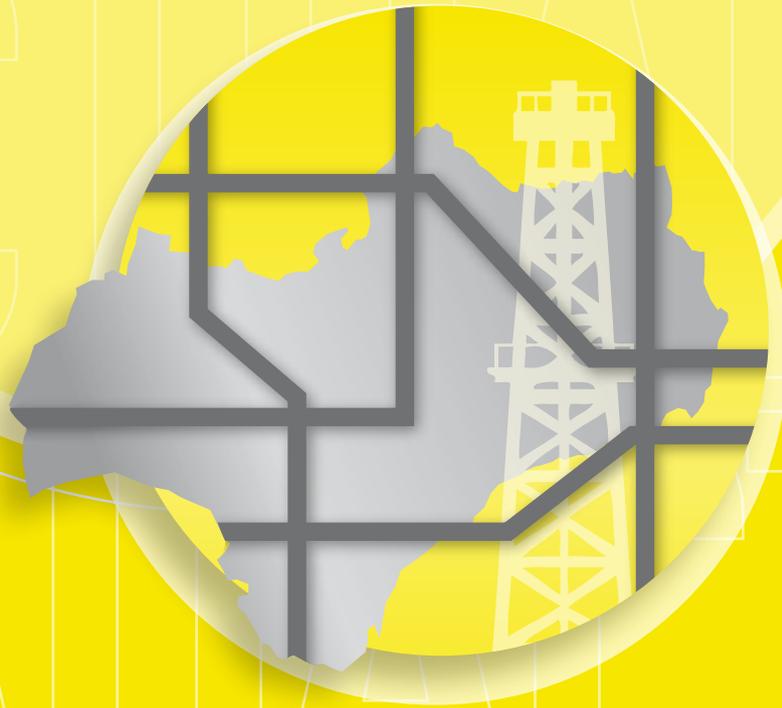


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Andalusia's geo-energy relevance for Spain and Europe



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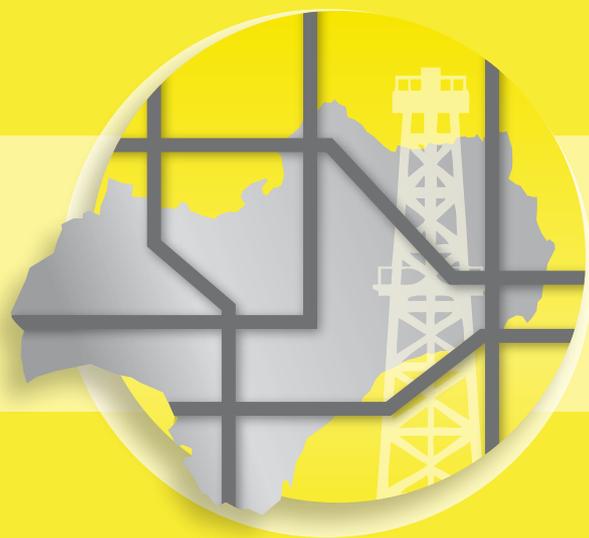
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Andalusia's geo-energy relevance for Spain and Europe

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Abstract

Andalusia is a strategic key region for hydrocarbon's entrance into the Iberian Peninsula. Its relevance in gas and oil pipelines is matchless with other regions of Spain and Portugal, given the international connections of the Medgaz and the Maghreb-Europe gas pipelines, although it is also relevant for the entry of Liquid Natural Gas, the own production of natural gas, as well as in oil terms. This paper will show up the geo-energy relevance of Andalusia for Spain and Europe.

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1. Introduction: the importance of gas, oil and pipelines

Energy is one of the key strategic planning issues for any government. Its origins, means of transport and processing, as well as its locations on the globe, are different variables that affect multiple elements of the daily life of a country, such as the price of energy itself, the existence of infrastructures and industry and the jobs required to maintain them etc.

Since the Industrial Revolution, but especially during the 20th century, three energy sources have been solidified as the main sources in the global energy mix: coal, oil (or crude oil) and natural gas. In 2018, the sum of the three accounted for more than 80 % of the world's energy supply (Figure 1).

