has led the transition, reducing its energy intensity by nearly 20 %, while the United States managed to decouple its energy consumption from GDP and keep its energy demand relatively flat. While the U.S. and the EU have been slowly reducing their demand, China and SSA have been increasing their oil consumption. Primary energy use in China and Central Africa has nearly tripled, and primary energy use in India, East Africa, and the Middle East has more than doubled (Berdysheva, & Ikonnikova, 2021).

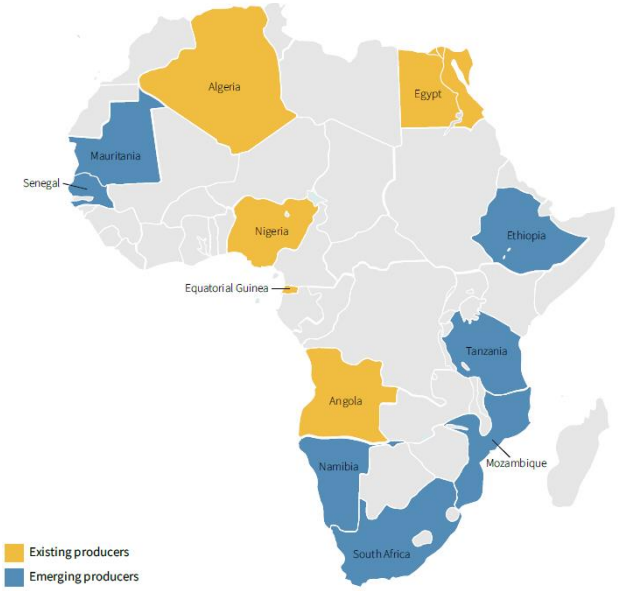
Graph 8: *ratio of net energy exports from 2000 to 2018 based on UNCT database*



Source: Berdysheva, & Ikonnikova, 2021

2. Case studies of African LNG and Hydrogen countries exporting to the EU: Nigeria, Angola, Mozambique

Graph 9: *Natural gas in Africa amid a global low-carbon energy transition*
Existing and emerging producers, 2022

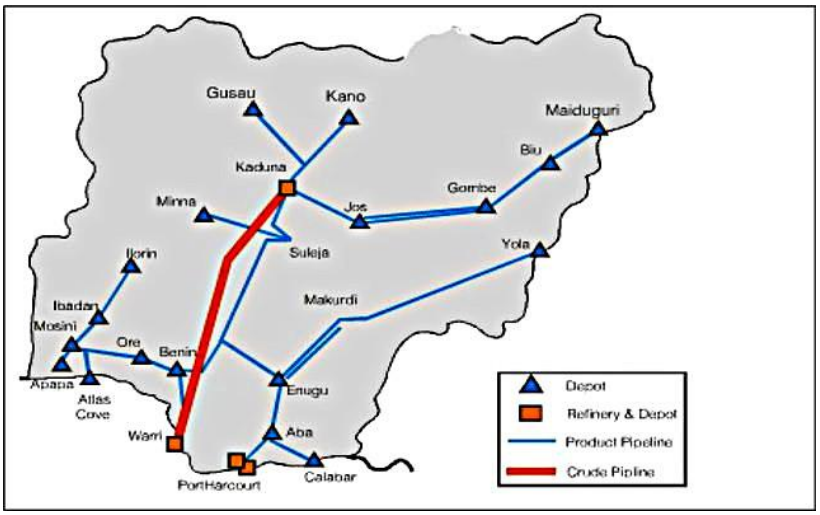


Source: Anwa & Neary & Huxham, 2022

Although the exploration of oil and gas frontiers in sub-Saharan Africa continues, the overarching narrative for Africa's oil and gas sector in recent years has been one of retreat and retrenchment. As international oil companies have streamlined their portfolios, they have generally sought to divest assets (Gavin, 2023). While Shell is pursuing divestment assets, such as its 30% interest in the Shell Petroleum Development Company of Nigeria (SPDC), the Eni-BP Azule Energy joint venture has seen the partners doubling up to secure economies of scale in one of Africa's largest producers, Angola. This trend has coincided with Africa's share of global oil output declining from 12.3 % in 2010 to just 8.1 % in 2021 (Gavin, 2023). However, one of the most exciting exploration prospects worldwide concerns Namibia, where TotalEnergies and Shell are pushing forward with ambitious drilling campaigns in the offshore Orange Basin, said to be the world's most sought-after new oil region, with 'advantaged' resources and low production costs. Near-term production opportunities, which can then self-fund exploration prospects, remain the key opportunity for both host countries, with near-term fiscal returns, and investors. Another clear theme that has emerged from recent exploration and production (E&P) activity in Africa is that oil company investment is no longer dominated by established giants such as Angola and Nigeria. Investments will be spread across several countries, including Senegal, Namibia and even Uganda. However, political volatility in many countries could hamper E&P's progress (Gavin, 2023).

2.1 Nigeria: gas exporter to the EU

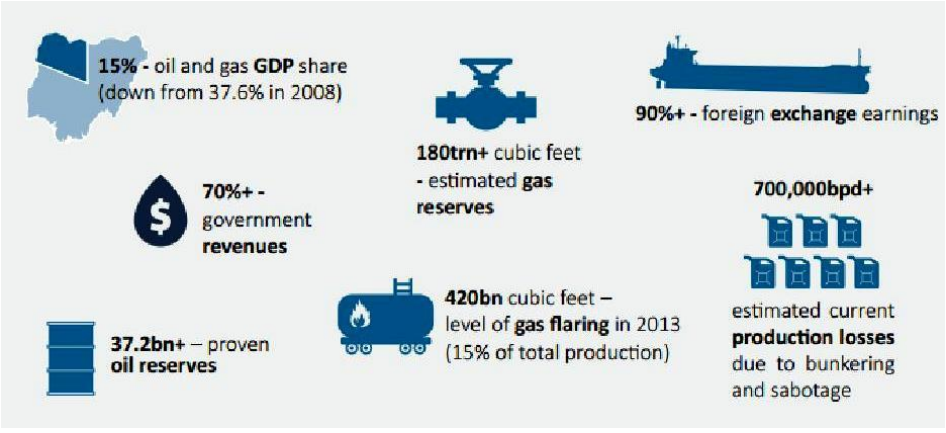
Graph 10: *Nigeria's pipeline infrastructure*



Source: Olu-Adeyemi, 2020

Nigeria leads the West African region in LNG exports with 27.6 bcm amid an uncertain outlook (Adekoya, 2021). Despite the sharp decline in LNG utilization rates in many parts of the world last year, gas exports from West African producers, particularly Nigeria, showed some resilience in 2020, trading 27.6 billion cubic feet (bcm) of gas, out of a total of 39 bcm traded by the region. In 2019, the country's exports were down one per cent, and not far from the 30 Bcm/year (22 million mt/year) capacity of the six-train[2] Nigeria LNG (NLNG) facility (Adekoya, 2021). Nigeria's biggest LNG Train 7, an expansion under construction at the Nigeria LNG Terminal in Bonny Island, will again significantly enhance the country's gas consumption. It is one of the most ambitious construction projects in Nigeria, second only to the nearly completed Dangote refinery (LNG Train 7, en. Wikipedia).

