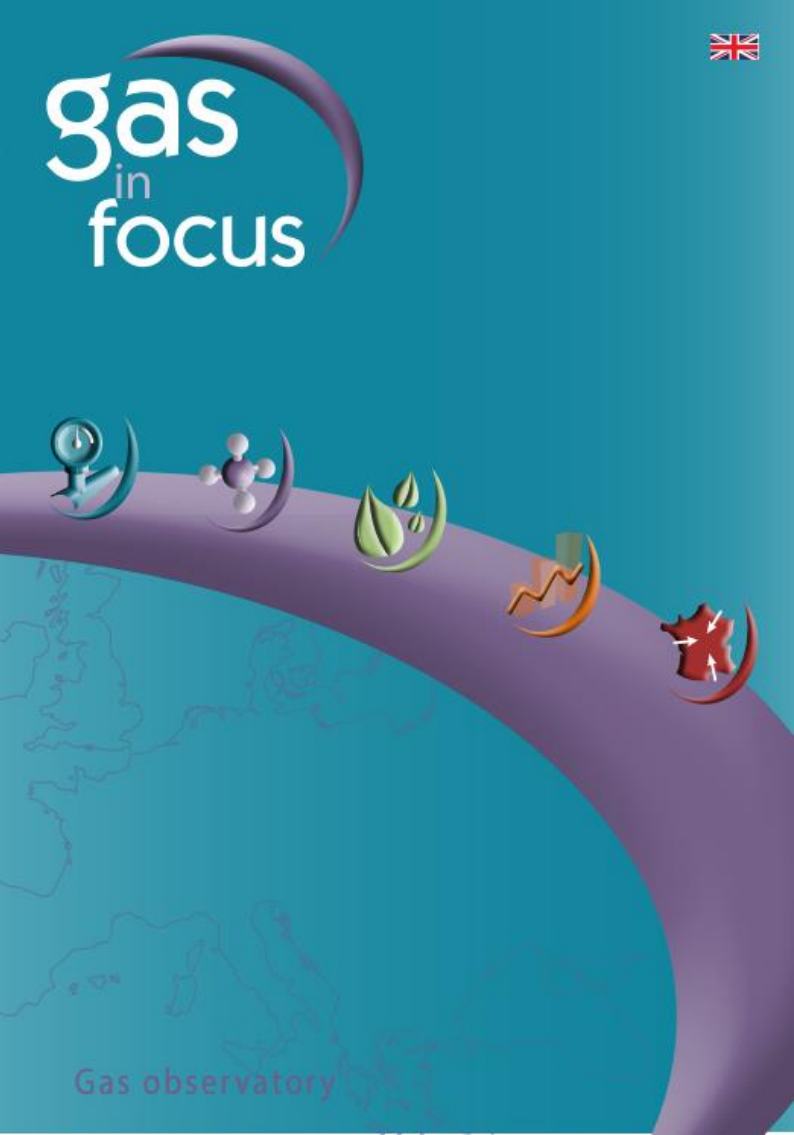
gas in focus



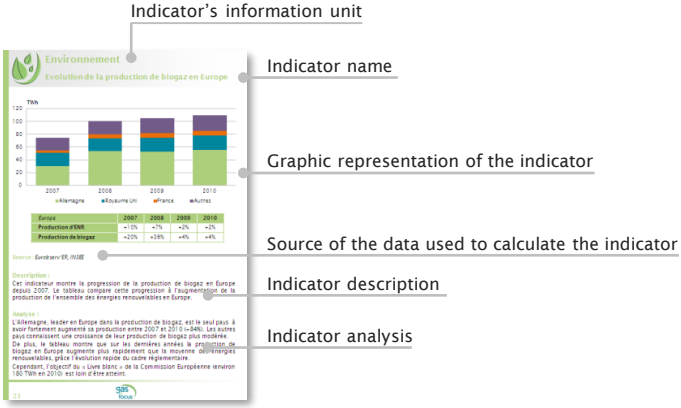
Gas observatory

Guidelines

Information units' signage :

In order to make the navigation in this memo easier and more entertaining, we have chosen to point out each information unit with a color and a pictogram :

Page template :



The evolutions of the energy sector.

European-wide energy policies reflect how national rulers are looking for a balance between economic efficiency and commitment to the energy and environmental transition.

Such a dynamic raises technological challenges and deep transformation needs for all the actors of the energy market. Renewable energy sources' integration, increased storage needs, mobility transformation and networks adaptation to the Smart Grid era are several trends demonstrating evolutions of the energy sector.

In order to support this energy transition, natural gas and renewable gases play a major role thanks to their complementarity with other energy carriers and the multiplication of synergies between networks.

The **Gas in Focus** observatory aims to highlight natural gas and renewable gases in the energy transition by sharing consolidated, educational and reliable data linked to the entire sector.

Thanks to the expertise of its founders, **GRTgaz** and **Sia Partners**, this natural gas observatory provides key information for the sector. It is organized around five detailed topics with both illustrated databases and focus.