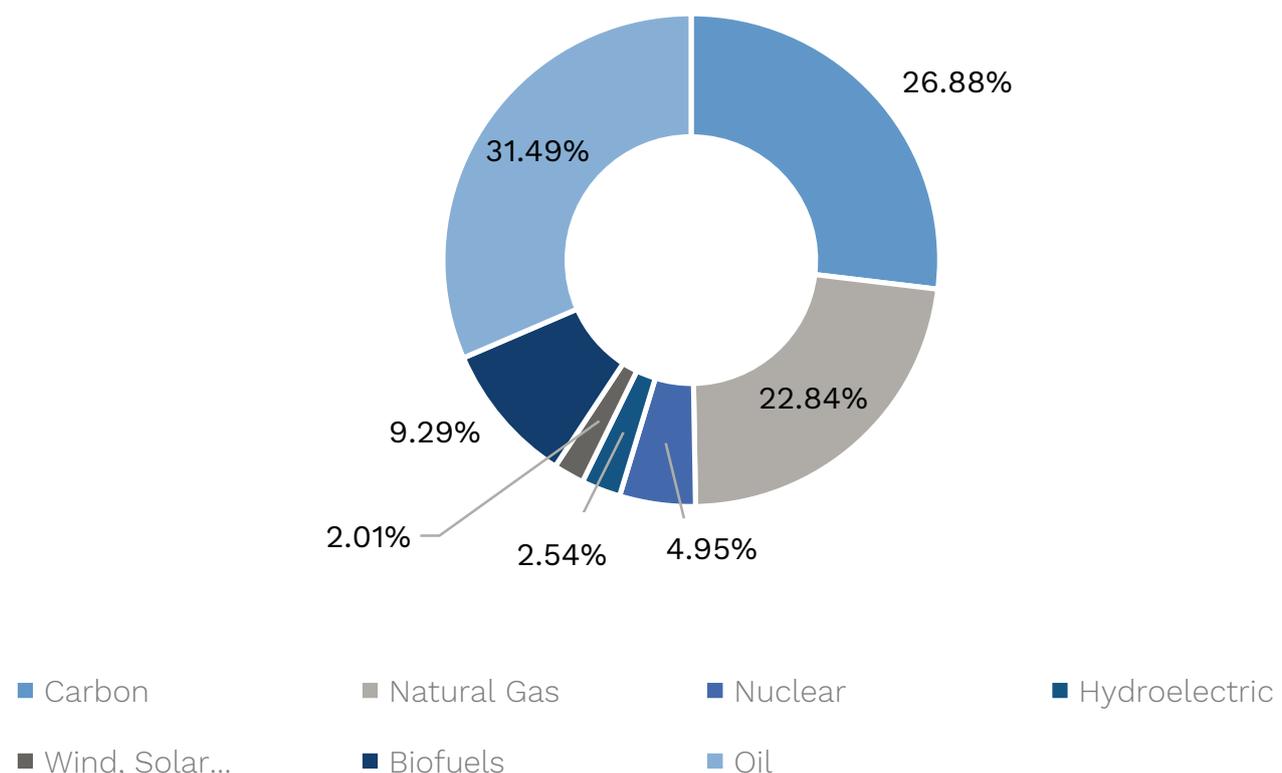
Although renewable energies are gradually beginning to gain ground in the electricity supply of many countries, most notably in the West, the demands of the industry still require large quantities of oil and gas, especially the latter, which is the least polluting source of hydrocarbons (EIA, 2020).

However, the distribution of oil and gas is not consistent across the globe, some countries have larger reserves or easier access to them, especially in the case of natural gas.

In both cases, hydrocarbon transport is carried out by pipelines (gas or oil pipelines), or by tanker ships, which in the case of gas involves the transport of Liquefied Natural Gas (LNG) and usually requires higher costs. The price of LNG is also affected by the regasification process.

It is therefore understandable that both energy resources have been politically

Graphic 1. World energy supply (2018)



Source: Own elaboration based on IEA (2020)

instrumentalised, as they flow through pipelines, by countries with reserves and by producers (but also by transit countries). A clear example is Russian energy power in Europe. As Yves Lacoste (2008: 324) points out:

Intercontinental transport of gas by LNG tankers is relatively dangerous and costly, as it is necessary to mobilise significant resources to feed the gas coolers that keep the gas at a very low temperature in order to avoid explosions (...). The growing need for gas has given Russia a new geopolitical importance.

However, the political instrumentalisation of oil decreased as the twentieth century progressed, since “the oil transport procedure, where the use of tankers is the main means of transporting crude oil” endows it with “great flexibility” (Sánchez Ortega, 2014: 16).

The case of gas differs, among other factors, due to the few sources of supply, the notable benefit of transporting it through pipelines (and with this the transit of pipelines becomes relevant) and the state control - in many cases - of exports of the resource. As Sánchez Ortega (2014: 16) points out:

In the case of gas, on the other hand, bilateral supply relations are still very present, with hardly any open markets and with gas pipelines dominating as a means of transport, which imposes great rigidity on the gas trade and makes it more capable of being instrumentalised in the service of power.

The territory through which pipelines run is therefore crucial for the main form of natural gas transport.

Although Spain is not a purely oil or gas exporting country, we ask ourselves: What is the importance of Andalusia in geo-energy terms? What value does the autonomous community have in terms of pipelines? And in other energy terms? This document will explain this relevance.