Graph 11: *Nigeria's oil and gas sector in numbers*

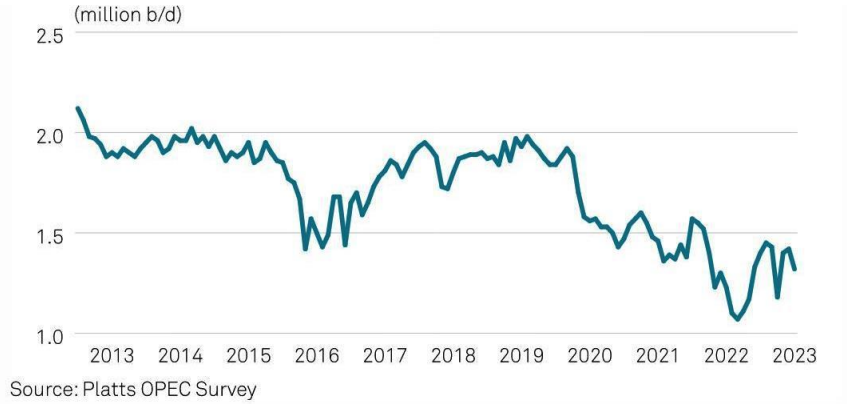


Source: Ighalo & Enang & Nwabueze, 2020

[2] "LNG plant consisting of one or more *LNG trains*, each of which is an independent unit for gas liquefaction and purification. A typical train consists of a compression area, propane condenser area, and methane and ethane areas". (Liquefied natural gas, en. Wikipedia)

Nigeria's gas supply system is still skewed to favour exports over domestic utilization. This leaves unfulfilled what have always been the twin objectives of Nigeria's gas policy: robust foreign exchange earnings and stimulation of the national economy. So far, neither has been achieved (Gbakon, & Ojaraida, 2020). The Federal Government's revenue from the export-oriented NLNG of $43 billion in the last twenty years is about the same amount distributed on average annually to the states through the Federal Allocation Accounts Committee (FAAC). While domestic gas supply is sufficient to generate only 16W of electricity per capita, the lowest in a comparison of selected African countries (Gbakon, & Ojaraida, 2020).

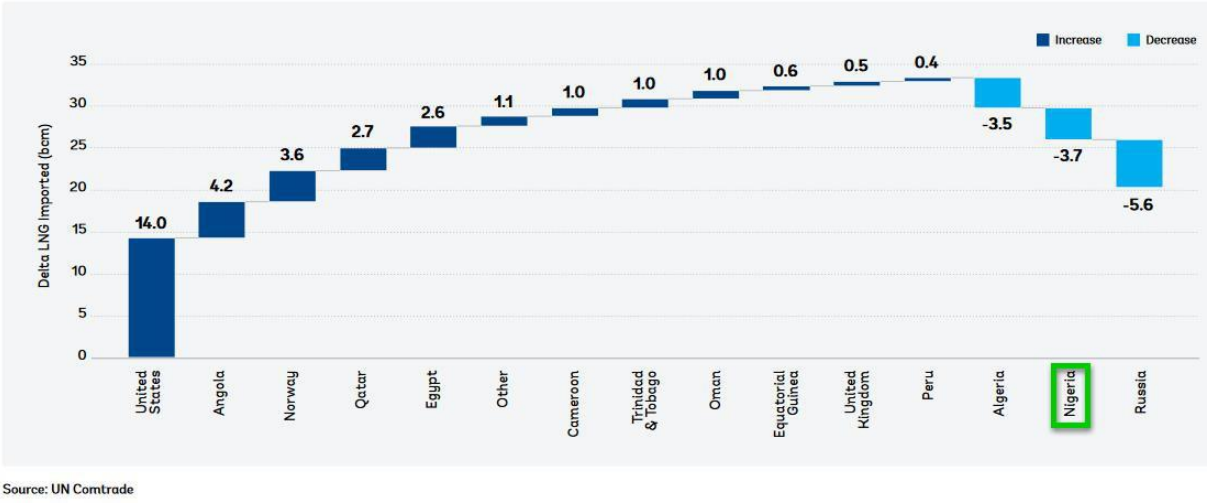
Graph 12: *Nigerian oil (and gas) output has collapsed in recent years*



Source: Mitchell, 2023

Africa's gas exporters will collectively decline by more than 6% in 2020, from 39.7 mtpa in 2019 to 37.3 mtpa in 2020. This was accompanied by sharp declines in LNG utilization rates in other parts of the world in 2020, particularly in the U.S., the largest buyer of Nigerian gas, over the summer, while Egypt, which is exposed to spot markets, almost completely halted LNG exports in the April-September period (Adekoya, 2021).

Graph 13: *Change in LNG imports from gas exporting countries to the EU, 2021 and 2022 (Nigeria, year-to-date November comparison as this is the latest data available for 2022)*



Source: © Worldbank, 2023

Gas received increasingly more attention as noted by deliberate policy actions of the government taken at various times, e.g. the enactment of the NLNG fiscal act in 1989, introduction of the Associated Gas Framework Agreement (AGFA) provision in the PPTA

in 1998, the incentives for gas utilization projects in the Corporate Income Tax Act (CITA) introduced in 1998 and 1999, Gas Pricing policy of 2008, the National Gas Policy framework of 2016 and more recently the Flare Gas Regulations of 2018. They were all targeted at the different components of the gas value chain, i.e. upstream production, market sector development, pricing, off-take, and related downstream utilization (Gbakon, & Ojaraida, 2020).

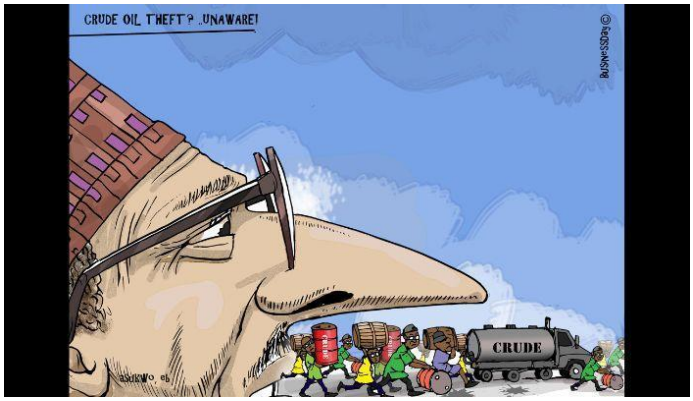
Nevertheless, there is still potential in gas exports for Nigeria, noting that Africa consumes 63% of its total gas production, and Nigeria provides its neighbours via the West African Gas Pipeline, from Nigeria's Escravos region of the Niger Delta area to Benin, Togo and Ghana. It was the first regional natural gas transmission system in sub-Saharan Africa. Nigerian gas is mainly for power generation (Adekoya, 2021).

However, only a small amount of Nigeria's oil and gas is exported to the EU. Nigeria has been unable to exploit European demand caused by the ongoing Russian invasion of Ukraine (Mitchell, 2023). With its limited export infrastructure and the projected trans-Saharan gas pipeline being further retarded by the military coup in Niger, Nigeria has found itself unable to satisfy rocketing European demand for gas following Russia's invasion of Ukraine. Nigeria exported just 9.06 million mt of LNG to Europe in 2022, according to data from S&P Global, slightly below its 2021 figure of 9.58 million mt (Mitchell, 2023). The record gas prices which contributed to Europe's skyrocketing energy bills, could have provided Nigeria's economy with much-needed foreign currency revenues similar to levels of the 1973 oil crisis or the Gulf War oil windfall in the early 1990s (Oladipo, 2022).

