LNG Trade In The Atlantic Basin:
Facing The Complex Future of Decarbonization

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Summary

Key Words

LNG trade, Atlantic Basin, decarbonization, open strategic autonomy

Key findings

- Decarbonization is a process of no return, but it will only be uniform across some regions of the world and in some areas of the Atlantic Basin. In the North Atlantic Basin (in particular, the U.S. and the EU) the policy frameworks and physical deployments are clear and, until now. have driven GHG emissions reductions.
- The processes involved will be complex given the broad implications for the global economy and the numerous sectors involved.
- Gas demand will grow -- more or less -- depending on which decarbonization scenario unfolds; but growth will be very significant, in any case.
- Since the beginning of the war in Ukraine, LNG supplies to Europe from the U.S. have been decisive in substantially decreasing Europe’s dependency on Russia (even if, presumably, at higher prices).
- In the context of ‘open strategic autonomy’, LNG in the Atlantic Basin, especially in the North Atlantic, has a strategic role to play in the service of energy security. However, high and volatile energy prices are proving to be challenges.

1. Introduction

Since the publication of our paper "LNG trade in the Atlantic Basin: situation and perspectives"[1] the landscape in the Atlantic basin has changed dramatically. (Hamilton & Quinlan, 2023) found three major shifts that are transforming the transatlantic energy economy: (i) the United States (U.S.) has become a critical energy supplier to Europe (as will be demonstrated in this document); (ii) both U.S. and European Union (EU) policy initiatives seek to accelerate each side's efforts to address climate change, boost the transition to clean energy and competitiveness, and reduce strategic vulnerabilities; and (iii) the dense and deep transatlantic ties between investors, innovators and energy companies offer opportunities for North America and Europe to lead the next generation of clean technologies.

In fact, the report on the Future of European Competitiveness stresses the importance of a joint plan for decarbonization and competitiveness and of taking actions to increase security and reduce dependencies (European Commission, 2024a).

The energy crisis in Europe – sparked by the Russian invasion of Ukraine -- has revealed the key role of the U.S. in helping to secure EU energy supply through the export of LNG to Europe. As we shall see below, the EU reaction has been the REPoweEU initiative.

The relationship of Europe -- and in particular Germany -- with Russia was not seen positively by the U.S. (Steinberg & Urbasos Arbeloa, 2024). During the 1980's, German energy policy towards Russia was not viewed as beneficial by the Reagan administration. More recently, he Nordstream project was not considered an optimal solution for energy security, and the Ukrainian crisis in 2014 represented an inflexion point, as the U.S began to lead the group of European countries critical for the EU-Russia relationship. In the meantime, the shale gas revolution in the U.S. converted the country into an exporter of gas. As a result, the invasion of Ukraine by Russia, along with the European response, converted the U.S. into a reliable supplier of gas for Europe, although with prices that are subject to criticism in (European Commission, 2024a) (also known as the Draghi Report).

Transatlantic (US-Europe) relations experienced various commercial tensions during the Trump administration; this changed under President Biden, as the matter of commercial tariffs was channelled through the recently created Trade and Technology Council. At the same time, the Inflation Reduction Act (IRA) was, to a certain extent, accepted by the EU. It is also worthwhile mentioning the Carbon Border Adjustment Mechanism (CBAM) developed by the EU. The new emphasis in deploying the concept of 'open strategic autonomy' and the return to domestic industrial policies are also key questions that we address in Section 2.

The Atlantic Basin can be considered from two main perspectives (Isbell, 2013): (i) the broad Atlantic Basin and (ii) the narrow Atlantic Basin. The first perspective is more political and incorporates all four Atlantic Ocean coastal continents. The second conception, the 'geo-economic' Atlantic Basin, is more specific regional scaling, embracing only those countries with an Atlantic coastline and those landlocked countries directly linked to the Atlantic Basin, such as Paraguay. In this paper although we shall refer in some cases to the broad Atlantic Basin (i.e. in GHG emissions and the LNG trade), given the relevance of the north Atlantic Basin in terms of LNG trade, and between the U.S. and Europe, most of the focus shall be put on this part of the basin.

[1] (Álvarez Pelegry, E. & Larrea Basterra, 2018).

In this paper, we will address the LNG trade in the Atlantic basin in the context of decarbonization, focusing on the relationships between the U.S. and Europe. Therefore, we shall refer to some relevant policies in these two regions.

This paper is structured as follows. Section 2 reviews the context and main trends referring to the decarbonization process, related policy aspects, and the concept of open strategic autonomy. Section 3 presents an overview of energy consumption and use in the Atlantic Basin to focus on section 4 on the increasing relevance of gas, especially liquefied natural gas (LNG). Section 4 includes a reflection on the role of LNG in facilitating energy cooperation for the decarbonization process.

2. Context and main trends

In this section we begin by putting into context the process of decarbonization in the Atlantic Basin, looking at the evolution of greenhouse gas (GHG) emissions. Secondly, we refer to some considerations on policy issues, and relevant pieces of regulation, in an attempt to demonstrate that the decarbonization process is well established in the north Atlantic (i.e., U.S. and the EU). Thirdly we examine the concept of 'open strategic autonomy', as we understand that it is in this context that we should examine the LNG trade in the Atlantic Basin.

2.1. Evolution of GHG emissions

Following the first assessment report of the Intergovernmental Panel on Climate Change (IPCC) in 1990, a multilateral agreement was reached two years later, the "United Nations Framework Convention on Climate Change" (UNFCCC). At present, there are 198 signatories to this agreement. The parties to the agreement meet annually, in the so-called Conference of the Parties (COP). The first COP took place in Berlin in 1995; the next one is scheduled to be held in Azerbaijan in November 2024 (COP 29).

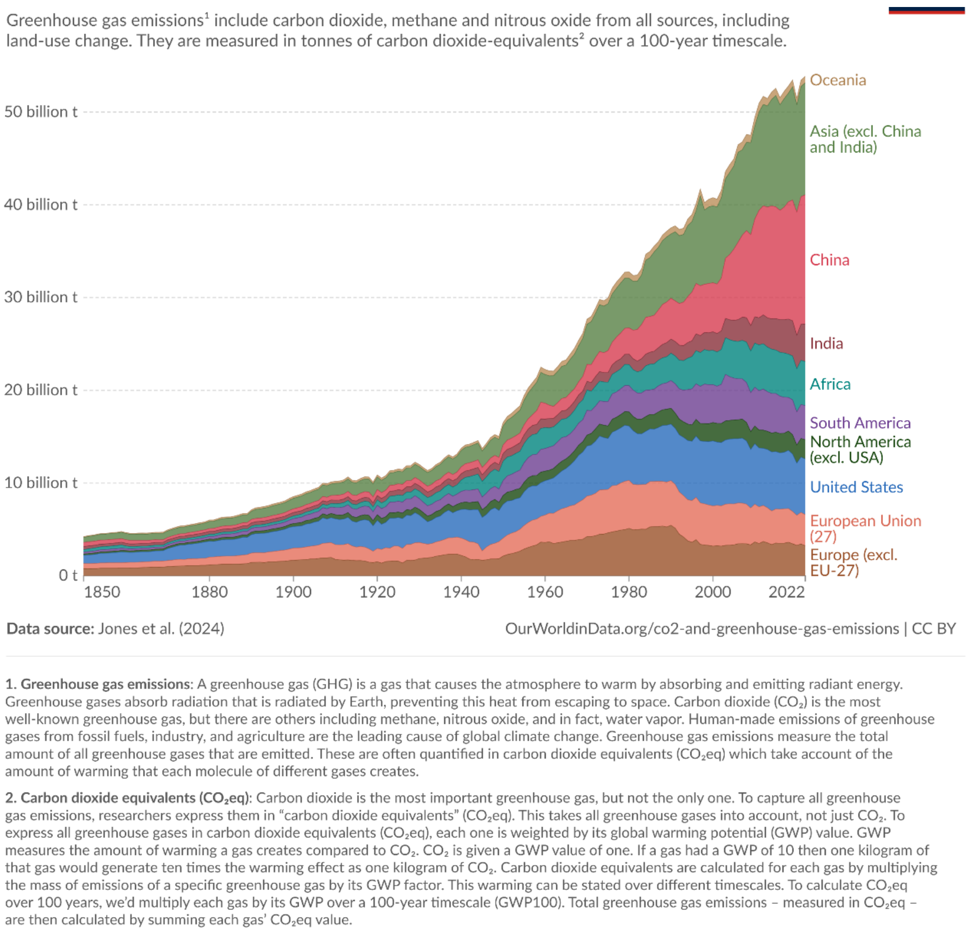
In 2019, the total GHG emissions of CO_2 equivalent were 59 Gt-eq., of which 8% were generated in Europe (down from 16% in 1990), 9% in Africa (7% in 1990), 12% in North America (18% in 1990) and 10% from Latin America and Caribe (10% in 1990). Consequently, the Atlantic Basin accounts for 37% of total GHG emissions. This means that Europe emits 7.8 tCO_2eq./per person, Africa 3.9, North America 19.0 and Central and South America 9,2[2].