2. Europe's energy problem: external dependence

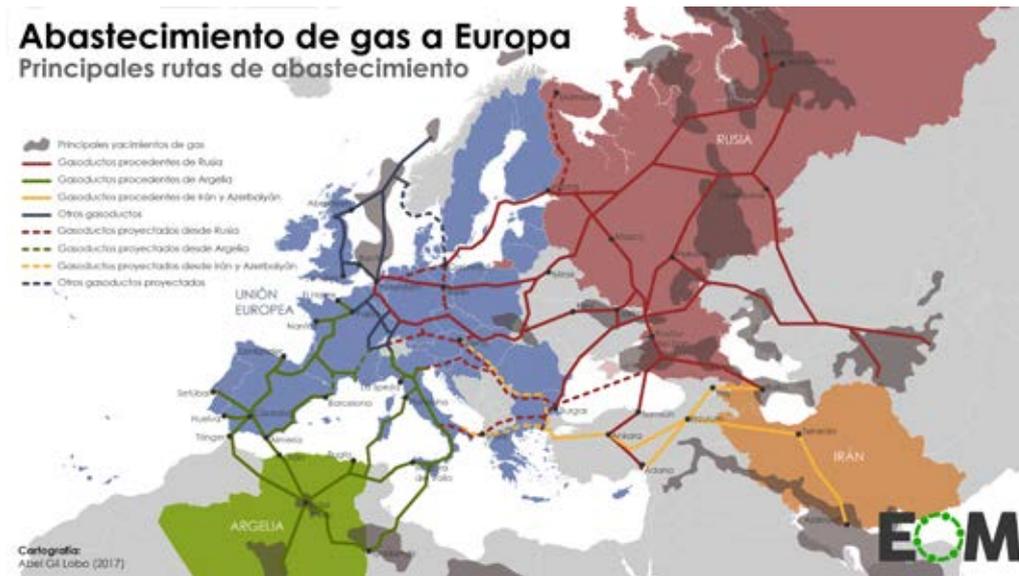
The European Union (EU), despite being an economic giant, is not at the forefront of world reserves of natural gas or oil, and even so, it needs a constant supply of both to maintain its economy. This has meant that, overall, it needs to import hydrocarbons from third countries, including Russia, Iran, Azerbaijan, Norway and, finally, Algeria as exporters of natural gas. Gas is still supplied mainly through pipelines (although LNG is gaining more and more strength), which generates dynamics of dependence and soft power over the European Union (and other European countries), especially on Russia's part.

In fact, up to a third of the gas and oil consumed by the EU comes from Russia, which thus enjoys a significant element of soft power over the Union due to its lack of energy cohesion and the fact that several gas and oil pipelines run from Russia, underlining its importance, particularly in the case of gas, for the cheap supply of this energy (Peña-Ramos and Amirov, 2018: 489; Peña-Ramos, 2017: 2).

This has led EU leaders to look for supply alternatives, not only to reduce the influence of a third country, but also because of the danger of being overly dependent on a supply line that could be affected by conflict, as happened in the case of Ukraine in 2014 (and in other previous crises). According to professional opinions collected by Rivas (2018):

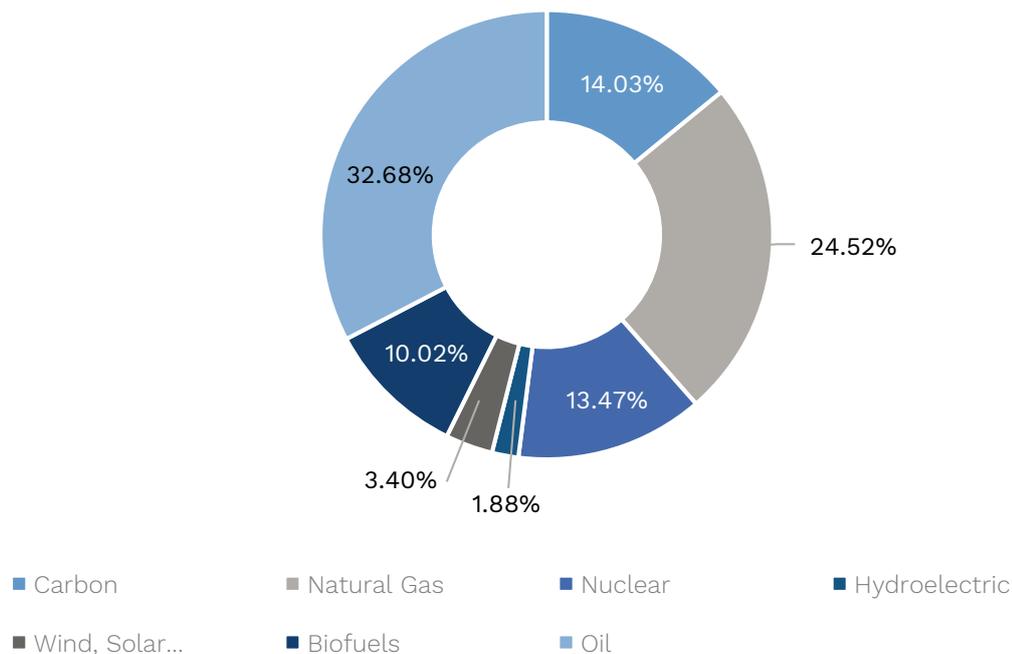
Dependence on a single source can pose a danger to supply that can be affected by political and economic conflicts, such as those between Russia and Ukraine in 2006 and 2009. As a result, the EU strengthened its security of gas supply rules in 2010. Almost eight years after this reinforcement, projects such as Nord Stream 2, a gas pipeline that will connect Russia under the Baltic Sea with Germany, avoiding crossing the Eastern Europe countries and doubling Germany's dependence on Russian gas, are on the agenda.