However, there is growing concern in Nigeria that militants could be set to resume regular attacks on oil and gas infrastructure. In November 2021, a gas pipeline in Rivers State was damaged by explosions, which impacted oil and gas production, and briefly suspended exports of Nigeria's Brass River crude. Earlier in January 2021, residents of Oduoha Community in Emohua Council of Rivers State were thrown into panic after a gas pipeline operated by the Nigerian LNG Limited (NLNG), and Nigeria Agip Oil Company (NAOC), running through the community to a terminal in Bonny Island, exploded (Adekoya, 2021). Therefore, the outlook is uncertain, with a coalition of former oil rebels in the Niger Delta, now known as the Reformed Niger Delta Avengers (RNDA), stating on 6 January 2021, threatening to resume attacks on installations. The original Niger Delta Avengers were responsible for the bulk of the attacks on Nigeria's oil infrastructure in 2016. Nigeria is relatively exposed to the spot market with around 50% of its LNG exports sold on a spot or short-term basis in 2019 (Adekoya, 2021).

In addition, the ongoing oil theft has had a more severe impact at the same time as the NLNG gas supply declined. Much of the feed gas supplied to Nigeria's NLNG project at Bonny Island is derived from associated gas. Therefore, the decline in the country's oil production due to upstream issues and crude oil theft resulted in a significant reduction in feed gas supply too. The rising crude oil theft overwhelmed Nigeria's energy business as the volume of gas the Nigeria LNG Limited (NLNG) for international markets has declined by 38% (Oladipo, 2022).

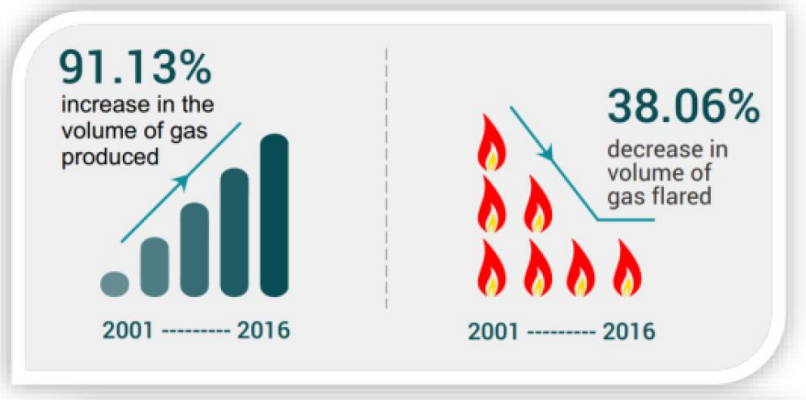
Cartoon 3: *Crude oil theft? Unaware!* [3]



Source: © Business-Day, Oladipo, 2022

Finally, environmental pollution by gas flaring has been a serious problem in Nigeria, with a global negative impact over decades. Gas flaring in the Niger Delta has been the world's biggest single environmental polluter. More gas is flared in Nigeria than anywhere else in the world. Estimates are notoriously unreliable, but roughly 2.5 billion cubic feet of gas associated with crude oil is wasted in this way every day. This is equal to 40% of all Africa's natural gas consumption in 2001. The flares have contributed more greenhouse gases than all of sub-Saharan Africa combined. And the flares contain a cocktail of toxins that affect the health and livelihood of local communities, exposing Niger Delta residents to an increased risk of premature deaths, child respiratory illnesses, asthma and cancer (Zibima & Jack, 2020; Osuoka, 2002).

Graph 14: *Trends in gas production and flaring in Nigeria*



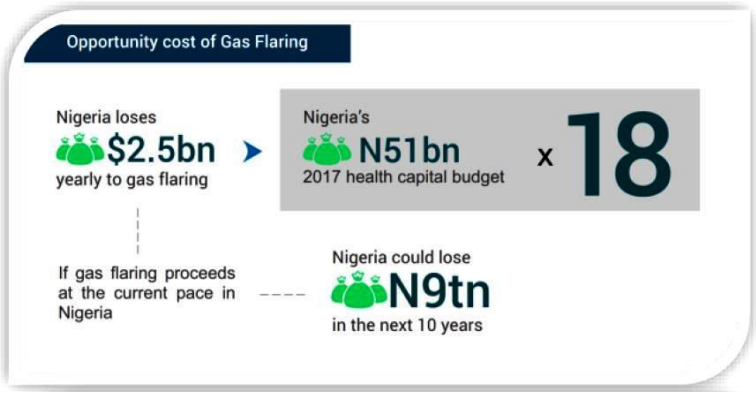
Source: Ighalo. & Enang & Nwabueze, 2020

Besides the grave environmental consequences of gas flaring, it remains an unwise practice in light of the impending global energy crisis in the coming decades (Ighalo. & Enang & Nwabueze, 2020). The potential of the Nigerian gas sub-sector can be fully realized if the commercialization mechanisms are put in place in line with the Gas Master Plan. The Nigerian Gas Master Plan of 2006 was put in place to stimulate economic growth in the country through the development of the natural gas sub-sector (a sub-sector of the petroleum industry). The key components of the Gas Master Plan are the Domestic Gas Supply Obligation, the Gas Pricing Framework and the all-important Gas Infrastructure Blueprint. The plan was presented with some key objectives. The completion of a comprehensive gas

[3] Cartoon depicting Nigerian President Muhammadu Buhari (2015 to 2023) allegedly unconcerned by rising oil theft © Business-Day, Oladipo, 2022.

pipeline network and the promotion of foreign direct investment are good means to achieve the commercialization initiative. Approximately $3.5 billion worth of investment is coming into the country to achieve the gas flare commercialization goals by 2020 (Ighalo. & Enang & Nwabueze, 2020).

Graph 15: *Nigeria's opportunity cost of gas flaring*



Source: Ighalo. & Enang & Nwabueze, 2020

Unfortunately, the lack of policy coherence on gas flaring, including climate change alleviation efforts, has been slowed by partisan politics, poor governance, lack of regulatory compliance, and policy conflicts between environmental protection and economic development priorities. Nigeria urgently needs inclusive stakeholder engagement across sectors and levels of local and regional government, a strengthening of federal institutions, a revaluation of economic aspirations through revenue diversification, and leadership that can temper the power of international oil companies (IOCs) to exploit the complexity of the multi-level governance structure (Aigbe & Stringer & Cotton, 2023).

Cartoon 5: *cartoon on environmental pollution by decades of gas flaring, Nigeria*

Source: © Today's Woman (TW) Magazine Nigeria; Zibima & Jack, 2020

Several pro-environmental groups have emerged throughout the Niger Delta, hitherto relying heavily on local, grassroots campaigns and traditional media to hold the Nigerian government, oil companies and other polluters accountable for environmental protection and environmental sustainability. Recently, new social media platforms have provided viable alternative structures for environmental activism and advocacy in the region, including the use of art in advocacy messaging and public awareness. The successful use of imagery and cartoons to translate the signifying ineptitude and corruption of government in environmental regulation underscores its usefulness and impact (Zibima & Jack, 2020). Among others, the Stop the Soot campaign has become a watershed in the emergence of a new form of advocacy that uses new media and the visual arts to demand environmental change and accountability.

It has attracted the attention of not only the Nigerian government but also members of the international community such as the United Nations and the World Health Organization (Zibima & Jack, 2020).