Since the Kyoto Protocol (1997) and the creation of the IPCC, the framework and commitments for decreasing GHG emissions have been reinforced. The 2015 COP in Paris signalled a milestone with a joint agreement for holding the global average temperature of the Earth to well below 2ºC above preindustrial levels (1850-1900) and for pursuing efforts to limit the increase to 1.5ºC. In 2023, 97 parties that cover approximately 81% of global GHG emissions adopted net-zero pledges: (i) 27 parties enshrined this in legislation, (ii) 54 parties committed themselves in a policy document or with a long-term strategy, and (iii) 16 parties did so with an announcement by a high-level government official[3].

This implies a decrease in GHG emissions at the global level. However, total global emissions have increased almost every year from 1990 (37.9 tCO_2eq.) to 57.4 in 2022[4]. In Europe, GHG emissions have decline by 31% compared to 1990 and renewable sources will account for an estimated 22.5% share by 2022[5].

[2] (IPCC, 2023), p.45.
[3] (IPCC, 2023), p.VII.
[4] (UNEP, 2023), p.V.
[5] (EEA, 2023), p.5.

Graph 1. Annual greenhouse gas emissions by world region, 1850 to 2022



Source: (Our World in Data, 2022).

In 2005, the EU-27 emitted 4,296 tons of CO_2eq in contrast to 3,119 tCO_2eq in 2020, below the target for that year. The target for 2030 is 2,121, and the current estimate is 2,249[6] -- that is, the objective of the so-called "Fit for 55", (namely, a reduction of 55% in GHG emissions in 2030 in comparison with 1990). For 2050, the objective is NetZero emissions, according to the European Climate Law of 2021.

Growth in renewables in Europe is a firm reality. Installed capacity in renewables has expanded from nearly 200 GW in 2005 to more than 500 GW in 2021[7]. This growth is due primarily to new capacities in the wind and solar photovoltaics. Renewables have been growing also as a percentage of final energy consumption: from 10.2% in 2005 to 22.5% in 2022. The objective is to reach 42.5% in the final energy consumption by 2030; the current estimate for that year is 33.1%[8].

The United States, which is party to the UNFCCC and ratified the 2015 Paris Agreement, generated, in 2022, 6,343.2 MtCO_2eq. Net emissions (including sinks) reached 5,489.0 MtCO_2eq.

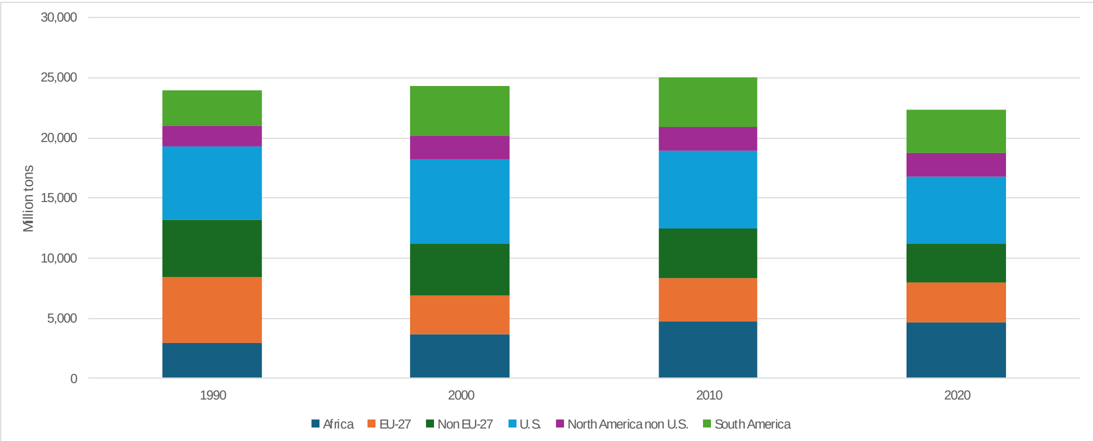
[6] (EEA, 2023), p.17.
[7] (EEA, 2023), p. 29.
[8] (EEA, 2023), p.17.

Since 1990, GHG gross emissions have decreased by 3%, increasing from 1990 to 2005 and with a reduction of 15% in the period from 2005 to 2022[9].

This decrease in the U.S. may be explained by the use of competitive gas in power generation (displacing coal), the deployment of renewables, and the maintenance of the share of nuclear generation. In fact, coal generation decreased from 54.1% in 1990 to 20.3% in 2022; natural gas generation and non-fossil fuel renewable energy generation, largely from wind and solar energy, increased. Natural gas represented 10.7% of total power generation in 1990 and increased over the 33-year period to 38.8% in 2022[10].

These figures show that the North Atlantic Basin has pushed GHG emissions down more sharply (i.e. Europe and U.S.) than Central and South America. Africa has increased them almost yearly until 2021) (Our World in Data, 2022). Decarbonization has been mainly due to the transformation of the electricity sector and the reduction in coal consumption. Gas has facilitated decarbonization.

Graph 2. Total GHG emissions by territory of the Atlantic Basin



Source: own elaboration based on (Our World in Data, 2022).

2.2. Policy aspects

In 2019, the European Commission presented the European Green Deal (EGD), a strategy for growth and decoupling the increase in Gross Domestic Product (GDP) from GHG emissions. The EGD has a strong regulatory approach and covers a wide range of aspects as well as economic sectors (i.e. transport, energy, agriculture, buildings, industry- iron and steel, cement TIC, and chemical products). Later the EU agreed to reduce GHG emissions by at least 55% in 2030 in comparison with 1990.

The EGD involves the European Climate Law (for net zero emissions in 2050), the Biodiversity Strategy, the Strategy from the Farm to the Fork, the Industrial Strategy, the Action Plan for Circular economy, a new rule for batteries, the mechanism for just transition, the Forest Strategy for Forests and the Strategy for the Sustainability of Chemical Substances among others (L'Hotellierne-Fallois et al., 2024).