Map 1. Gas supply to Europe - Gas supply to Europe, Main supply routes



Source: The World Order, 2018

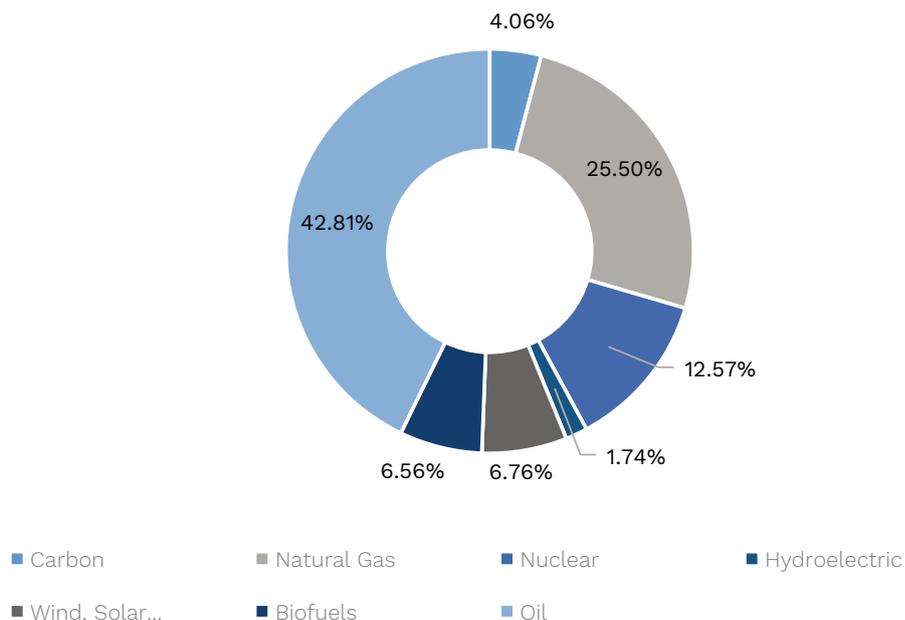
Figure 2. European Union energy supply (2018)



Source: own elaboration based on IEA (2020)

While Norway, and to a lesser extent the Netherlands, are partners in this regard, one of the major alternatives for the Union to provide itself with a continuous gas supply, without losing geopolitical power or depending on politically unstable countries or countries with a difficult gas connection (Azerbaijan, Egypt or Libya) has been Algeria.

Figure 3. Spain's energy supply (2018)



Source: own elaboration based on IEA (2020)

Spain, on the other hand, although it has a low presence of coal in its energy mix, favoured by an aggressive decarbonisation policy (Montes, 2020), the importance of hydrocarbons is very significant, as they contribute more than half of the Spanish energy supply (graph 3).

All this presents us with a geo-energetic picture from which we can extract the following premises:

- Europe (in particular the European Union) is highly dependent on the supply of hydrocarbons, especially natural gas, which is an indispensable part of the energy used by both households and industry.
- Spain also has a strong leadership of hydrocarbons, as well as dependence on foreign imports of both oil and natural gas.
- Algeria is one of the major alternatives (or complementary sources) to Russia as a gas supplier to the EU, along with Norway and, to a lesser extent, the Netherlands.
- So, what role can Andalusia play in the Eurasian context? What value can this autonomous community have?

3. The role of Andalusia

Andalusia enjoys a privileged geographical location as the most southerly Spanish region. Indeed, it is very close to North Africa and has access to both the Atlantic Ocean and the Mediterranean Sea.

This location makes Andalusia an ideal location to import hydrocarbons through pipelines from Africa; mainly natural gas from Algeria, whose supply has never failed due to the strategic importance of the resource for the country (Rivas, 2018). Furthermore, the region is equally important for the arrival of Liquid Natural Gas and crude oil by sea.

This document will emphasise that Andalusia is an important region in terms of gas; it is home to two of the most important gas pipelines in the western Mediterranean region. Furthermore, this paper will briefly analyse Andalusia's relevance as a zone for gasification and the extraction of gas. Finally, the document will touch upon the possible future benefits of the trans-Saharan African project.

Equally, the paper will highlight the role of Andalusia in the overall Spanish pipeline system and will seek to draw conclusions.

3.1 Andalusia and the gas pipelines

Andalusia is a strategic location for the arrival of natural gas into the European and Spanish gas network. Indeed, two important gas pipelines transporting gas from Algeria pass through Andalusia, although this is not the only source of gas for Spain or the EU.