Find all our analysis on the Gas in Focus dedicated website : www.gasinfocus.com

Summary

Infrastructures

Uses

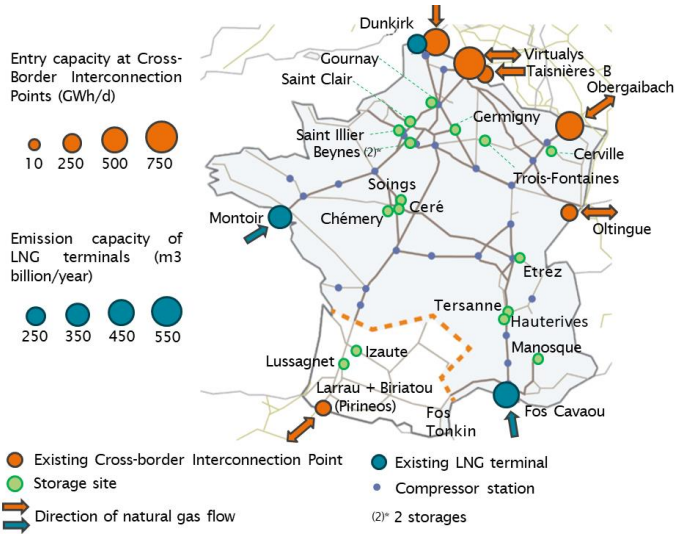
New gases

Markets

Supply

Infrastructures

Major gas infrastructures in France



Sources: *GRTgaz, Teréga (2020)*

Description:

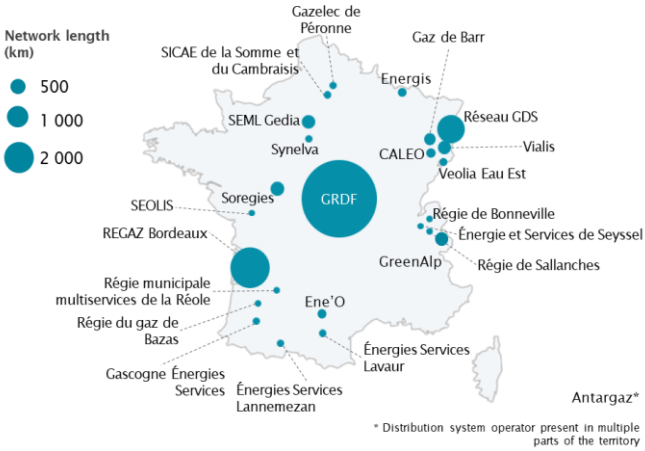
This map shows the major gas infrastructures in France (transmission, storages and LNG terminals), as well as the main interconnection points with bordering countries.

Analysis:

France no longer has any major natural gas resources within its territory. 80% of the consumed natural gas is imported by pipeline from interconnection points (Norway, Russia, the Netherlands, etc.), and 20% is imported by sea via the LNG terminals (Algeria, Nigeria, Qatar, etc.).

Close to 15 underground storage sites allow for a balance to be maintained between supplies which are relatively constant throughout the year and consumption levels which vary seasonally.

Natural gas distribution system operators in France



Source: *CRE, SPEGNN, gtg2007 (2020)*

Description:

This map shows the locations of the main Distribution System Operators (GRD) for natural gas in France and the length of the network under concession to each operator. For ease of reading, the size of the GRDF icon is not proportional to the length of its network (200,715 km for approximately 9,973 municipalities served).

Analysis:

The Law of April 8th 1946, which structured the nationalization of the energy sector, preserved the rights of municipalities in matters related to the public distribution of electricity and gas. Therefore, while private companies were nationalized, certain local publicly-owned companies remained in business.

Today, approximately 400 municipalities in France hire a local operator to manage their natural gas distribution network in the framework of a public service agreement. Distribution System Operators are regulated companies, whose mission is to guarantee access to their network and ensure natural gas flows through this network transparently and without discrimination.

Gas transmission operators in Europe

Source: ENTSOG (2020)

Description:

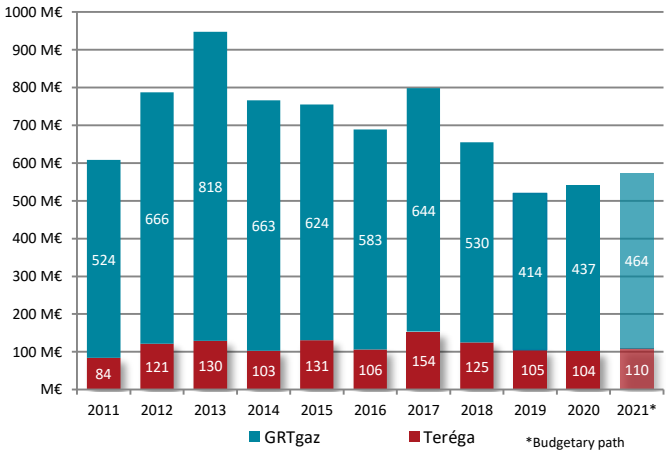
This map shows the locations of European Transmission System Operators (TSO).

Analysis:

The EU-28 has approximately 40 Transmission System Operators today, managing around 200,000 kilometers of network. For the most part, these companies are located within their historic geographical scope. The size of the networks varies to a great degree as it is directly related to the size of the countries in which the Transmission System Operators operate.