During the second half of 2021, the European Commission presented the "Fit for 55" package, which revised the objectives to 2030, raising the ambition of GHG emissions reduction, and including 13 interrelated measures, among them the modification of the Emissions Trading

[9] (EPA, 2024), p. ES-5.
[10] (EPA, 2024) p.ES-11.

Scheme (ETS), the Carbon Border Adjustment Mechanism (CBAM), the revision of the rule for Effort Sharing; as well as other measures to mitigate emissions in aviation and maritime transport, and infrastructures for alternative fuels.

Recently the EU adopted two important measures: the Net-Zero Industry Act (NZIA) and the Critical Raw Material Act (CRMA). The NZIA, established in 2024, creates a regulatory framework to boost the competitiveness of the EU industry and technologies crucial for decarbonization. The Act sets a goal for Net-Zero manufacturing capacity to meet at least 40% of the EU´s annual deployment needs by 2030. The law encompasses final products, components and machinery necessary for manufacturing net-zero technologies, including, among others, renewable technologies, batteries, biogas and biomethane, Carbon Capture and Storage, and grid technologies[11]. This law is relevant to the Atlantic basin, particularly when compared to the U.S. Inflation Reduction Act (IRA) and the possibilities of direct investments, across the Atlantic as well as export and imports of intangible services (i.e. knowledge, patents, education). RePowerEU, the policy measures to respond to the Russian invasion of Ukraine and reduce the dependence on Russian gas, are of great relevance for the Atlantic Basin.

The invasion of Ukraine by Russia, and the new role of China, have changed multilateralism strategies. The U.S. and the EU have turned to reinforce the concept of strategic autonomy and stress the development of their own resources. However, as it is impossible to be fully self-sufficient in all aspects, the concept of 'open strategic autonomy' has taken prominence in the last few years. In line with this concept, the EU may be developing open strategic autonomy (see next section). This could be considered relevant for the Atlantic Basin, along with the approach of the European Commission in the relation to third parties via the "Open Gate" project.

The Draghi Report[12] stresses the importance of regaining competitiveness in Europe and addressing issues such as energy, industry and CRM. In relation to gas the report highlights the price differences between U.S. LNG and prices of natural gas in Europe. Some recommendations may be relevant in the context of this paper, namely: (i) encourage a progressive move away from spot linked sourcing, (ii) reinforce joint procurement and (iii) develop selective strategic import infrastructures.

On August 16, 2022, President Biden signed the above-mentioned Inflation Reduction Act. The IRA includes more than 20 new or modified tax incentives and tens of billions of dollars in grants and loan programs to foster new clean technology investment and deployment, and the transition to a clean energy economy, while trying to control inflation (The White House, 2023)[13].

The IRA includes clean energy production tax credits (PTC) and investment tax credits (ITC). It also includes $27 billion for a GHG emissions reduction fund, $40 billion in loan authority to guarantee loans for innovative clean energy projects.

The objective of the IRA is to support projects and investment levels sufficient to achieve the ambitious goals of producing 100% carbon pollution-free electricity by 2035; a 50-52% reduction from 2005 levels in economy-wide net greenhouse gas pollution in 2030; and net zero emissions economy-wide not later than 2050. To meet these climate goals, the U.S. needs to accelerate the deployment of commercially available clean energy technologies and to invest in new technologies that have game-changing potential (The White House, 2023).

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[11] To see the complete list of technologies see (European Commission, n.a.). For a description of the process of elaboration and discussion of the law, see (Moreno-Torres Gálvez, 2024).
[12] (European Commission, 2024b).
[13] For more detail see (Larrea Basterra & Mosquera López, 2024).

The invasion of Ukraine by Russia in 2022 had a tremendous influence on the gas trade in Europe. The polices to reduce Russian gas imports in Europe, along with the REPowerEU program to reduce demand and diversify gas imports, resulted in a step-jump increase of LNG imports from the U.S.

2.3. Open strategic autonomy

The European Commission defines 'open strategic autonomy' as "the EU' s ability to make its own choices and shape the world around it through leadership and engagement, reflecting its strategic interests and values" (Alcidi et al., 2023).

EU strategic autonomy (EU-SA) refers to the capacity of the EU to act autonomously, without being dependent on other countries in strategically important policy areas. From 2013 to 2016 it was mainly seen as an approach to security and defence matters. From 2017 to 2019, EU-SA was considered a way to defend EU interest in a hostile geopolitical environment. In 2020, COVID-19 shifted the focus toward mitigating economic dependence on foreign supply chains. Since 2021, the scope of EU-SA has been widened to virtually all policy areas (Damen, 2022).

(Damen, 2022) considers the shock of the Ukraine invasion to have brought the debate back to complex realities and the need to react with concrete practical actions. Consequently, in March 2022 the European Council meeting decided to phase out EU dependency on Russian gas, oil and coal and adopted the Versailles Declaration to reduce dependencies in other areas, including CRM, semiconductors and digital technology. In May 2022 the Commission presented the REPowerEU, as mentioned, as a plan to save energy, diversify energy imports and accelerate the substitution of fossil fuels with renewable energy sources.

This situation is not exclusive to the EU. Most major powers have implemented similar policies, but with ultimately a similar effect (Alcidi et al., 2023). In the U.S., "America First" became the central slogan under the Trump administration and more recently the IRA sets domestic objectives. Similarly, China developed, in 2015, the "dual circulation strategy", the idea of a self-sufficient nation and the industrial policy plan of "made in China in 2025". India also pushed the "Make in India" initiative in 2014.

Because of European open strategic autonomy, some mechanisms must be created and put in place to respond to the reality of the impossibility of total self-sufficiency and to channel open relations. In this regard, the EU-US Trade and Technology Council and the Global Gateway initiatives should be considered.

3. Energy overview in the Atlantic Basin[14]

Africa's total energy supply is highly GHG-emitting, due to its dependence on fossil fuels, biofuels and waste. In Central and South America, crude oil accounts for 41 % of total energy supply. In North America, 70% depends on crude oil and natural gas. Europe is the territory where nuclear and renewables (non-biofuels and waste) account for the highest percentage. Overall, fossil fuels, biofuels and waste account for the lowest percentage. Even so, this figure amounts to 81%. Despite the energy transition process and the efforts made over the last two decades, it is in Africa and in Central and South America where renewables have the greatest weight.

[14] For more detail of each region see Annex 1.

Graph 3. Total energy supply by source (2022)

Source: own elaboration based on IEA statistics.

The composition of the electricity mix differs across the Atlantic Basin. Africa is particularly dependent on coal, followed by North America. Natural gas is also particularly relevant in both territories. Nuclear energy represents between one fifth and one sixth of the electricity mix in Europe and North America respectively. Central and South America have a highly decarbonized electricity mix, with 72% of electricity consumption coming from renewables. This is followed by Europe, with 60 %, which also includes nuclear power. The least decarbonized electricity mix is that of the African continent.

Table 1. Electricity by source in 2022 (%)

	Coal	Oil	Natural gas	Nuclear	Hydro	Wind, solar, etc.	Biofuels and waste	Oil products
Africa	26.10	7.21	41.61	1.08	18.32	5.40	0.28	
Central and South America	3.80	6.90	15.40	1.60	54.30	12.60	5.60	
North America	17.60	1.30	36.60	16.40	13.00	9.00		5.7
Europe	17.1	1.5	20.9	18.7	14.8	21.0	6.0	

Source: own elaboration based on IEA statistics.