3.1.1 Maghreb-Europe gas pipeline

Also known as the Pere Duran Farell pipeline, the Maghreb-Europe pipeline was the first pipeline to connect Africa and Spain. This line transports natural gas from the Hassi R'Mel gas field, one of the largest in the world and

the most important in Algeria, to Spain. Firstly, the pipeline passes through Morocco (which is a source of soft power for this country) and then crosses the strait of Gibraltar before entering Spain in Tarifa, although the receiving terminal is in Zahara de los Atunes, in the province of Cadiz (Andalusia Energy Department, 2019: 36).

When it opened in 1996 the initial capacity of the Maghreb-Europe pipeline was 8.5 billion cubic metres of natural gas per year (8.5 bcm). However, thanks to the installation of additional compression stations in Algeria, the capacity has increased to 12 bcm. (GALP, 2010).

Its total length is 1620 km, including 530 km in Algeria and 525 km in Morocco, which runs into the 45 km maritime (underwater) section in the Strait of Gibraltar. It is important to mention the pipeline from Al-Andalus in Tarifa to Cordoba (as well as other subsequent lines in Andalusia) after which the main pipeline heads towards Badajoz (Extremadura pipeline) and thereafter supplies a large part of Portugal's gas pipeline before ending up in Galicia (maps 3 and 4).

It should be emphasised that not all of the gas passes through the Extremadura pipeline, given that one branch breaks off to support the Spanish national gas network via the Tarifa-Cordoba pipeline. Indeed, the Spanish network of up to 11,000 km of gas pipelines (ENGÁS, 2015: 6) is largely supplied by this pipeline and the one mentioned below.

Map 2. Route of the Maghreb-Europe gas pipeline



Source: GALP (2010).

Map 3. Sub-route of the Maghreb-Europe gas pipeline into Spain



Source: Shaban (2015)

Map 4. National Gas infrastructure system (simplified)



Source: ENGÁS (2015:11)

Map 5. Medgaz gas pipeline route



Source: J. G. N. (2020).

The shareholders of Europe Maghreb Pipeline Limited (EMPL) are the following; the Spanish Naturgy Energy Group Co. with 77.2% and the Portuguese Galp Energy SGPS Co. with 22.8%. Furthermore, Metragaz, the company which runs the Moroccan stretch of the pipeline, belongs to the aforementioned companies in similar proportions; alongside a small holding (0.68%) by the Moroccan National Office for Hydrocarbons and Mines (EMPL, 2020).

3.1.2. The Medgaz Pipeline

The gas reception facility in Almería opened in 2009 (capital of the region of the same name) and became the second link between Andalusia and the international network of gas coming from the Hassi R'Mel gas fields in Algeria.

In this case, the undersea pipeline crosses a large part of Algeria in order to reach the Andalusian provincial capital, without passing through Morocco. The export of gas through this pipeline began in 2011 and has provided gas to the Spanish gas network ever since.

This gas pipeline improved the supply security to Spain and Europe, seeing that it added 8 bcm per year to the gas network; an increase of 11.2% on the official capacity of natural gas entering the peninsula (Andalusia energy department, 2019: 36).

The official capacity of a pipeline, as tested by the relevant administration, coincides with the 'design capacity available during normal operation, not including emergency or reserve equipment, and without considering the potential operating margins and restrictions of subsequent connected facilities'; (Reganosa, 2020). This is in contrast to the design capacity (of whoever builds the pipeline) and the transport capacity (indicated by the operator).

It will be the verified capacity by the appropriate body in the relevant administrative authorization of the facility. This will coincide with the usable design capacity during normal operation, not including emergency or reserve equipment, and without considering the potential operating margins and restrictions of subsequent connected facilities.

The stretch of pipeline along the seafloor is over 210 km long and over 750 km in total. It transports natural gas at over 2000 metres below sea level making it a cutting edge western Mediterranean project. Furthermore, it was considered a Project of Common Interest for the EU, not only because it secures the safety of the supply from Algeria and does not need to cross Moroccan territory, but because the Medgaz pipeline is the most efficient way to transport gas to Spain. This justifies the investment of up to 900 million euros in the project (CEPSA, 2018).

The majority shareholder in the project is the Algerian state-owned gas company Sonatrach with a 51% share (originally 43%). The remaining 49% share belongs to Medina Partnership; a consortium with an equal share (50% of the 49%, or 24.50% each) belonging to the aforementioned Naturgy Energy Group Ltd and the U.S company BlackRock (Medgaz, 2020b; Reuters Staff, 2020).

The expansion of the Beni Saf compression station (where the underground pipeline starts) will lead to a 25% annual increase in the nominal capacity of the the Medgaz pipeline; from 8 bcm to 10 bcm of natural gas in the coming years. 68 million euros have been earmarked for the expansion of the pipeline (Medgaz, 2020a).

In conclusion, almost 40% of Algerian gas exported to Europe arrives in Andalusia via Medgaz and the Maghreb-Europe pipeline; the other major source is the Trans-Mediterranean pipeline, which arrives in Italy.