The Transmission System Operators are regulated companies that build and operate pipelines, and they sell their networks' transmission capacities.

Transmission system operators' investment programmes in France



Source: *CRE (2020)*

Description:

This graph presents the evolution of investments made by the two natural gas transmission operators in France.

Analysis:

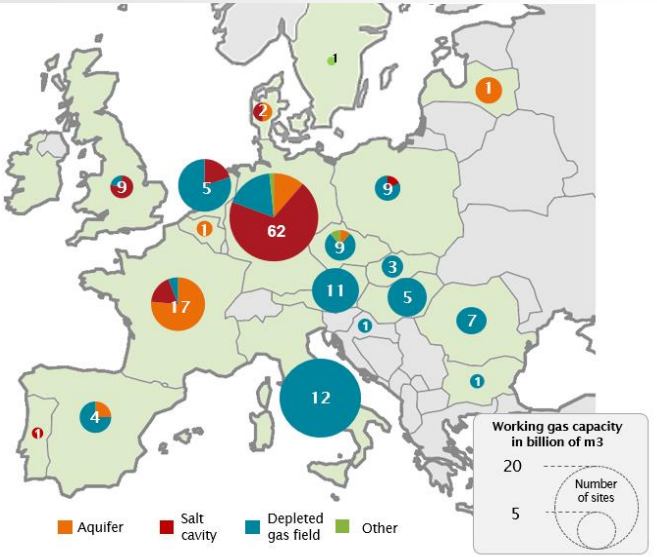
The establishment of the TRF (Trading Region France), a liquid market zone interconnected with the European market, required several investments in the gas transmission network until 2018.

Now, the amounts invested are mainly allocated to the development of the principal network, to reinforce the infrastructures safety, and to renew obsolescent facilities.

All these investments are subject to the approval of the French Energy Regulatory Commission ("Commission de Régulation de l'Énergie"). Every year, the Transmission System Operators publish their ten-year investment plan.

Infrastructures

Underground storage sites for natural gas in Europe



Source: GIE (2018)

Description:

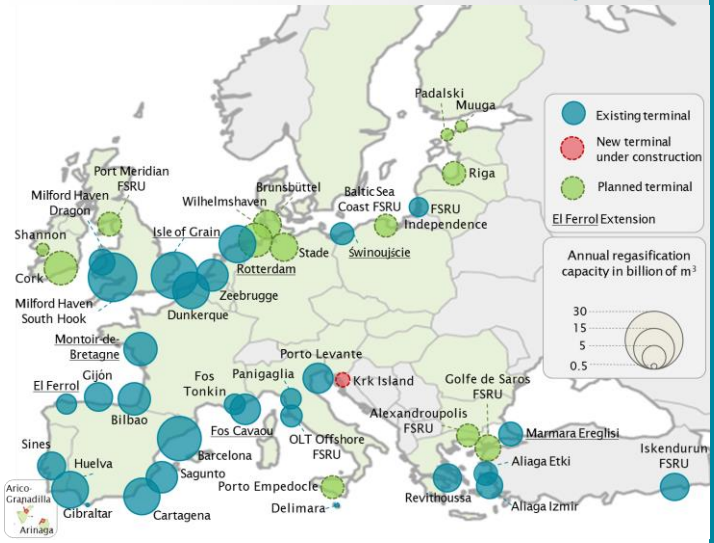
This map represents the working gas capacities of underground storage sites in billion of m^3 and the number of storages in each European country.

Analysis:

The total working gas capacity in Europe today totals around 158 billion m^3, including 117 billion m^3 in the UE-28. Global storage capacity is currently estimated at over 360 billion m^3.

France, Germany and Italy can hold approximately 1/3 of their annual requirement in stock. These countries store natural gas in a unique logistics chain to maintain a balance between supply and demand.

Existing and planned LNG terminals in Europe



Sources: *GIIGNL, GLE (2019)*

Description:

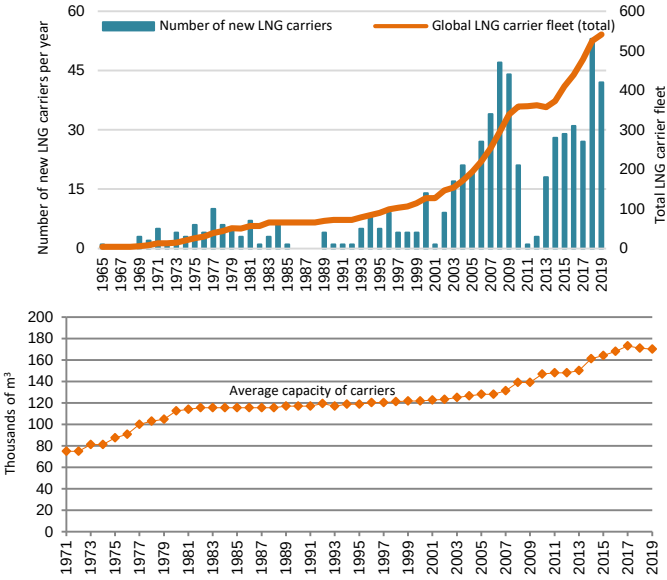
This map shows the natural gas regasification facilities in Europe that are either currently operating, under construction or planned. The final investment decision has not been made for all planned LNG terminals indicated on the map.