Domestic energy production by source shows Africa's high dependence on fossil fuels and on biofuels and waste. Central and South America shows the lowest dependence on coal, but crude oil and natural gas account for more than half of domestic energy production. Europe shows high diversification where natural gas, nuclear and biofuels account for about 60% of domestic energy production. In North America, 83% of domestic energy production comes from fossil fuels.

Table 2. Domestic energy production by source in 2022 (%)

Domestic energy production	Coal	Oil	Natural gas	Nuclear	Hydro	Wind, solar, etc.	Biofuels and waste
Africa	14.20	32.70	20.60		1.45	0.95	30.10
Central and South America	6.30	44.60	17.90	0.78	8.52	2.69	19.20
North America	10.40	38.20	34.90	7.70	1.95	2.57	4.16
Europe	13.30	15.50	20.30	19.00	4.6	9.3	17.70

Source: own elaboration based on IEA statistics.

4. Gas in the Atlantic Basin. The increasing relevance of LNG trade

Coal is disappearing from the energy landscape, and gas is becoming the only fossil fuel with a future. The potential increase in natural gas consumption in the electricity sector would be due to an acceleration in the growth rate of electricity demand and delays in the expansion of renewable energies (IEA, 2024d). Delays in wind power deployment (due to issues such as permitting, licensing, grid connection, or modest delays in implementation, among others) could have a real impact on natural gas demand.

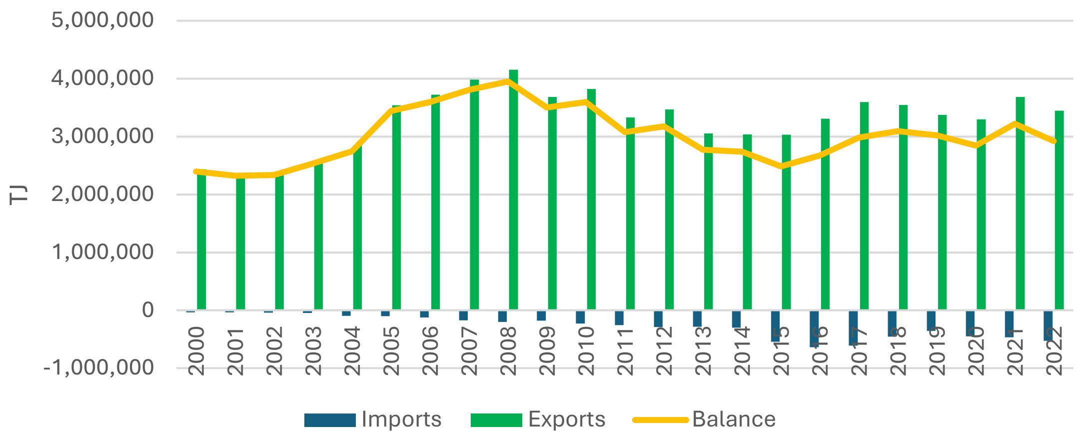
Natural gas and LNG are important in the Atlantic Basin. It is an energy source whose trade is agile and flexible. However, what is the weight of gas in the Atlantic Basin?

In 2023, global gas demand remained stable. In Europe, demand fell by 7% (34 bcm), to its lowest level since 1994. Similarly, gas production in the region declined by around 7%, due to declines in Norway, the UK and the Netherlands. Whether seaborne or pipelined, the Russian Federation's share of EU gas imports fell from 43% in 2021 to 23% in 2022, and then to a further 14% in 2023, falling behind Norway and the US. On the opposite, in ten years, US LNG exports have grown from 0.2 bcm in 2013 to 114 bcm in 2023, making it the world's leading LNG supplier, ahead of Qatar and Australia (Energy Institute, 2024).

In the case of **Africa**, in 2022, 17.9% of energy supply was gas (5,953,057 TJ), with an increasing trend between 2000 and 2022 and an increase over the period of 201%. In total, it accounted for 4% of global gas consumption. Indigenous production increased by 149.2% over the period 2000-2022, with Algeria, Egypt and Nigeria being the main producers. Gas exports increased by 40%, constituting 20% of Africa total energy exports.

In Africa, electricity production from gas amounted to 376,606 GWh in 2022, with an increase over the period under study of 256%. Once again, Egypt, Algeria and Nigeria are the main electricity producers.

Graph 4. Trade in Gas, Evolution in Africa



Source: (IEA, n.a.b).

In the case of **South and Central America**, in 2022, 19.7% of energy supply was gas (5,475,949 TJ), with a growing trend between 2000 and 2022 and an increase over the period of 59%. In total it accounted for 28% of global gas consumption. The share of gas production in 2022 was 102.9% with 5,633,896 TJ. Indigenous production increased by 57% in the period 2000-2022. Gas exports increased by 169% between 2000 and 2022, constituting 9% of world gas exports.

In Central and South America, electricity production from gas amounted to 211,094 GWh in 2022, with an increase in the period under study of 134%. According to Ieda Gomes, Argentina, Brazil, Chile and Colombia are highly dependent on hydroelectric generation. However, due to past events, they built LNG import terminals[15]. Thanks to these facilities, the fall in hydroelectric generation due to El Niño did not pose a serious problem for these countries, whose electrical system showed resilience, even though prices increased considerably (OIES & Bill Farren-Price, 2024).

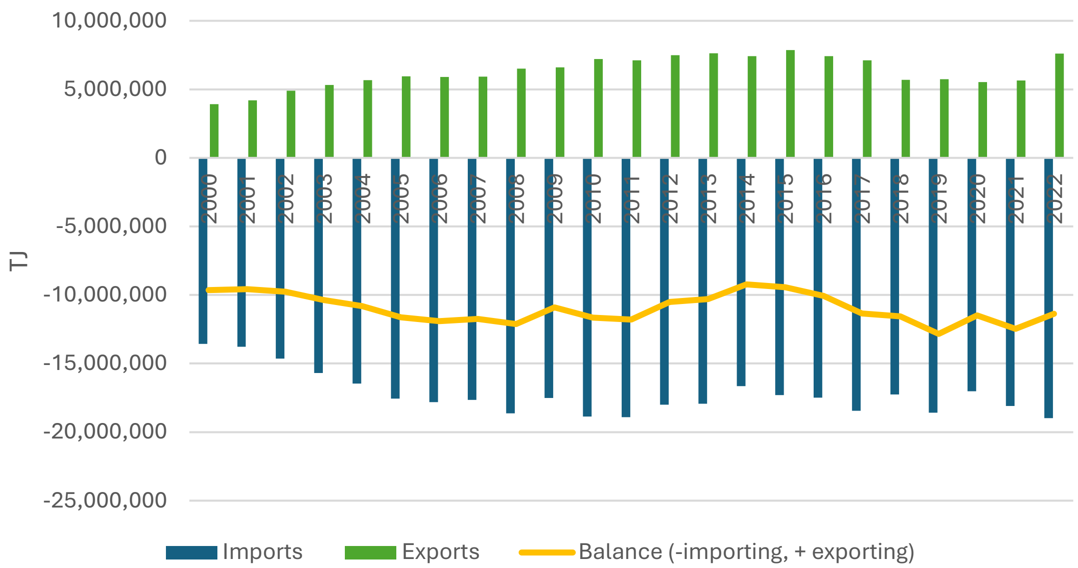
Graph 5. Trade in Gas, Evolution in South and Central America

[15] Chile has two LNG terminals in operation, Brazil has eight, Colombia has one and Argentina has one more. Of these, 10 are FSRU and two are land-based (Chile).