Furthermore, up to eight countries receive their gas supplies through the Spanish natural gas network, fed in part by Andalusian infrastructure. (ENAGÁS, 2015: 11).

Almost 40% of Algerian gas exported to Europe arrives in Andalusia via Medgaz and the Maghreb-Europe pipeline; the other major source is the trans-Mediterranean pipeline, which arrives in Italy

3.1.3. Liquefied Natural Gas and the Poseidon Gas Deposit

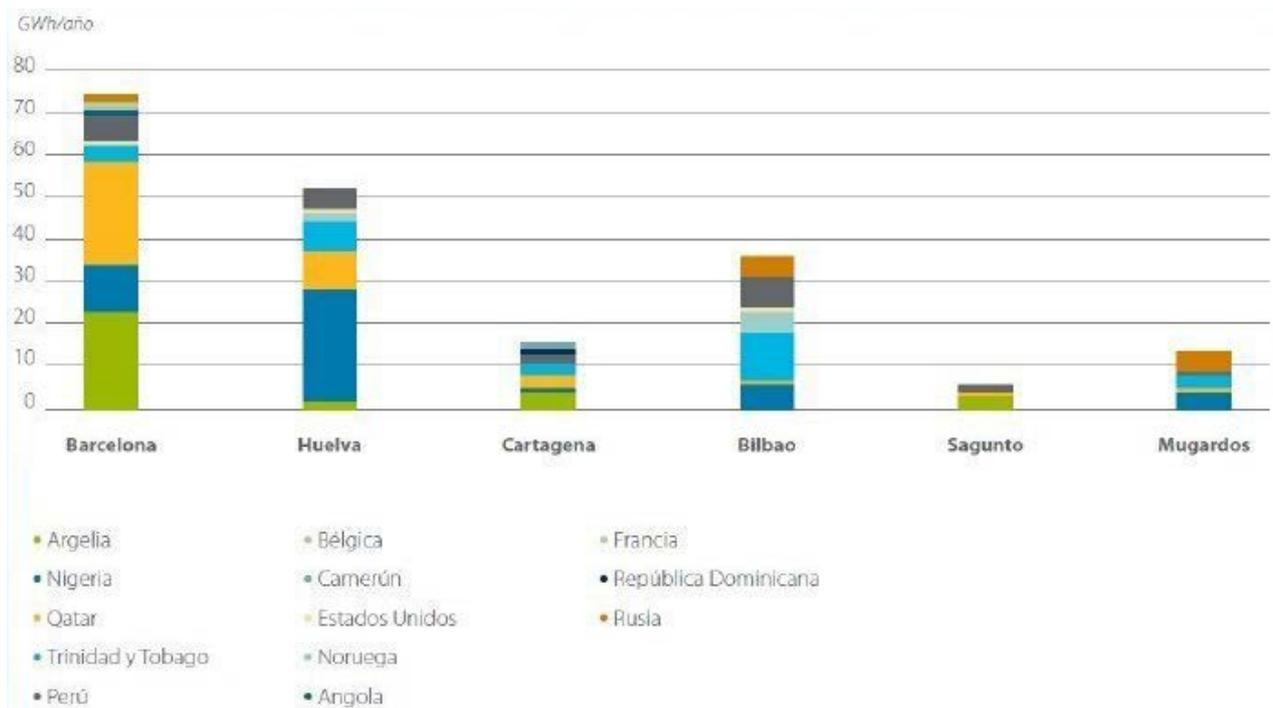
In terms of gas, Andalusia is not just relevant because it is the arrival point for gas pipelines. In fact, Andalusia has one of the most important ports for the arrival of Liquefied Natural Gas in Europe.

Spain has the largest regasification capacity in the EU; that's to say, the conversion of LNG into gas form. Indeed, seven of the twenty-two European regasification facilities are located in Spanish territory. The variety of origins of hydrocarbons allows 'the Spanish national gas system to reach an appropriate level of supply security, especially considering that domestic gas production accounts for less than 1% of total demand' (UFG, 2020).

Graph 6 shows the unloadings, separated by origin, in each of the six regasification plants in Spain. The Huelva plant, which is the most important in Andalusia and the second most important in Spain, received gas from seven separate sources in 2017: Algeria, Nigeria, USA, Norway, Peru, Qatar and the T&T Company. This has contributed strongly to the operational security of the national gas system. (Andalusia Energy Department, 2019: 35).

Indeed, LNG is slowly making up a larger proportion of natural gas imports into Spain. Between 2015 and 2018, LNG accounted for slightly less than half of gas imports, but in 2019 it exceeded 50% (UFG, 2020). The fact that Andalusia has the second most important regasification plant in Spain reinforces its strategic importance in terms of energy.

Furthermore, the Poseidon marine gas field is located in the Gulf of Cadiz, 30 km from the Mazagón coast (Huelva); there are two licences; Poseidon North and Poseidon South. This meant that Andalusia was the only natural gas producing region for years (Revilla, 2009) until extraction began in the Viura gas field project (La Rioja).