Analysis:

Worldwide, the LNG industry is constantly growing with 21 exporting and 42 importing countries in 2019 and a growth of 13% compared to 2018. In 2019, 7 new terminals were built.

In Europe, projects are multiplying. Currently, LNG regasification capacity represents about 20% of global capacity, or 136.2 billion m^3, close to the USA (15%) but behind Japan (24%).

Evolution of the global LNG carrier fleet



Source: IGU - WORLD LNG REPORT (2020)

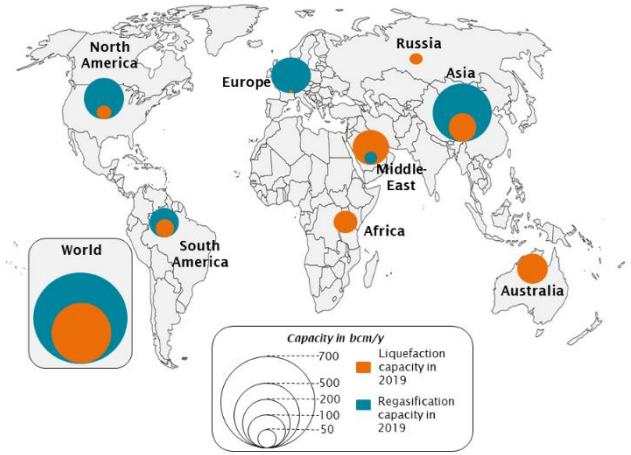
Description:

These graphs show the evolution of the global LNG carrier fleet : annual vessels commissioned, total number of LNG carriers in service and average capacity.

Analysis:

The implementation of new LNG carriers remains important with 42 new vessels in 2019.

At the same time, the average capacity of the LNG carriers increased to reach more than 170,000 m³ in 2019, which corresponds to the authorized limit of the Panama Canal since its widening.



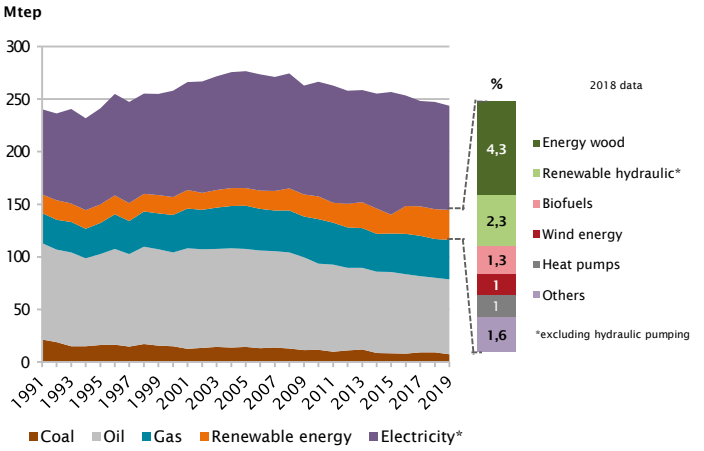
Sources: *GRTgaz, GIIGNL, IGU (2020)*

Description:
This map shows both the natural gas liquefaction and regasification global capacities in different areas of the world.

Analysis:
When it is liquefied, natural gas can be easily transported by ship over long distances: it facilitates world trade. In 2019, 354.7 million tonnes (Mt) of LNG were traded. After several years of market tension, due in particular to strong Asian demand, LNG is currently abundant. This is the consequence of the significant increase in liquefaction and parallel regasification capacities. Thus, the total liquefaction capacity amounted to 331 bcm/y in 2019, while the world regasification capacity represented 635 bcm/y. This growth will continue as nearly 115 bcm/y of new liquefaction capacity has been approved for commissioning between 2019 and 2026.

Uses

Breakdown of the consumption of primary energy in France



* Excluding renewable primary electricity and hydraulic production by pumping

Sources: SDES, Insee (2020)

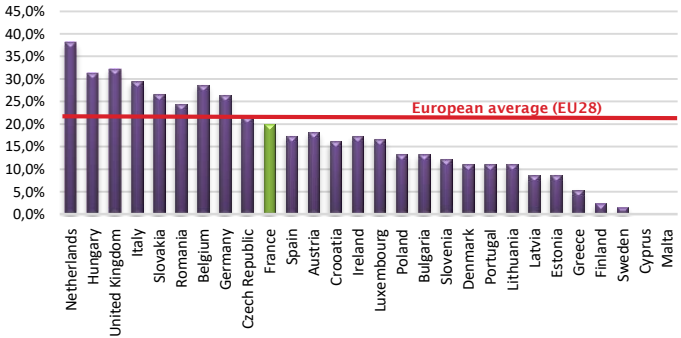
Description:

This graph presents the evolution of the breakdown of the various energy sources for the total consumption of primary energy in France. Primary energy refers to the energy content of the resource as found in nature (fissile material for nuclear generated electricity, natural gas, coal, etc.).

Analysis:

The breakdown of primary energy sources has not changed significantly over the past 20 years, with the exception of a significant drop in coal's contribution. We also note the growth of renewable energies, now added to the traditionally-used hydraulic-based resource.