Source: (IEA, n.a.c).

Gas accounted for 24.7% of **Europe**'s energy consumption in 2022 (18,760,293 TJ), down 10% and representing 13% of the world's gas consumption in 2022. In 2022, gas produced on European territory accounted for 46.8% of the total, with a decreasing trend of 23% between 2000 and 2022 and representing 6% of world gas production. As just noted, dependence on gas supplied from abroad via pipeline may pose risks associated with security of supply as highlighted by the Russian invasion of Ukraine. In this context, LNG has opened new opportunities for transporting gas by ship, although a complex and expensive infrastructure and pipeline network are also required for distribution to end consumers. Due to the lack of gas on European territory, Europe increased its imports in the period 2000-2022 by 40%. In fact, Europe's intention to reduce dependence on Russian gas pushed Europe to become the world's largest importer of LNG in 2023 (OIES & Bill Farren-Price, 2024).

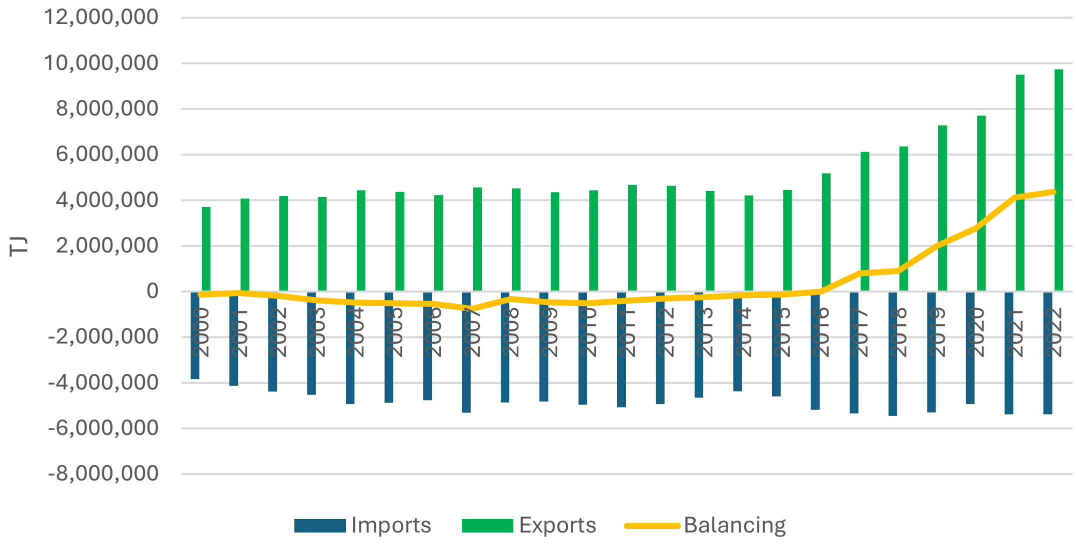
Graph 6. Trade in Gas, Evolution in Europe



Source: (IEA, n.a.a).

In the case of **North America**, in 2022, 36.3% of energy supply was gas (40,355,138 TJ), with a rising trend between 2000 and 2022 and an increase over the period of 47%. In total it accounted for 28% of global gas consumption. The share of gas production in 2022 was 110% with 44,377,518TJ. Indigenous production increased by 69% in the period 2000-2022. Gas exports increased by 9.8%, constituting 22% of world gas exports. In North America, electricity production from gas amounted to 2,009,239 GWh in 2022, an increase over the period under study of 182%.

Graph 7. Trade in Gas, Evolution in North America



Source: (IEA, n.a.d).

In the U.S., according to Trisha Curtis, LNG projects rely heavily on shale production to meet rising global LNG demand through 2030 (OIES & Bill Farren-Price, 2024).

4.1. LNG trade in the Atlantic Basin

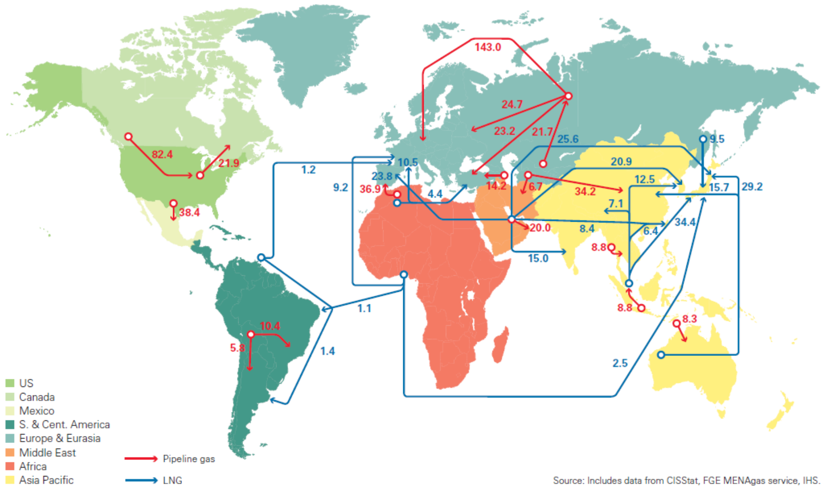
International gas trade (piped+LNG) has remained between 900 and 1,000 bcm since 2017. In 2023, there was an overall decline of 2.7% to 936 bcm. However, LNG exports increased by 1.8% to 549 bcm. As a result, LNG now accounts for almost 59% of all gas traded globally. Europe increased its imports of LNG from the United States by 6% and maintained the weight of those from the Russian Federation at around 19 bcm. The overall balance between LNG and pipeline trade (now accounting for around 41%) is now almost inverse to the position in 2017 (Energy Institute, 2024).

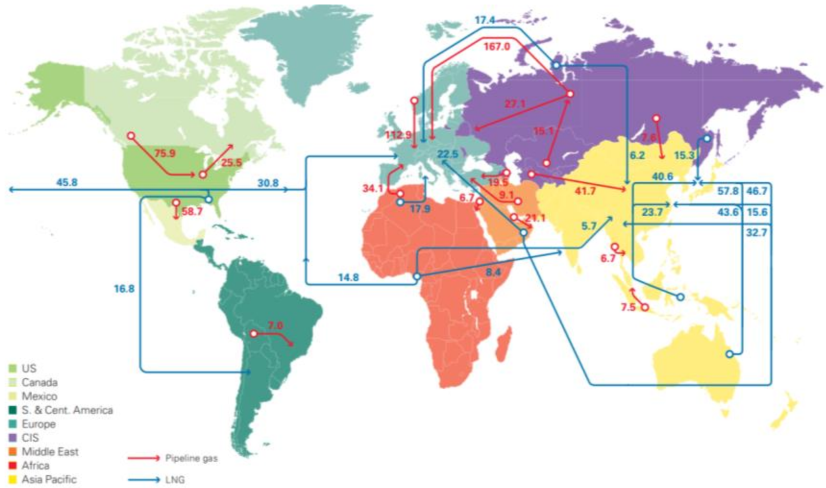
As can be seen in

Map *1*, and

Table ***3*** and Table 4, the evolution of LNG trade worldwide is mainly driven by demand from Europe and Asia, which are the main importers and dependent territories. This has worsened after the Russian invasion of Ukraine. And as we observed above, the global trade patterns of natural gas are now increasingly driven by advances in LNG trade. The U.S., for example, has now overtaken both Australia and Quatar to become the world's largest exporter of LNG. Collectively, these three countries accounted for 64% of total LNG exports.