Figure 6: Distribution of origins per regasification plant

Source: Andalusian Energy Agency (2019: 35)

3.1.4. The TransSaharan pipeline: an impossible project?

The project, while it is still in the early stages of conceptualisation and construction, has a great potential for the construction of a gas supply line from the Warray field in Nigeria to the Algerian community of Hassi R'Mel. (Woellwarth, 2020). In other words, a project which could connect the Algerian gas pipeline network, which supplies Europe, with the Niger delta in the Gulf of Guinea. It should be noted that Nigeria has the ninth largest proven reserves of natural gas, with over 5200 bcm, even more than Algeria which has 4400 bcm (ENERGY.EU, 2010).

If fully developed, the Trans-Saharan pipeline would entail close collaboration between Nigeria, Niger and Algeria, as well as the strategic international involvement that a project of this scale tends to encourage.

The French hydrocarbon company Total S.A and the Anglo-Dutch company Royal Dutch Shell have expressed their intention to invest in the project. Meanwhile Russia's Gazprom confirmed its participation in 2009, together with the Nigerian National Petroleum

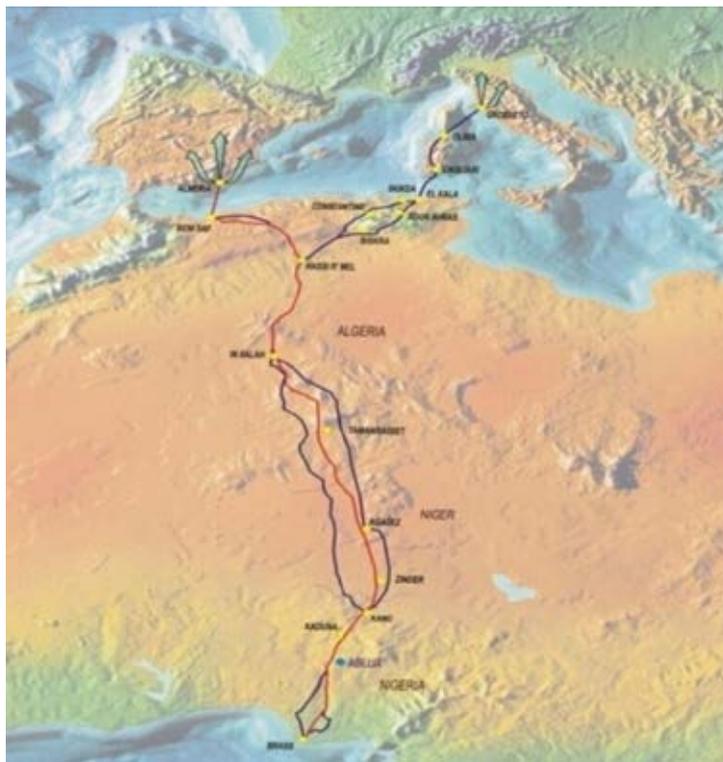
Company NNPC, through an investment of 2.5 billion dollars in the project. India also expressed its interest in the project through the Gas Authority of India or GAIL (Business Standard, 2013).

Algeria's Sonatrach and Nigeria's NNPC are running the project currently, with a small contribution from Niger. According to the Infrastructure 100 report by KPMG (2014: 30):

If built, the \$20 billion trans-Saharan natural gas project would be one of the world's most expensive energy export programs. By providing a critical link between the resource-rich areas of Africa and the attractive markets of Western Europe, the pipeline would help Europe diversify its natural gas supply by sourcing natural gas from Nigeria, through Niger, to Algeria and then on towards Spain and Europe.

This project could add up to 30 bcm annually to the supply coming from Algeria (Fabi, 2009) and if all these supplies were supplied to Europe, it would represent a 50% increase in that supply.

Map 6: Trans-Saharan Gas Pipeline Route Projections



Source: Egbe et al. (2016: 144)

However, the embryonic stage of the project is not only due to the lack of funds, but also because of conflict over the control over the Niger Delta, which poses a threat to safe transit across the Sahara. This long route is not a particularly safe option, owing to, among other factors, the limited control Niger has over its territory, as well as possible interceptions by jihadist groups.

3.2. Andalusia and oil pipelines

In terms of oil pipelines, Andalusia's network is the longest in Spain with over 1100 km throughout Huelva, Seville, Cádiz and Córdoba; 870 km of which are managed by the CLH company (Europapress, 2016).

Andalusia has two petrol refineries. The first is the Gibraltar refinery - San Roque (Cádiz) - which has a storage capacity of 1.2 million m³ of oil and 900,000 m³ of storage for oil-bearing products. Secondly, the Rábida refinery in Palos de la Frontera (Huelva) has an even larger capacity of over 1.4 million m³ of crude

oil and 1.1 million m³ of oil-bearing products. Together, the refineries distil up to 22.5 million tonnes of crude oil per year. (Andalusia Energy Department, 2019: 40).