Share of natural gas in Europe's final consumption of energy



Source: Eurostat (2020)

Description:

The share of natural gas in the final consumption of energy refers to the ratio between the total consumption of natural gas (industrial, residential/service and production of electricity) and the final total consumption of energy for the year 2019.

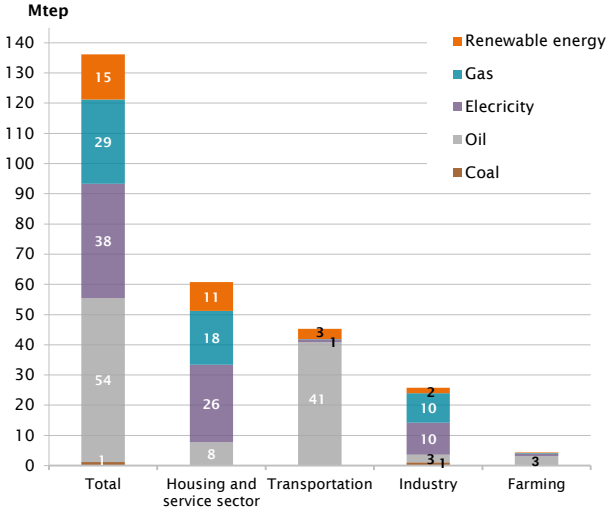
Analysis:

In 2019, the share of natural gas in the final consumption of energy for the EU-28 was 22.6%. In France, the share was 20%: it is a little bit less than the European average and it is due to the widespread use of electricity to heat housing. This situation is specific to France, which has a large number of nuclear power plants.

Producing countries, or countries close to producing countries, obviously have a greater share of gas in their final consumption of energy.

Uses

Final energy consumption by sector in France



Source: SDES - Bilan énergétique de la France pour 2018 (2020)

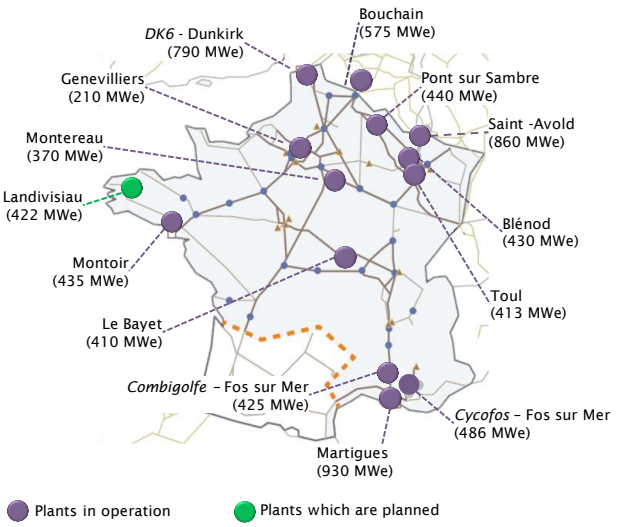
Description:

This graph presents the breakdown of the different sources of energy used in the total consumption of energy in France in 2018, both in general and respectively for Transportation, Industry, Farming and Housing and Service sectors.

Analysis:

Natural gas is as used as electricity in industry and housing. However, in Service sector, because of specific uses such as air conditioning, gas ranks second after electricity.

In industry, gas is used mainly for process heating and also as a raw material for the chemical industry (fertiliser and refining).



Source: GRTgaz (2020)

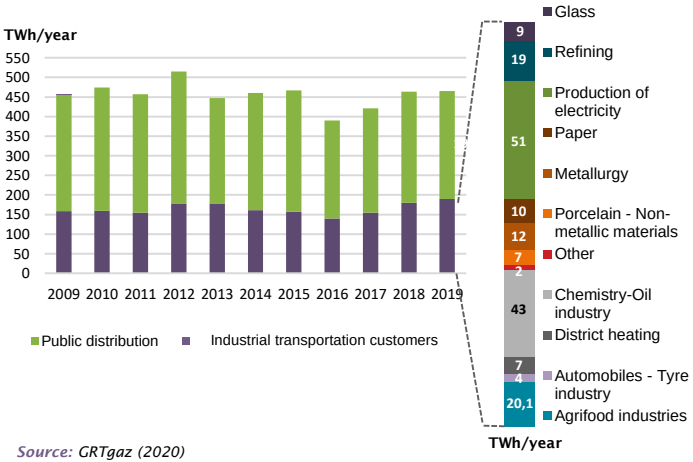
Description:

This map shows the locations of the centralized production sites for the power generation using natural gas currently in operation or planned in France as of July 1st 2020.

Analysis:

In 2019, the electrical capacity of the French natural gas-fired power plants was 6.7 GWe. The year 2019 has known an increase in production (39 TWh or +23.8% compared to the previous year) due in particular to a drop in hydroelectric and nuclear power generation.