Cartoon 6: *Animation of Bribery of Regulators by Polluters*

Source: © Zibima & Jack, 2020

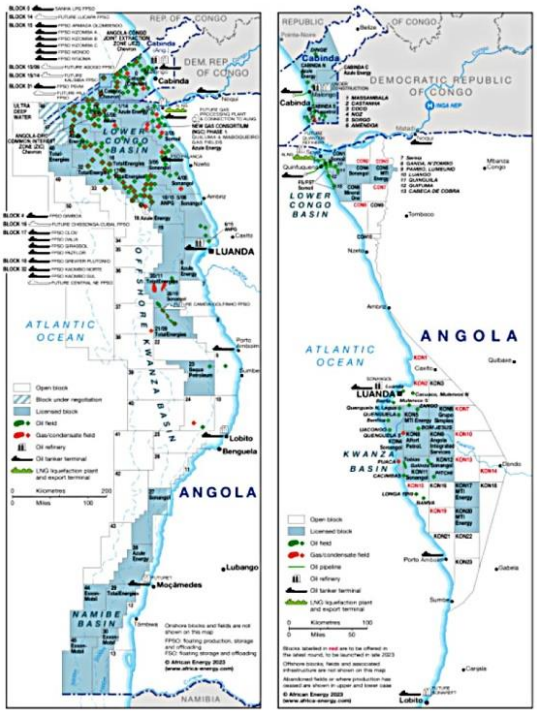
Cartoon 7: *Loading... the Niger Delta's global time bomb!* [4]

Source: © Francis Odupute, cartoonmovement.com (clipping, 2023)

[4] Francis Odupute is a Nigerian visual artist and journalist. He has won international media awards through his editorial cartoon stories and reports. He is the founder and CEO of African Press Cartoon, a media and edutainment start-up in Benin City, Edo State, Nigeria. (Francis Odupute, Bio (excerpt), cartoonmovement.com, accessed: 5 December 2023).

2.2 Angola: gas exporter to the EU

Graph 16: *Angola oil & gas infrastructure map* [5]



Source: © African Energy, Issue 484, 14 May 2023

Angola is the second largest hydrocarbon exporter country in South Saharan Africa (Claramunt Torche, 2019). Angola and Equatorial Guinea are two established SSA producers most focused on maximising the value of their gas reserves through LNG exports, rather than growing domestic demand (Anwar & Neary & Huxham, 2022). Angola's domestic gas demand is expected to remain relatively stagnant, even under optimistic economic growth scenarios, due to a lack of domestic pipeline gas infrastructure, coupled with an energy system already dominated by hydropower and cheap supplies of fuel oil. Angola's LNG supply comes exclusively from offshore drillings west of the Congo estuary (see Graph 17), which produce associated gas volumes that would otherwise have been wasted through flaring (Anwar & Neary & Huxham, 2022).

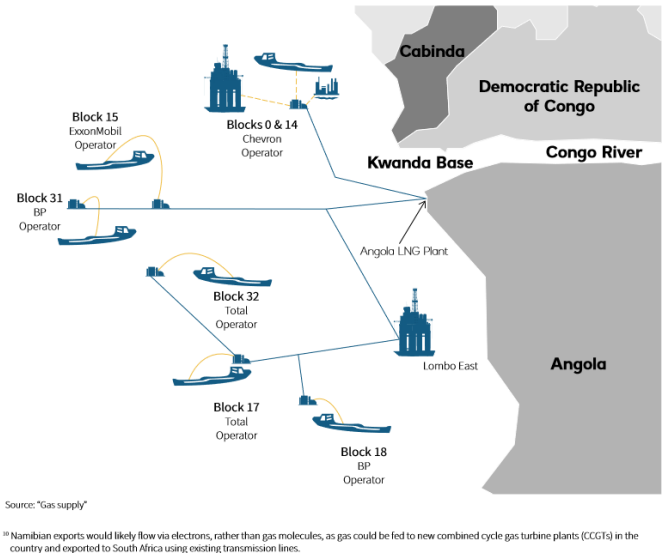
However, the latter only applied in theory. Since it was commissioned, the plant has suffered repeated production interruptions due to technical failures, including a two-year shutdown from 2014 to 2016. During the technical breakdowns, the gas that inevitably accrues from oil production was flared. The trail of smoke was visible for miles for years. These problems have significantly increased the cost of the plant (Hydrocarbons-Technology (2023).

The long-anticipated Angola LNG project was an integrated gas utilisation scheme comprising offshore and onshore operations at Soyo, at the mouth of the Congo River, south of Cabinda Province. The LNG terminal consists of a single natural gas liquefaction train, with a capacity of 5.2 million metric tons per year (mtpa), or 0.75 billion cubic feet per day (bcfd). It is owned by Angola LNG Ltd., a consortium consisting of Chevron (36.4%),

[5] Map of the hydrocarbons sector in Angola, showing the associated downstream infrastructure such as oil and gas pipelines, tanker terminals, refineries and LNG facilities. (left: off-shore facilities; right: on-shore facilities; green ship: LNG plant & terminal at Soyo; (south of Cabinda); black ships: oil tanker terminal) (African Energy, Issue 484, 14 May 2023)

Angolan national oil company Sonangol (22.8%), Eni SPA (13.6%), Total (13.6%), and BP (13.6%). Construction was completed in 2012, and the first liquefied gas was produced in 2013 (Hydrocarbons-Technology, 2023).

Graph 17: *Angolan offshore infrastructure map*



Source: Anwar & Neary & Huxham, 2022

But by May 2021, the LNG terminal was running out. BP, Chevron, Eni, Total and Sonangol announced that they would combine their existing Angolan portfolios into a joint venture and raise funds to take advantage of future opportunities for exploration, development and potential portfolio growth, both in Angola and regionally. The new gas will initially come from the Quiluma & Maboqueiro fields. The project includes two offshore wellhead platforms, an onshore gas processing plant and a tie-in to the Angola LNG terminal for marketing of condensate and gas via LNG cargoes. Project execution activities are scheduled to commence in 2022, with the first gas planned for 2026 and an expected plateau production of 330 mmscf/d (approximately 4 bn cubic metres per year) (Hydrocarbons-Technology, 2023).

Gas exports from neighbouring Namibia are likely to be in the form of electricity rather than gas, as gas could be fed into the country's new Combined Cycle Gas Plant (CCGT) and exported to South Africa using existing transmission lines (Anwar & Neary & Huxham, 2022).

Also, the government in Luanda announced in November 2023 that it plans to produce, before 2030, biofuels for domestic use and export, with an initial investment of around 20 bn dollars (around 19 bn euros) (Redacção F8, 2023). The National Oil, Gas and Biofuels Agency (ANPG) presented the strategy for the introduction of biofuels, which combines the objectives of reducing greenhouse gas emissions, technological development and energy transition, among others. The strategy had already been approved in 2009 to meet the commitments of the Kyoto Protocol. It was expected to have a significant impact on Angola's imports of petroleum products due to insufficient domestic refining capacity, thus contributing to foreign exchange savings. Sonangol, the state-owned oil company (controlled by the ruling MPLA) and ENI, signed a memorandum of understanding for the construction of a biorefinery (Redacção F8, 2023). This could contribute to the implementation of Sonangol's energy transition strategy, which provides for the identification and evaluation of several opportunities, such as agro-industrial supply chains for the production of low-carbon biofuels,