Map 1. Major natural gas and LNG movements 2016-2021-2023 (Trade flows worldwide (billion cubic meters))





Source: (BP, 2017), (BP, 2022) and (IGU, 2024).

In the period under analysis (between 2016 and 2023), U.S. LNG exports to Europe have increased dramatically. In fact, the relevance of the U.S. may be visualized in

Map *1*, which shows that North America is the single region with exports to Europe above 50 million tons (56,6 Mt in 2023, approximately 73 bcm).

Table 3. LNG trade movements 2016 (Billion cubic meters-bcm)

		FROM														
	2016	**US**	**Brazil**	**Peru**	**Trinidad & Tobago**	**Norway**	**Other Europe**	**Russia**	**Oman**	**Qatar**	**United Arab Emirates**	**Algeria**	**Angola**	**Egypt**	**Equatorial Guinea**	**Nigeria**
TO	US	-	-	-	2.3	0.1	-	-	-	-	-	-	-	-	-	-
	Canada	*	-	-	0.2	0.1	-	-	-	-	-	-	-	-	-	-
	Mexico	0.7	0,1	2.9	0.5	-	-	-	-	-	-	0.1	-	-	0.1	0.8
	North America	**0.7**	**0,1**	**2.9**	**3.1**	**0.2**	-	-	-	-	-	**0.1**	-	-	**0.1**	**0.8**
	Argentina	0.4	0,4	-	1.4	0.5	0.3	-	-	1.1	-	0.2	*	-	0.1	0.8
	Brazil	0.2	-	-	0.3	0.3	0.2	-	-	0.7	-	-	0.1	-	0.2	1.1
	Chile	0.7	-	-	3.2	0.2	0.1	-	-	0.1	-	-	-	-	0.1	-
	Other South and Central America	0.1	-	-	2.4	0.2	0.2	-	-	-	-	-	-	-	0.1	0.1

South and Central America	**1.5**	**0,4**	**-**	**7.2**	**1.1**	**0.7**	**-**	**-**	**1.8**	**-**	**0.2**	**0.1**	**-**	**0.4**	**2**
Belgium	-	-	-	-	-	0.1	-	-	2.7	-	*	-	-	-	-
France	-	-	0.2	-	0.6	*	-	-	0.8	-	6.2	-	-	-	1.9
Italy	0.1	-	1.7		0.1	*	-	-	5.2	-	0.1	-	-	-	0.1
Spain	0.1	-	-	0.6	0.7	*	-	-	2.5	-	2.9	0.1	-	-	4.5
Turkey	0.2	-	-	0.3	0.1	0.2	-	-	1	-	4.4	-	0.1	-	1.4
UK	-	-	-	0.1	0.2	0.1	-	-	9.6	-	0.4	-	*	-	*
Other Europe and Eurasia	0.1	-	2	0.2	2.4	*	*	-	1.9	0.1	0.9	-	-	-	-
Europe and Eurasia	**0.5**	**-**	**-**	**1.2**	**4.1**	**0.5**	*****	**-**	**23.7**	**0.1**	**14.9**	**0.1**	**-**	**-**	**9.2**
Middle East	**0.5**	**-**	**-**	**1.1**	**0.2**	**0.9**	**-**	**1.3**	**4.5**	**-**	**-**	**0.1**		**1.2**	**3.2**
Africa	**0.1**	**-**	**-**	**0.5**	**0.3**	**0.9**	**-**	**-**	**6.4**	**-**	**-**	**0.1**		**0.1**	**1.4**

Note: * means <0.05 %.

Source: own elaboration based on (BP, 2017).

Table 4. LNG trade movements 2023 (Billion cubic meters-bcm)

	FROM															
2023	**US**	**Peru**	**Trinidad & Tobago**	**Other America**	**Norway**	**Other Europe**	**Russia**	**Oman**	**Qatar**	**United Arab Emirates**	**Yemen**	**Algeria**	**Angola**	**Egypt**	**Nigeria**	**Other Africa**
TO																
Canada	*	0.1	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-
Mexico	0.4	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
US	-	0.1	0.3	0.1	-	-	-	-	-	-	-	-	-	-	-	-
North America	**0.45**	**-**	**0.5**	**0.1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Argentina	2.1	0.1	0.2	0.1	-	*	-	-	0.2	-	-	0.1	-	0.1	0.1	0.1
Brazil	1	-	*	-	-	0.1	0.1	-	-	-	-	0.1	-	-	-	-
Chile	0.9	-	2	-	-	*	-	-	-	-	-	-	-	0.1	-	0.6
Other South and	3.5	-	1.9	0.7	-	0.4	-	-	-	-	-	-	-	-	1.4	0.1

Central America																
South and Central America	**7.5**	**0.2**	**4.1**	**0.7**	**-**	**0.5**	**0.1**	**-**	**0.2**	**-**	**-**	**0.2**	**-**	**0.1**	**1.5**	**0.8**
Belgium	2.6	0.2	-	-	*	*	3.9	-	4.6	-	-	0.2	0.3	0.1	0.1	0.1
France	13.2	-	0.4	-	1.2	0.1	4.8	0.1	2.3	-	-	5.6	0.9	0.2	0.6	0.9
Italy	5.1	0.4	-	-	-	0.8	0.3	-	6.7	-	-	2.3	-	0.3	0.3	0.4
Spain	7.4	-	0.5	0.1	0.3	0.1	6.5	0.3	1.3	-	-	1.8	0.3	0.4	4.8	0.6
Turkey	3.5	0.5	0.2	0.2	0.3	0.8	1.4	0.1	-	-	-	6.1	-	1.3	0.5	0.1
UK	11.6	-	0.4	-	0.4	*	-	-	2.8	-	-	0.5	0.3	0.3	0.5	-
Other EU	32.4	2.1	2.7	-	3.2	0.4	2.5	0.3	3.7	0.1	-	0.7	1.4	0.6	2.5	0.7
Rest of Europe	-	0.1	-	-	-	0.1	0,1	-	-	-	-	-	-	-	-	-
Europe	**76.2**	**-**	**4.2**	**0.3**	**5.5**	**2.3**	**19.4**	**0.8**	**20.8**	**0.1**	**-**	**17.2**	**3.7**	**3.2**	**9.3**	**2.7**
Egypt	-	3.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
United Arab Emirates	-	-	-	-	-	-	-	-	1.1	-	-	-	-	-	-	-
Other Middle East & Africa	0.1	-	-	-	-	*	-	0.1	-	-	-	-	-	-	-	-
Middle East & Africa	**0.1**	**-**	**0.2**	**-**	**-**	*****	**0.1**	**0.6**	**6.2**	**0.1**	**-**	**0.1**	**-**	**-**	**1.2**	**0.3**

Note: * means <0.05 %.

Source: own elaboration based on (Energy Institute, 2024).

They have also increased to Central and South America, but to a much lesser extent (1 to 10). Exports from the U.S. to Africa have yet to take off. LNG exports to Europe have also increased, but to a lesser extent, from countries such as Angola, Egypt and other African countries. Meanwhile, LNG exports to Europe from Algeria have increased very slightly, and those from Nigeria have remained completely stable.