Breakdown of natural gas consumption in France



Source: GRTgaz (2020)

Description:

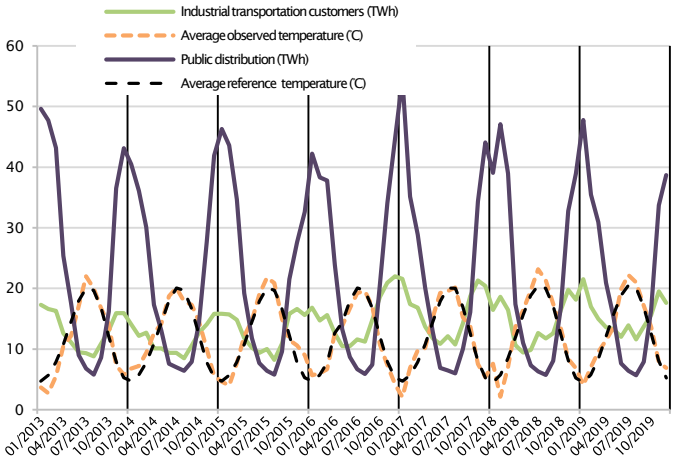
This graph presents the breakdown of natural gas consumption by customer type. For 2019, industry consumption is broken down by business sector.

Analysis:

Public distribution to household customers and SMEs represent close to two-thirds of the consumption of natural gas.

Certain industry sectors that are major consumers of natural gas are connected directly to the transmission networks. There are close to 1,000 sites of this type in France, representing one third of total consumption.

N.B. *In France, natural gas transmission is provided by two different transmission operators, each having its own zones: GRTgaz and Teréga. In 2019, 94% of total consumption fell within the GRTgaz network, and 6% in Teréga's.*



Source: GRTgaz (2020)

Description:

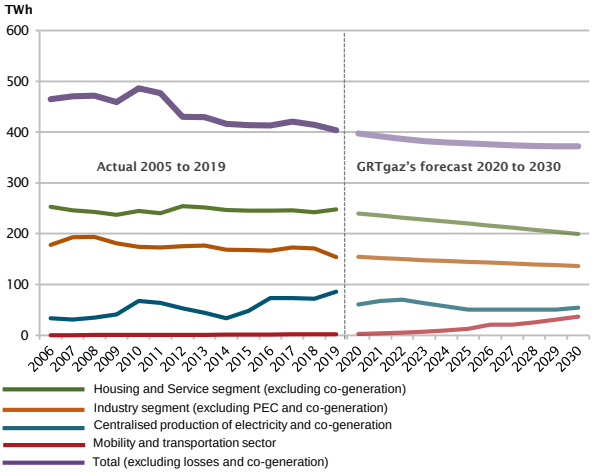
This graph presents the evolution of the average weighted temperature by consumption (observed in GRTgaz's zone) as well as the evolution of the consumption of public distribution and industrial customers directly connected to GRTgaz's transmission network.

Analysis:

A comparison of the temperature and consumption curves indicates that the weather has a direct and overriding effect on the seasonal fluctuations of natural gas consumption. We also note the impact of the slowdown in industrial activity over the summer.

Uses

Forecasted evolution of the annual consumption of natural gas



Source: Perspectives gaz (2019)

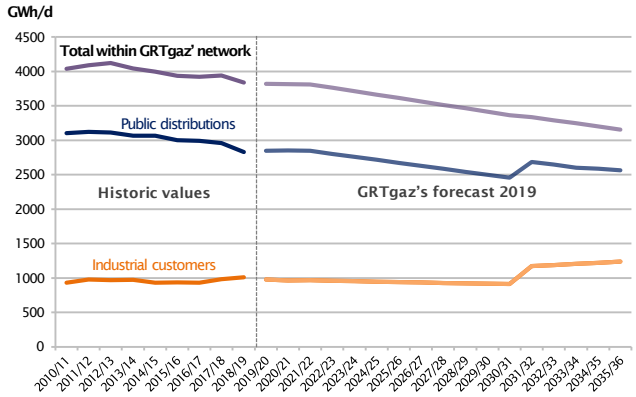
Description:

This graph shows the annual natural gas consumption forecasts established by sector of activity and for the entire French zone.

Analysis:

The forecast data are calculated on the basis of an increase in gas mobility and the development of renewable gases (blue scenario of the *Perspectives gaz 2019*).

Over the past decade, French gas consumption has been on a decreasing trend for traditional uses (residential, tertiary and industrial), although the years 2016 and 2017 were characterized by an increase in gas demand. For new uses, such as the mobility and transportation sector, the forecasts of rising gas consumption by 2030 are clearly part of an energy transition context aimed at achieving carbon neutrality in the long term.



Source: Ten years plan for the development of GRTgaz' network (2020)

Description:

This graph presents forecasts for the demand in natural gas at peak times as established by GRTgaz according to its reference scenario, with a breakdown between public distribution and industrial customers connected directly to the transmission network. High and low scenarios correspond to the evolution of centralised production of electricity and co-generation.

Analysis:

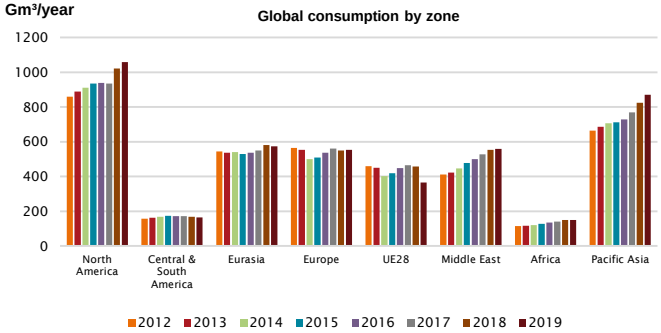
Peak consumption is a criterion when sizing energy transmission networks. The peak allows for an evaluation of the maximum capacity a network must face when conditions of use are extremely intense. With regard to consumption that is very sensitive to weather (public distribution and residential-service), the most stringent conditions are considered established when the temperature adopted is the lowest that has been observed over 50 years (2% risk, hence the term "P2 peak").