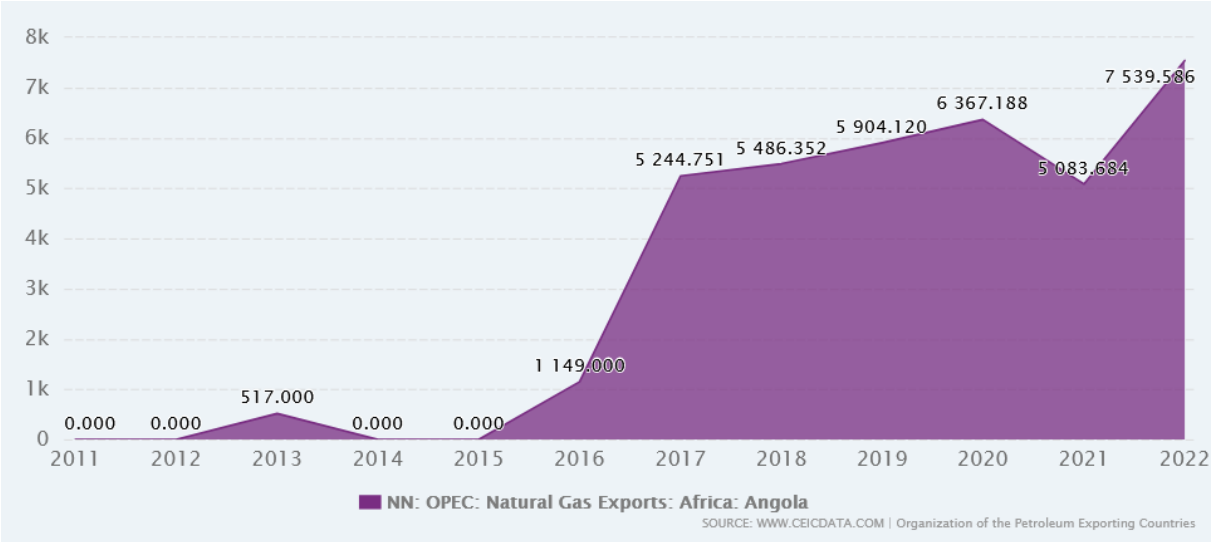
the valorisation of residual biomass and the promotion of synergies between agricultural production chains and bioenergy. The ultimate goal of this strategy was not just to produce oil for export, but to process the oil in Angola, to have its own biorefineries spread throughout the country, to produce locally and to use the final product internally and export some of it. The initial investment in the first few years was estimated at around 12 to 20 billion dollars, with a feasibility study to be carried out in the short term in 2024 (Redacção F8, 2023). Apparently, Luanda did not bother about the controversial international discussion concerning several disadvantages associated with the use of biofuel, including the "food vs fuel" debate, biofuel production methods being sustainable or not, leading to deforestation and loss of biodiversity.

Cartoon 8: '*Whether biofuel or LNG, … always MPLA!'* [6]

Source: © Redacção F8, 2023

When it comes to gas exports, Angola ranked only as an 'also-ran' at the bottom of 208 listed countries worldwide, at least up to 2015.

Graph 18: *Angola's natural gas: Exports from 2011 to 2022*

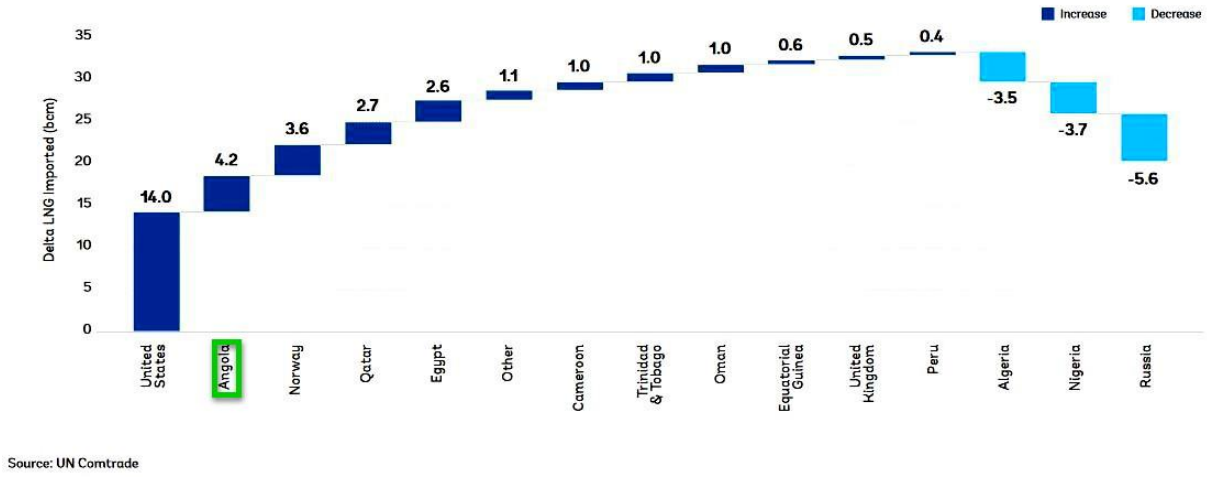


Source: © CEIC, 2023

[6] Referring to widespread corruption of Angola's MPLA government by SONAGOL and its successor, the ANPG (Redacção F8, 2023)

Luanda and the Angolan media do not seem to regard the EU as a dominant energy actor. Both give prominence to the country's bilateral energy relations with specific European states. The terms 'EU' and 'Europe' are mainly used to provide a geographical context for individual European states or to describe one of the markets for Angolan oil and gas. Unlike the 2018 Africa-EU Energy Partnership (AEEP), which foresees the construction of transport infrastructure and an overall increase in oil and gas exports to EU countries, no such measures are included in the EU-Angola bilateral relations documents (Tichý, 2021).

Graph 19: *Change in LNG imports from gas exporting countries to the EU, 2021 and 2022 (Angola, year-to-date November comparison as this is the latest data available for 2022)*

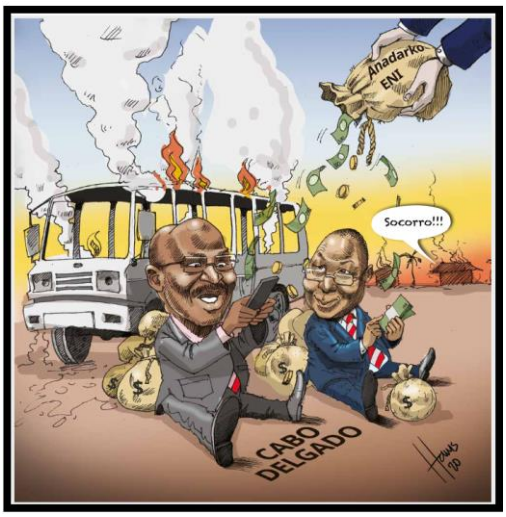


Source: © Worldbank, 2023

Most notably, the EU has significantly increased its gas imports in the form of LNG from the United States, Angola, and Norway. In addition to the significant reduction in gas imports from Russia, there has also been a decrease in overall gas imports via pipeline from Algeria and via LNG from both Nigeria and Algeria (WB 2023).

2.3 Mozambique: gas exporter to the EU

Cartoon 9: *Mozambican gas fields in Cabo Delgado threatened by terrorists*
Mozambique's President Filipe Nyusi enjoys fresh money from ENI and Anadarko



Source: © Canalha de Mocambique, *Suplemento humorístico*, 18 March 2020

In 2010–2011, Anadarko Petroleum and Eni discovered the Mamba South gas field, recoverable reserves of 4,200 billion cubic metres (150 trillion cubic feet) of natural gas in the Rovuma Basin, off the coast of northern Cabo Delgado Province. Once developed, this could make Mozambique one of the largest producers of liquefied natural gas in the world. Production was scheduled to start in 2018 but was delayed by attacks from Islamist terrorists and their ongoing insurgency in Cabo Delgado. The majority of the project and its associated operations have been awarded to the company TotalEnergies (Mineral industry of Mozambique, en. Wikipedia).

For a country with an economy that produces just $26 bn a year and is rebuilding itself after the Mozambican War of Independence (1964-1975) and the subsequent brutal 16-year civil war that ended in 1992, this sounded promising. It was certainly enough to make a difference to the country, which for decades has been at the bottom of a range of indices measuring poverty, health and education (Akwagyiram, 2013).