Since the start of the Russian invasion of Ukraine, Germany has put floating storage and regasification units (FSRUs) into operation (Habibic, 2023) to solve the problems of dependence on Russian gas, along with reducing consumption. In France, the authorities approved the project of a floating LNG terminal in Le Havre (GRT Gaz, n.d.). Also in Italy, an FSRU unit was put into operation in March 2023 in the Tuscan port of Piombino, with a capacity of 2 bcm this year and about 5 bcm by 2024 (Reuters, 2023). In Spain, where there was non-operational regasification capacity, the Gijón (El Musel) terminal came into operation in the summer of 2023, with the reception of the first LNG tanker (EFE, 2023).

Europe is indeed increasing its capacity to import LNG and is projected to increase regasification capacity to 370 bcm per year by 2030. This represents a 50% increase from pre-war capacity in Ukraine (IEA, 2024d).

According to (BP, 2024), due to the situation caused by the war in Ukraine, Russian natural gas exports (LNG and piped) are not expected to grow in any of its scenarios by 2030 (Current Trajectory and Net Zero). In fact, expected increases in LNG exports in both scenarios will be minimal. In the longer term, in the case of the Current Trajectory scenario, LNG exports are expected to more than double between 2040 and 2050, with gas exports to China via pipeline gaining importance and gas exports via pipeline to the rest of the world falling below 50 bcm. In the high decarbonization scenario (Net Zero), no increases are foreseen for 2040 or 2050 either for LNG. On the contrary, exports are expected to fall to about half of those in 2021, although there will be an increase in gas sold to China via pipeline.

The U.S., especially (until 2028), but also Canada and Africa in the Atlantic Basin, expect an increase of LNG export capacity during the present decade – although there could be delays and significant cost overruns that already affect some 20% of projects involving LNG terminals (IEA, 2024d). The last World Energy Outlook of the IEA also expects an "unprecedented" additional capacity of LNG export plants after 2040. According to Jack Sharples, the main uncertainties concern whether the new U.S. LNG projects will obtain the necessary authorizations (OIES & Bill Farren-Price, 2024).

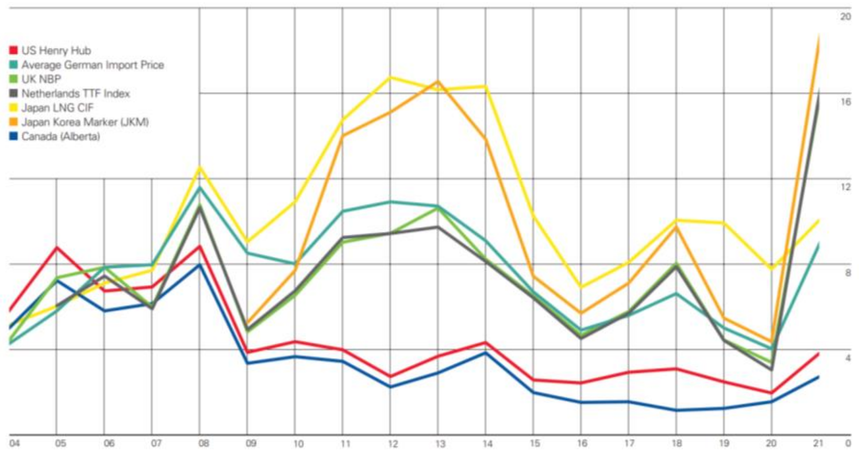
The growth of gas production in the United States and the Middle East is expected to continue for the rest of the 2020s, mainly due to their fundamental role in LNG exports (BP, 2024). Moreover, there is a clear trend towards increasing the weight of LNG compared to natural gas in a gaseous state.

There is currently a high risk of disruption to natural gas supplies due to the escalating violence in the Middle East and the fact that around 8% (4,1 Billion cubic feet-Bcf) of total LNG trade flows through the Red Sea (EIA, 2023) and that around 20% of the world's LNG supply passes through the Strait of Hormuz (IEA, 2024d). However, the IEA believes that despite the high geopolitical risk (which will play a key role in shaping the global gas markets according to Bill Farren-Price (OIES & Bill Farren-Price, 2024)), a reduction in market prices could be expected due to a possible reduction in demand. It also foresees a wave of new LNG projects.

4.2. Gas and LNG prices

Gas prices in different parts of the world may be seen in Graph 8.

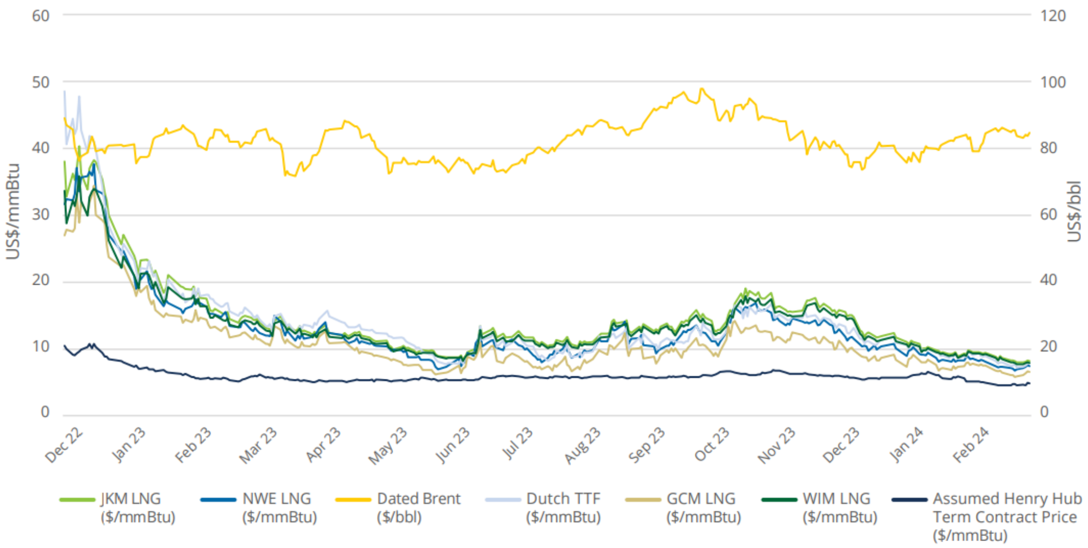
Graph 8. Gas prices from 2004 to 2021 ($/mmBtu)



Source: (BP, 2022).

In December 2022 after the Ukraine invasion, gas prices jumped to levels of 30-40 US$/MMBtu. During 2023, gas prices decreased as may be seen in Graph 9.

Graph 9. Comparison of major LNG, pipeline gas and oil benchmarks. December 2022 to end-February 2024 ($/mmBtu)



Source: (IGU, 2024).

It is interesting to note the differential of Herny Hub prices in the U.S. with prices in Europe (TTF) and Asia (JKM) as well as the relative stability of the crude oil (Brent) price. Price differential between the U.S. and Europe have also been recently pointed out (European Commission, 2024b).

5. The role of LNG for facilitating energy cooperation for the decarbonization in the Atlantic Basin

In the complex future of decarbonization, natural gas as a fossil energy is subject to questioning and controversy. The question of future demand and in particular the role of LNG is of relevance to this paper, considering the well-known IEA scenarios, particularly those related to net-zero emissions in 2050. This is not the place to discuss in detail those scenarios[16], but Mike Fulwood presents three scenarios developed by the OIES gas program (OIES & Bill Farren-Price, 2024).