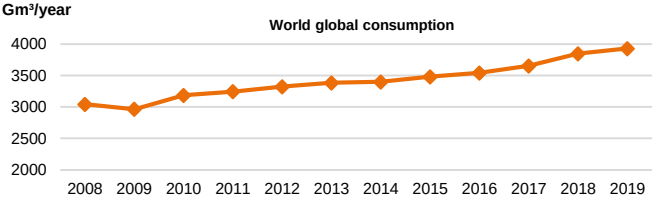
With regard to industrial consumption, except in a few specific cases, the maximum nominal power drawn by the industrial site is used.

We assume that the consumption peak forecast changes in parallel with forecasts for volumes consumed. The total peak increase is therefore mainly attributable to power plants.

Uses

Global consumption of natural gas





Source: BP Statistical Review (2020)

Description:

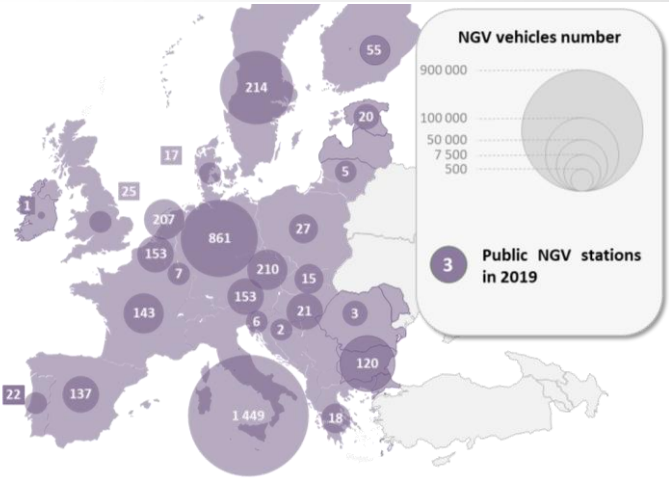
These graphs present the global evolution of the natural gas consumption by zone & in the world over the years.

Analysis:

Gas is the third energy source, just after oil and coal. Apart from a decrease in 2009, world global consumption of natural gas is incresasing over the years, and it reached 3,929.2 Gm³ in 2019.

World global consumption of natural gas is driven by the demand in America and in Asia, due to a strong economic & demographic growth comnbined with low gas prices. EU represents 12% of world's global consumption of natural gas.

Vehicles and NGV stations in Europe



Sources: NGVA Europe (2020), Mobilité Gaz Open Data (2019)

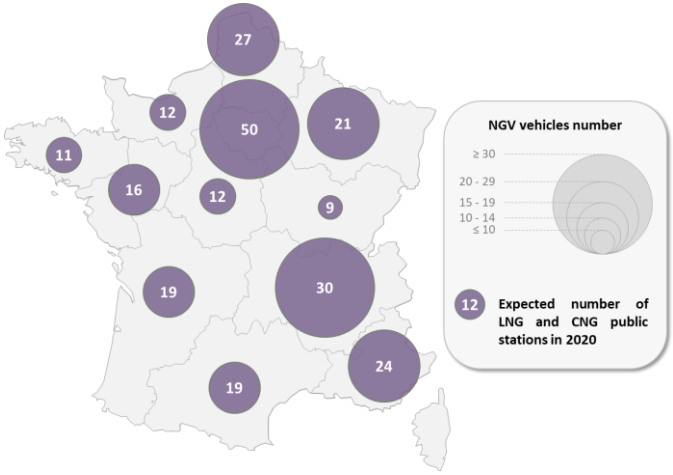
Description:

This map represents the number of NGV vehicles and stations across European countries (E.U 27) in 2019.

Analysis:

The weight of natural gas in the mobility sector varies significantly between the different European countries. Italy (1,449 stations) and Germany (861 stations) dominate the European market, while countries such as Ireland or Romania have a recent development that is struggling to take off. Some European countries have implemented policies that are very favorable to the NGV industry. Indeed, France and Germany have an advantageous tax system for NGV vehicles. Since January 1, 2019, NGV vehicles over 7.5 tons are exempt from motorway tolls corresponding to the tax on air pollution. A multitude of European countries have significantly increased the number of their installations during the year 2019. This is the case, among others, in France (+55 stations), Spain (+62) or Italy (+187).