Map 7 shows the San Roque and Huelva refineries (managed by CESPAs) as crucial entry points, although the ports of Huelva, Rota, Algeciras and Motril should be mentioned. Also noteworthy is Arahal (Seville) which is a crucial location, that links all of the storage facilities.

Furthermore, it should be noted that there are six airports with some storage capacity, almost all of them operated by CLH: Seville (4758 m³), Almería (1550 m³), Jerez de la Frontera (1270 m³), Granada (225 m³, the only one managed by MITRASA), Málaga (180 m³) and Córdoba (131 m³). The total capacity of the Andalusian airports is 8114 m³ of crude oil (Andalusia Energy Department, 2019: 40).

Andalusia has a further twelve storage facilities in addition to the airports already mentioned, with varying ownership and capacity, although the role of CLH in the oil framework of Andalusia and Spain is crucial. Of these twelve facilities, nine are run by CLH, and the others are shared between Secicar, Decal España and VOPAK. Those belonging to the main company (CLH) are in, Palos de la Frontera which is the most important with a capacity of over 560,000 m³ of crude, followed by Córdoba (over 223,000 m³), Arahal (224,000 m³), Algeciras (192,500 m³), Málaga (131,000 m³), Motril (123,000 m³) and Rota (118,000 m³). Meanwhile, the lower capacity facilities are in Seville (almost 84,000 m³) and San Roque (just over 13,500 m³).

Three other companies own the remaining facilities: one in Motril, run by Secicar, with a capacity of over 106,000 m³ of crude; another in Palos de la Frontera, run by Decal España, with almost 600,000 m³ of capacity and which surpasses that belonging to CLH in the same town: and finally, VOPAK runs a facility in Algeciras with a capacity of over 400,000 m³ of crude, and which also has a greater capacity than the CLH facility in the same town. The reserve capacity of the twelve facilities (run by CLH and the others) is 2,779,759 m³ of crude oil (Andalusia Energy Department, 2019: 40).

4. Conclusions

This document has shown the relevance of Andalusia in geo-energy terms, given its strategic position close to the African continent and the gateway to Europe. With regard to natural gas, the following conclusions can be drawn:

- Andalusia, and more specifically Tarifa, is the gateway to the Maghreb-Europe (or Pere Duran Farell) gas pipeline, which comes from the Algerian field of Hassi R'Mel and transits through Morocco, thanks to which 12 bcm of natural gas is transported annually. This line in turn feeds the Al-Andalus pipeline, the Extremadura pipeline and the national gas line in Portugal, as well as the Spanish line.
- Also in Andalusia, is the entry point for the Medgaz gas pipeline (Almeria), which also comes from the aforementioned Algerian field and connects both countries directly, supplying 8 bcm to the national gas system. Furthermore, the nominal capacity of this line is expected to increase to 10 bcm in the coming years.
- In total, almost 40 % of the natural gas exported by Algeria to Europe via pipelines enters the old continent via Andalusia. This means that up to 8 countries are supplied with gas thanks to the national network, which is largely supplied by these lines.
- Andalusia has the second largest regasification plant in Spain in Huelva, the EU country with the greatest capacity for this process. LNG accounted for more than 50% of gas imports in 2019.
- In the Gulf of Cadiz are the two terminals of the Poseidon field, which have kept Andalusia as the only gas-producing region in Spain for years.
- As a possibility for the future, the development of the trans-Saharan gas pipeline, which would connect the Warry field (Nigeria) with Hassi R'Mel, could add up to 30 bcm per year to the supply of natural gas exported by Algeria, to be divided between the entry routes to Andalusia and Italy.

Andalusia is therefore fundamental in geo-energy terms for Spain and for Europe, as it is the gateway to the only two gas pipelines entering Spain from Algeria, and because of the natural gas regasification plant in Huelva, as well as, to a lesser extent, the Poseidon field.

With regard to crude oil, we can conclude the following:

- The Andalusian oil pipeline network is the most extensive in Spain: it is over 1,100 km long and crosses the provinces of Huelva, Seville, Cadiz and Cordoba.
- Andalusia has two oil refineries that distil up to 22.5 million tonnes of crude oil per year, located in San Roque (Cadiz) and Palos de la Frontera (Huelva).
- Thanks to its location on the shores of the Mediterranean Sea and the Atlantic Ocean, the region has port facilities through which crude oil enters, in Huelva, Rota, Algeciras and Motril.
- There are twelve crude oil storage facilities in Andalusia, as well as six airports with storage capacity. Their total capacity is 2,779,759 m³ and 8,114 m³ respectively.

Through Andalusia, oil is supplied not only to the region itself, but also, in particular, via the line from Córdoba, to the centre of the peninsula (via the Rota-Zaragoza pipeline) and, by extension, to Aragon, Catalonia and the north of the peninsula. Thus, Spain benefits from all the maritime inflows provided by Andalusia, and from its two refineries.

This shows the special importance of Andalusia as a strategic region for Spain in geo-energy terms, in the case of both natural gas and oil.

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