Scenarios are considered up to 2050. The declared policies scenario (DPS) is broadly similar in concept to the IEA's stated policies scenario (STEPS) with a global temperature rise over 2ºC. The net zero with carbon capture and storage (NZwthCCS) net zero is achieved in 2050 but does not limit temperature rise to 1.5ºC. In the fragmented (FRAG) scenario, net zero by 2050 is not achieved but global emissions are on a steep downward trajectory from 2030 onwards. Global gas demand rises in all the scenarios between 2022 and 2030. From a level of just under 4,100 bcm in 2022, demand reaches 4,584 bcm by 2030 in DPS, 4,392 bcm in FRAG and 4,322 bcm in NZwthCCS. This is in marked contrast to IEA NZE where demand decreases to 3,442 bcm by 2030.

Two issues are particularly relevant in these scenarios: namely, (1) the role of blue and green hydrogen, and (2) the role of carbon capture and storage (CCS)[17]. In DPS, gas demand is flat in

[16] For more detail see (Álvarez Pelegry, Eloy, 2023).
[17] It does not seem to have a significant role in the results, because the development of biogas and biomethane in Europe has policies to deploy them.

North America and Europe, but it falls sharply in the FRAG and NZwthCCS scenarios. LNG demand will rise through 2030 in all three scenarios but then will peak. Europe is the largest importing region in DPS (OIES & Bill Farren-Price, 2024). Natural gas may maintain and increase its importance, in the NZwthCCS, if it is accompanied by CCS developments.

(Zwickl-Bernhard & Neumann, 2024) try to model the role of Europe in the global LNG market under two scenarios: one of net zero and the second one based on persistent fossil demand. In this second scenario import volumes in Europe are covered mainly by the U.S. and Nigeria[18].

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[18] In this scenario, a response to the geopolitical tension prompts the adoption of European domestic natural gas with CCS and that of the role of LNG is greater in the Net Zero scenario.

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Annex 1. Specificities of the energy sector in each of the major areas of the Atlantic Basin

Africa

By 2030, Africa could be home to one-fifth of the world’s population. While energy demand is increasing, per capita energy use remains one of the lowest in the world, despite the continent’s abundant energy resources. In fact, Africa accounts for only 6 of global energy use. In parallel, it accounts for less than 3 of global energy-related carbon dioxide (CO_2) emissions (IEA, 2024a).

In Africa, more than 600 million people currently live without access to electricity, and nearly 1 billion do not have access to clean cooking supplies. To achieve energy access and climate goals, the continent’s energy expenditure must double by 2030, with more than two-thirds allocated to clean energy. This will require increasing volumes of financing, both from the international community and the private sector (IEA, 2024a).

Key areas for policy action include (i) achieving universal energy access (electricity access, clean cooking, investment and financing of modern energy access); (ii) transforming the electricity sector (integration of renewables and flexibility, grid investment and market reforms); (iii) changing the role of energy resources (prospects for fossil fuels, critical minerals and low-carbon hydrogen; and (iv) investing and financing (investment needs, structure of energy finance, tapping into new sources of finance, using public funds to mobilize private capital).

Central and South America

Central and South America account for 8 of the world's population and 7 of the global economy. They have extraordinary natural resources (fossil fuels and renewable energy, as well as critical raw materials-CRM). Thanks to its oil and gas resources, the region can contribute to diversifying oil and gas supplies in the short term, making progress in the development and export of advanced biofuels and low-emission hydrogen, as well as in the production of CRM essential for clean energy technologies.

Fossil fuels cover about two-thirds of the region's energy demand, compared with 80 of the world average, thanks to 60 of electricity coming from renewables. Hydropower accounts for 45 of the region's electricity supply. Fossil fuels dominate in end-use, and oil is the main transport fuel, although the share of biofuels in road transport is twice the world average. Central and South America accounted for 5 of all global energy-related greenhouse gas (GHG) emissions since 1971. Today, the region is a net exporter of crude oil and coal, and a net importer of petroleum products and natural gas (IEA, 2024b).

Key areas for policy action involve: (i) Sustainable urban transport and cities (low-carbon urban mobility, urban air pollution; (ii) energy efficiency potential (potential of fuel economy to reduce transport oil demand, building energy codes and minimum energy performance standards for appliances, increase efficiency in non-energy-intensive industries; (iii) CRM to solve global mineral security and regional economic growth (supply prospects, responsible and sustainable mining, moving along the supply chain; (iv) hydrogen (hydrogen-based fuels and low-emissions hydrogen production; (v) people-centred transitions (energy access, energy affordability, employment in the energy sector); (vi) electricity security and regional power integration (higher regional power integration, benefits and challenges to enhance regional power integration; (vii) transitions in producer economies (balance short- and long-term demand outlook, reduce greenhouse gas emissions, diversify economies); (viii) bioenergy (liquid biofuels, biogas and biomethane, bioenergy supply) and (ix) achieve net zero emissions: Investment and finance (sources of finance and challenges and ways to mobilize more investment).

Europe

The European energy sector has undergone significant changes due to the Russian invasion of Ukraine. Since the war triggered an energy crisis that pushed energy prices to record highs (especially those of electricity), European countries have put in place measures around the Repower EU plan to ensure security of supply, to reduce dependence on Russian fuels.

The measures in the Plan aim to respond to this ambition by saving energy, diversifying energy supply and accelerating the deployment of renewables to replace fossil fuels in households, industry and electricity production (European Commission, 2022).

While significant progress has been made in the deployment of renewables, reaching a record high, further efforts are needed to overcome current energy challenges, such as (i) strengthening clean energy supply chains, (ii) replacing obsolete infrastructure and (iii) achieving greater integration of the energy system across the region (IEA, 2023).

However, the transition towards a renewable energy mix has brought to the fore the European vulnerability in the supply of critical raw materials, essential for the development of renewable energies, which it seeks to address through the European Critical Raw Materials Act. This Law has clear benchmarks for domestic capacities along the strategic raw material supply chain and looks for diversifying EU supply by 2030 (European Commission, 2023):

- At least 10 of the EU's annual consumption for extraction,
- At least 40 of the EU's annual consumption for processing,
- At least 15 of the EU's annual consumption for recycling,
- Not more than 65 of the Union's annual consumption of each strategic raw material at any relevant stage of processing from a single third country.

North America

North America represents 18 of total energy supply (TES)[19]; 36 of natural gas and 35 of oil (IEA, 2024c). The United States (US) and Canada are two of the world's top 10 oil producers. The US are also the world's leading gas producer, playing a key role in ensuring energy security, and the world's second largest energy producer and consumer.

Despite the energy transition process, the US continue to develop its fossil fuel resources and have increased oil and gas exports in the wake of the Russia-Ukraine war. In parallel they have developed incentives to boost clean energy industries, through its Inflation Reduction Act (IRA). As a result, they are undergoing major changes in the energy mix.

Canada has a significant proportion of low-emission sources in its energy mix. Despite this, it is reinforcing a balanced approach between developing resources and strengthening its environmental performance. Mexico's energy mix is currently dominated by oil and gas. It is substantially increasing electricity generation with renewable energies as energy demand rises.

These countries have major policy packages in all energy-related areas, that is: power, transport, methane abatement, buildings, critical minerals, industry, economy scale, fuels and technology innovation, technology R&D and innovation, people-centred (clean energy) transitions, just transitions, energy efficiency, renewable energy, digitalization, and electrification (IEA, 2024c).

[19] It includes all the energy produced in or imported to a country, minus that which is exported or stored.