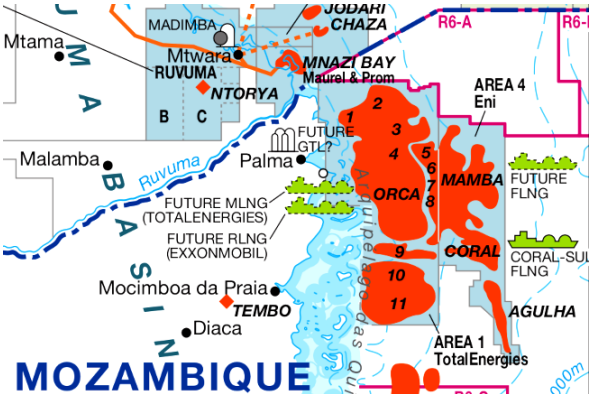
But turning those newly acquired wealth into sustainable capital was not straightforward, the often cited 'resource course' could be the final outcome. A small elite in the capital Maputo associated with the ruling party (FRELIMO) and with strong business interests, dominated the economy (Akwagyiram, 2013). Nigeria and Norway were examples of contrasting fortunes illustrating the fact that an abundance of natural resources does not automatically lead to wealth and prosperity but requires good governance.

Graph 20: *Divergent paths and divergent fortunes*

Nigeria	Norway
$400bn oil revenue stolen or misspent since 1960	Norway's sovereign fund worth $670bn (2012)
Nigeria's treasury loses $6bn a year to oil theft	Norway's annual oil revenue is $40bn
Nigerian GNI per capita is $1,200	Norway's GNI per capita is $88,890

Source: *BBC-news Africa*, Akwagyiram, 2013

Graph 21: *Mozambiquan gas fields in Cabo Delgado Province (including planned FLNG units)*



Source: Howard, 2023

With their projects, TotalEnergies, ExxonMobil and Eni pushed the citizens from Cabo Delgado even deeper into poverty. The companies bulldozed the people's villages and forced them to move to resettlement villages (Urgewald, 2023). Local people became increasingly frustrated. Once again, foreign powers and companies were making money at their expense. It was the perfect breeding ground for extremist insurgency. In 2017, a few years after the gas companies arrived in Cabo Delgado, terrorists began to devastate the region. They forced people out of their villages and then burned them down. Since 2017, the extremists have killed more than 4,000 people and forced almost a million to flee. Thousands of children have lost their parents while fleeing. Many still don't know where they are, how to find them or if they are still alive. Overall militarization of the region will only increase as the EU seeks to protect the Mozambican gas destined for Europe (Urgewald, 2023).

Nonetheless, Eni's Coral-Sul floating liquefied natural gas vessel, off Mozambique's northern coast at Cabo Delgado, flagged off the first shipment of LNG carried by a British-sponsored LNG tanker to help ease Europe's and the global 2021–2023 energy crisis caused by the Russian invasion of Ukraine (Hill & Nhamirre, 2022).

3. The LNG infrastructure in the EU

Cartoon 10: *EU - porous sanctions*

Source: © marian kamensky, *toonpool.com*, 27 September 2023

As the EU's energy system moves towards full decarbonisation, natural gas, with its relatively low carbon characteristics and abundant supply, could play an important intermediate role. (Sesini & Giarola & Hawkes, 2020). LNG can play an important strategic role in the European gas market. Declining domestic production in Europe (from 134 bcm in 2015 to a projected 108 bcm in 2020) and unevenly distributed reserves make European countries highly dependent on natural gas imports. Germany, Italy and France are among the world's top ten importers, accounting for 20% (by volume) of global imports. With 60% of Europe's gas needs being met by a limited number of gas suppliers (i.e. Norway and Russia being the main ones), there is a need to diversify supply sources (Sesini & Giarola & Hawkes, 2020).

But LNG alone is not enough to make the EU gas network resilient to demand shocks. As the effects of climate change become more apparent, regions like Europe will not only see their global average temperature rise but will also be more exposed to intense and unexpectedly cold weather events, where energy sources cannot be easily mobilised to balance energy demand. It is therefore crucial to consider the interdependence of LNG and natural gas storage to increase the resilience of the EU gas network (Sesini & Giarola & Hawkes, 2020).

Graph 21: *LNG in Europe: Ready or not?* [7]

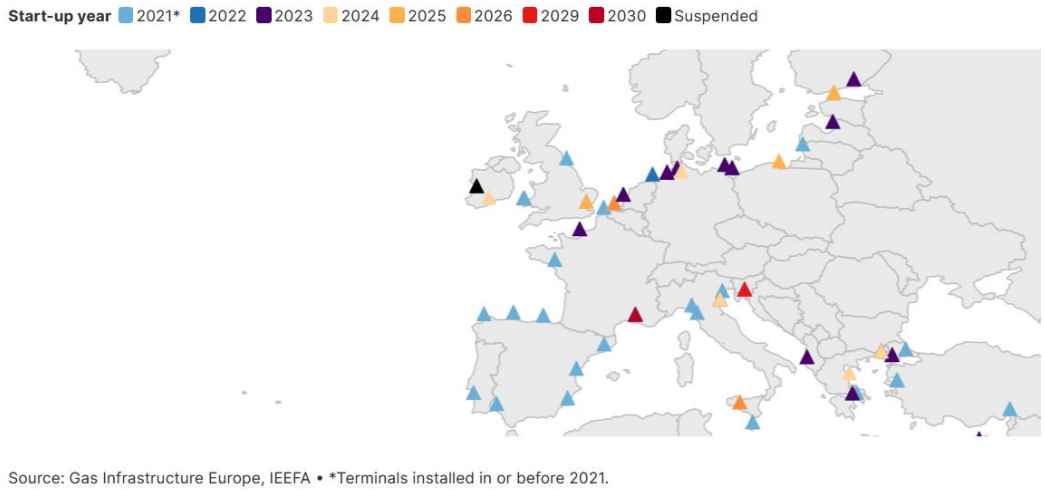
Source: Gas Infrastructure Europe, *statista*, Armstrong, 2022

[7] European countries with the most operational/planned LNG import terminals (Nov. 2022). Planned/under construction expansion of existing terminals not shown.

Although the EU has agreed on a plan to reduce natural gas consumption by 15% in the winter of 2022/23 compared to the previous five-year average, gas is not going away as an energy source any time soon. One of Europe's responses to the crisis is to increase imports of liquefied natural gas (LNG). By bypassing pipelines from the east, LNG terminals open up a wider range of potential suppliers. One of the main beneficiaries of this shift so far has been the United States. In the first half of 2022, the US became the world's largest supplier of LNG, with 71 % of its exports going to the EU and the UK (Armstrong, 2022). Germany, the biggest EU member state according to population and economic power, which has arguably developed the greatest dependence on Russian gas supplies despite repeated international warnings, has announced the construction of four LNG import terminals since the start of the Russian invasion of Ukraine. These will be the country's first terminals (Armstrong, 2022).

For example, Czech utility CEZ (CEZP.PR) has booked 2 billion cubic metres (bcm) of annual capacity at a yet-to-be-built onshore terminal for liquefied natural gas (LNG) to be imported into Stade, at the Elbe River, from 2027, spurring the construction of transport infrastructure and securing future energy supplies (Eckert, 2023). Until fixed terminals are available, Germany is using floating storage and regasification terminals (FSRUs) to help replace Russian gas supplies by pipeline. Three FSRUs are operating at the ports of Wilhelmshaven, Brunsbuettel and Lubmin after Germany arranged their charter and onshore connections. Wilhelmshaven, Stade and Mukran (at Sassnitz) a port on the Baltic Sea island of Rügen that will be connected to Lubmin on the mainland, are expected to receive additional FSRUs for the 2023/24 winter (Eckert, 2023).

Graph 22: *LNG regasification terminals in Europe*



Source: © IEEFA, 2023

German industry and the government also built up terminal capacity in anticipation of the increased use of hydrogen at the sites, which, if produced using renewable energy, can help the transition to a low-carbon economy (Eckert, 2023). State-owned Deutsche Energy Terminal held auctions for 2024 regasification capacity at Brunsbuettel and Wilhelmshaven 1 in November 2023 and planned rounds at Stade and Wilhelmshaven 2 in December. Privately-owned Deutsche ReGas reported in August that suppliers had booked 4 bcm of capacity per year for 10 years at Mukran, where it plans to deploy two FSRUs to supply the mainland. It has chartered a second FSRU, the 'Transgas Power', with a regasification capacity of 7.5 bcm, to complement the 'Neptune' currently operating at Lubmin. LNG from Mukran is expected to flow to onshore networks from the first quarter of 2024 via Gascade's new pipeline. The project has sparked local opposition. However, two legal challenges by

environmental groups DUH and NABU were rejected by the Federal Administrative Court in September (Eckert, 2023).

Utility Uniper (UN01.DE) launched Germany's first FSRU, Wilhelmshaven 1, in the North Sea deepwater port in December 2022 (Eckert, 2023). Tree Energy Solutions (TES) will operate a second FSRU, Wilhelmshaven 2, for five years from 2023. Uniper plans to add an onshore ammonia receiving terminal and cracker in the second half of the decade. Ammonia is planned to be used as a carrier for hydrogen, whose low density makes it difficult to transport over long distances (Eckert, 2023).

The EU Commission has approved a €40 million support measure for the onshore liquefied natural gas (LNG) terminal at Brunsbuettel at the North Sea, citing its contribution to the security and diversification of supply (Eckert, 2023). The Brunsbuettel FSRU, operated by the trading arm of RWE (RWEG.DE), will be commissioned in mid-April 2023. It is the forerunner of a land-based LNG plant, which now has an approved package of government support and could be operational by the end of 2026 when an adjacent ammonia terminal could also come onstream. State bank KfW (KFW.UL), Gasunie and RWE are shareholders, and Shell (SHEL.L) has committed to major purchases. The total cost of the onshore terminal is €1.3bn (Eckert, 2023).

However, the use of liquefied natural gas is controversial. The German Federal Environment Agency claims that increased use of LNG, especially compared to gas transported via pipeline, cannot be justified from a climate policy and energy efficiency perspective. Nevertheless, the agency states that an expansion of LNG infrastructure throughout the transition to cleaner energy could contribute to improved supply security as well as more competition (Armstrong, 2022).

Moreover, over half of Europe’s LNG infrastructure assets could be left unused by 2030 (IEEFA, 2023). Europe's LNG capacity in 2030 will be more than its total projected gas demand, including both LNG and pipeline gas. There is a significant discrepancy between regasification infrastructure under construction and planned and projected LNG demand in all countries analysed, with the highest risk of stranded assets projected in Spain (50 bcm), Turkey (44 bcm), the UK (40 bcm), France (14 bcm), Italy (10 bcm) and Germany (9 bcm) in 2030. The biggest importers of Russian LNG in 2022 were France (7.4 bcm), Spain (5.2 bcm), and Belgium (3.0 bcm). However over-engineered networks are expensive to build and maintain. (IEEFA, 2023).

4. Conclusion

Cartoon 11: *German Economics Minister Habeck visits the continent of opportunities* [8]

Source: © mandzel, *toonpool.com*, 4. December 2022

The export of liquefied natural gas (LNG) and green hydrogen from Sub-Saharan Africa to the European Union (EU) presents a compelling opportunity for economic growth, energy security, and climate cooperation. As the EU strives to diversify its energy sources and reduce carbon emissions, Sub-Saharan Africa possesses substantial reserves of natural gas and potential for hydrogen production, making it an attractive partner.

Sub-Saharan Africa is endowed with significant natural gas reserves, particularly in countries like Nigeria, Angola, Mozambique, and Tanzania. These reserves could serve as a reliable source of LNG for the EU, helping the region meet its increasing energy demands. To capitalize on LNG export prospects, Sub-Saharan Africa would need to invest in liquefaction facilities, storage terminals, and transportation infrastructure. Collaborative efforts between African nations and the EU, along with financial support and technological transfer, could accelerate this infrastructure development. LNG export projects could provide a substantial economic boost to Sub-Saharan African countries, fostering job creation, local development, and increased revenue. The EU, in turn, would benefit from a diversified and stable supply of natural gas, contributing to energy security.

But building the necessary infrastructure for LNG exports requires substantial investment, especially FDI. Securing financing for such projects may be challenging, and the risk of cost overruns could hinder progress. International financial institutions and partnerships could play a vital role in overcoming these challenges. Political and regulatory stability in the African countries concerned would be crucial for long-term investment in the energy sector. Sub-Saharan African nations must demonstrate a commitment to creating a stable business environment, while the EU should engage in diplomatic, economic and financial efforts to ensure reliable and secure supply chains.

Also, Sub-Saharan Africa has abundant renewable energy resources, such as solar and wind power, which can be harnessed for green hydrogen production. The EU's commitment to green hydrogen aligns with the potential for sustainable hydrogen exports from the region.

[8] Cartoon: The writing on the suitcase says - ‘Green hydrogen wanted’. The traffic signs refer to Habeck's visit to Namibia and South Africa in early December 2022.

Investing in greenfield hydrogen projects, with a focus on renewable energy sources and electrolysis of water can position Sub-Saharan Africa in the long-run as a key player in the global hydrogen market. Collaboration with the EU in technology transfer and knowledge sharing is essential to realizing this potential. Exporting green hydrogen contributes to the EU's climate goals and reduces dependence on fossil fuels. The environmental benefits could create a positive market sentiment and drive further investment in hydrogen projects.

Establishing hydrogen infrastructure and developing advanced technologies for efficient production, storage, and transportation pose significant challenges concerning technological and infrastructure barriers. Close collaboration between Sub-Saharan African nations and the EU, along with technological assistance, can help overcome these barriers.

Global competition in the LNG and hydrogen market is intense. Sub-Saharan Africa must position itself competitively, focusing on cost-effective production methods and ensuring a stable and transparent regulatory framework.

In short, exporting LNG and hydrogen from Sub-Saharan Africa to the EU presents a promising avenue for economic development, energy cooperation, and climate action. Overcoming challenges requires strategic collaboration, investment, and commitment from both regions. Through sustained efforts, the partnership has the potential to foster economic growth, enhance energy security, and contribute to the global transition towards a more sustainable and low-carbon energy future.

Therefore, the EU and its member countries, notably Germany, France and Italy are again turning more to Sub-Saharan African countries to create alternatives to Russian gas (Lohmann, 2022). They will have to assume also financial and political risks. In 2022, shortly after German Chancellor Olaf Scholz visited Senegal, where he spoke to the government about purchasing LNG, he underlined at the congress of the German Association of Energy and Water Industries (BDEW) in Berlin in July 2022 that it was much more predictable to create security of supply by establishing new supply chains for LNG than to enter into permanent cut-throat competition on the world market (Lohmann, 2022).

This raises the question of what contribution Sub-Saharan Africa can make in establishing such new supply chains. Nj Ayuk, the chairman of the African Energy Chamber, in Cape Town, who had met the chancellor in Dakar, pointed to Africa's large natural gas reserves and also to the efforts to develop the corresponding infrastructure, LNG terminals, but also pipelines through Africa that could be extended through the Mediterranean sea to southern Europe. Ayuk also related to the central problem of financing such projects. But Zakaria Dosso, managing director of the African Energy Investment Cooperation, cautioned that Africa needs to develop fair and reliable legal frameworks to attract foreign direct investment and secure all types of investments (Lohmann, 2022). This might have been one of the reasons why, for example, in December 2022, German Economics Minister Robert Habeck embarked on a goodwill tour of the 'continent of opportunity' in a bid to assemble a coalition of willing gas suppliers for Germany.

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Résumé : *[Perspectives d'exportation de GNL et d'hydrogène de l'Afrique subsaharienne vers l'UE]* – Depuis la guerre russe en Ukraine, de nombreux pays européens se sont efforcés de trouver des sources d'énergie alternatives. L'une des réponses consistait à augmenter les importations de gaz naturel liquéfié (GNL). En contournant l'utilisation de gazoducs venant de l'Est en construisant des terminaux GNL, l'UE a ouvert la porte à une plus grande variété de fournisseurs potentiels. Le Partenariat Europe-Afrique pour l'énergie et le climat fournit un cadre pour une alliance gagnant-gagnant. Les pays africains seront des acteurs clé à l'avenir, notamment les pays subsahariens comme le Nigeria, le Sénégal, le Mozambique et l'Angola. Selon le plan REPowerEU, les partenariats hydrogène en Afrique permettront d'importer 10 millions de tonnes d'hydrogène d'ici 2030, remplaçant environ 18 milliards de mètres cube de gaz russe importé. L'Algérie, le Niger et le Nigeria ont récemment convenu de construire un gazoduc transsaharien de 4 128 kilomètres qui traverserait les trois pays jusqu'à l'Europe. Une fois achevé, le gazoduc transportera 30 milliards de mètres cube de gaz par an. La Coalition africaine pour le commerce et l'investissement (ACTING) estime la capacité potentielle d'exportation de GNL subsaharienne à 134 millions de tonnes de GNL (environ 175 milliards de m3) d'ici 2030. L'Afrique subsaharienne devrait également devenir le principal producteur d'hydrogène vert d'ici 2050. Cependant, ce marché reste à développer et nécessite une expansion significative de la production renouvelable et de la disponibilité de l'eau. Cependant, les pays de l'UE et les entreprises concernées seraient bien avisés de prendre note de l'adoption d'objectifs européens beaucoup plus stricts de réduction des gaz à effet de serre pour 2030 et de la publication de la stratégie méthane de la Commission européenne. Cela étant dit, l'UE pourrait risquer de voir plus de la moitié des infrastructures GNL européennes inutilisées d'ici 2030, dans la mesure où la capacité européenne de GNL en 2030 dépasse la demande totale prévue de gaz, y compris le GNL et le gazoduc. Quoi qu'il en soit, il ne faut pas oublier que les pays africains souhaitent et doivent développer en priorité leurs marchés gaziers nationaux et que le potentiel d'exportation dépend de ce développement national. A long terme, un mix énergétique mondial serait nécessaire pour accélérer les changements induits par les nouvelles ressources, les nouvelles technologies et les engagements climatiques. Ces changements dans l'utilisation et la disponibilité des ressources énergétiques affecteraient également l'utilisation des combustibles fossiles. Quoi qu'il en soit, outre l'approvisionnement en GNL, l'UE doit également veiller à augmenter ses propres capacités de stockage afin de pouvoir garantir une réponse rentable à un goulot d'étranglement dans l'approvisionnement en gaz naturel. Cependant, le GNL seul ne suffit pas à assurer la résilience du système en cas de rupture d'approvisionnement. Les ressources énergétiques alternatives et les économies d'énergie restent essentielles.

Zusammenfassung : *[Perspektiven für den Export von LNG und Wasserstoff aus Afrika südlich der Sahara in die EU]* – Seit Russlands Krieg in der Ukraine bemühen sich viele europäische Länder darum, alternative Energiequellen zu finden. Eine der Antworten bestand darin, den Import von Flüssigerdgas (LNG) zu steigern. Durch die Umgehung der Nutzung von Pipelines aus dem Osten mittels des Baus von LNG-Terminals erschloss sich die EU eine größere Vielfalt potenzieller Lieferanten. Die Europa-Afrika-Energie- und Klimapartnerschaft bietet einen Rahmen für eine Win-Win-Allianz. Afrikanische Länder werden in Zukunft zentrale Akteure sein, darunter auch Länder südlich der Sahara wie Nigeria, Senegal, Mosambik und Angola. Dem REPowerEU-Plan zufolge sollen Wasserstoffpartnerschaften in Afrika bis 2030 den Import von 10 Millionen Tonnen Wasserstoff ermöglichen und damit etwa 18 Milliarden Kubikmeter importiertes russisches Gas ersetzen. Algerien, Niger und Nigeria haben sich kürzlich auf den Bau einer 4.128 Kilometer langen Transsahara-Gaspipeline geeinigt, die durch die drei Länder nach Europa führen soll. Nach ihrer Fertigstellung wird die Pipeline 30 Milliarden Kubikmeter Gas pro Jahr transportieren. Die African Coalition for Trade and Investment (ACTING) schätzt die potenzielle LNG-Exportkapazität südlich der Sahara bis 2030 auf 134 Millionen Tonnen LNG (ca. 175 Milliarden m3). Es wird erwartet, dass Afrika südlich der Sahara bis 2050 auch zum Hauptproduzenten von grünem Wasserstoff wird Dieser Markt muss jedoch noch erschlossen werden und erfordert einen erheblichen Ausbau der erneuerbaren Produktion und der Wasserverfügbarkeit. Allerdings wären die beteiligten EU-Länder und Unternehmen gut beraten, die Verabschiedung deutlich strengerer EU-Treibhausgas-Reduktionsziele für 2030 und die Veröffentlichung der Methanstrategie der Europäischen Kommission zur Kenntnis zu nehmen. Außerdem könnte die EU riskieren, dass bis 2030 mehr als die Hälfte der europäischen LNG-Infrastruktur stillgelegt wird, da die europäische LNG-Kapazität im Jahr 2030 den gesamten prognostizierten Gasbedarf, einschließlich LNG und Pipelinegas, übersteigt. Ungeachtet dessen darf nicht vergessen werden, dass die afrikanischen Länder ihre inländischen Gasmärkte vorrangig weiterentwickeln wollen und müssen und dass das Exportpotenzial von dieser inländischen Entwicklung abhängt. Langfristig wäre ein globaler Energiemix erforderlich, um den durch neue Ressourcen, neue Technologien und Klimaverpflichtungen vorangetriebenen Wandel zu beschleunigen. Diese Veränderungen in der Nutzung und Verfügbarkeit von Energieressourcen würden sich auch auf die Nutzung fossiler Brennstoffe auswirken. Unabhängig davon muss sich die EU neben der LNG-Versorgung auch um den Ausbau ihrer eigenen Speicherkapazitäten kümmern, um eine kosteneffiziente Reaktion auf einen Erdgasversorgungsengpass gewährleisten zu können. Allerdings reicht LNG allein nicht aus, um die Widerstandsfähigkeit des Systems im Falle eines Versorgungsausfalls zu gewährleisten. Alternative Energiequellen und Energieeinsparungen bleiben von entscheidender Bedeutung.