NGV filling points' projection in 2020 in France



Sources: AFGNV, Mobilité Gaz Open Data (2020)

Description:

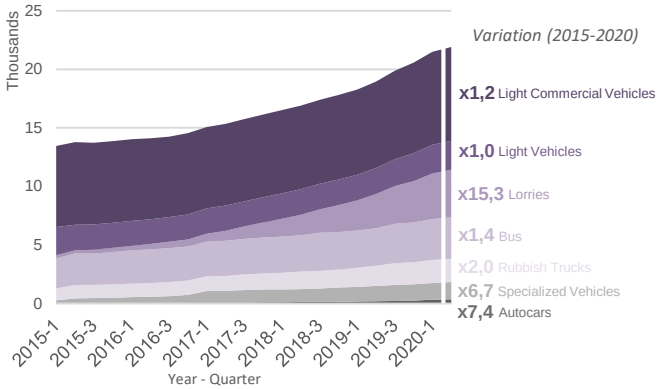
This map represents the localization of the 250 NGV filling points (1 L-CNG station = 2 filling points) expected to be deployed in France before the end of the year 2020.

Analysis:

Currently, France has around 158 NGV operational stations to supply ~22 000 vehicles. The major part of these vehicles are buses, business fleet and lorries.

The goal of 250 LNG and CNG refueling points deployed by the end of 2020 seems difficult to achieve. Significant efforts will have to be made by all stakeholders in order to massively pursue the development of CNG stations in France. The number of CNG vehicles has increased by 55% over the last 4 years, this strong development should accelerate the deployment of CNG stations in France.

Evolution of the NGV vehicles fleet in France by type of vehicles



Source : AFGNV

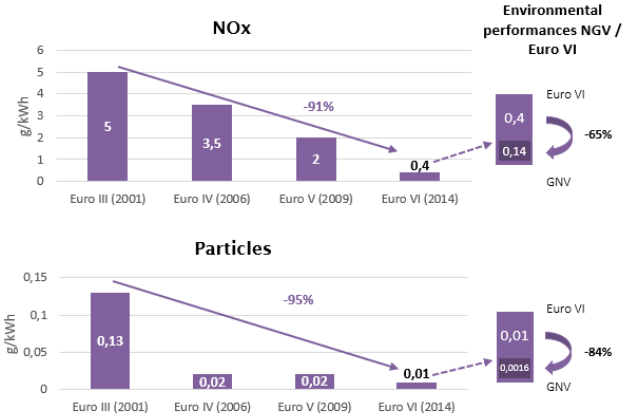
Description :

This chart shows the Natural Gaz Vehicles (NGV) fleet evolution in France since the beginning of 2015. The indicator underlines the evolution by vehicle categories for a better understanding of market trends. The Light Commercial Vehicles category refers to vehicle designed for goods transport and with a Gross Vehicle Weight Rating (GVWR) under 3,5 tons. The Light Vehicles refers to individual cars. And the Specialized Vehicles category refers mainly to sweepers and forklift trucks.

Analysis :

Natural Gas Vehicles (NGV) represent a tiny part of the French vehicle fleet with around 22 000 registered cars at mid-2020. France is late comparing to other countries like Iran, China, Pakistan or Italia, which is the European leader and in the world 7th place, with a 900 000 vehicles fleet. Nevertheless, this number of NGVs is growing quickly (+55% in 4 years), thanks to great performances of the lorry sector which has been multiplied by almost 5 in 3 years. GNVs represent a great and less polluting alternative compared to oil and diesel vehicles. The development of this sector is a strategic issue for France. The PPE (roadmap that sets objectives for the French energy transition) set the objectives of 110 000 registrations of light commercial vehicles and 60 000 registrations of lorries using GNV in 2028.

Evolution of the antipollution applicable standards in heavy trucks and NGV positioning



Sources: Ministère de la Transition écologique et solidaire (2020), IVECO-AFGNV (2015)

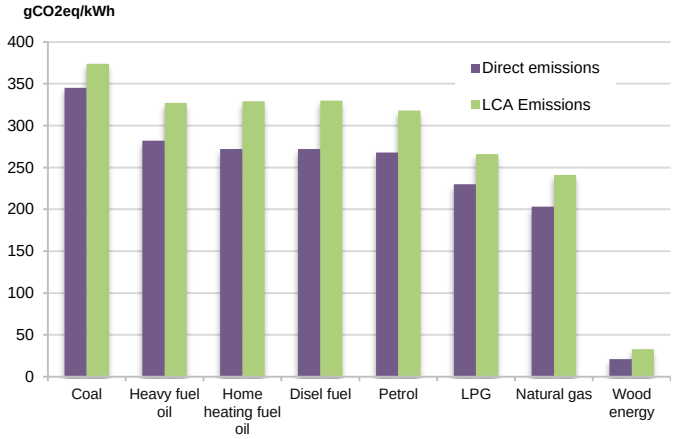
Description:

This graph presents European emission standards (Euro standards) of nitrogen oxides and particles for heavy trucks, as well as measured emissions for NGV's vehicles (WHTC cycle).

Analysis:

The Euro emission standards set the maximal limits about rejections of pollutants (nitrogen oxides, carbon monoxide, hydrocarbons and particles) for vehicles. These standards, which have been considerably strengthened, aim to limit the air pollution due to road transport.

NGV environmental efficiency is far better than traditional fuels' one. This efficiency can be seen through nitrogen oxides emissions or micro particles emissions. Both pollutants are strongly concentrated in high-density urban areas.



Source: ADEME (2018)

Definition:

This graph compares CO_2 emissions of the various fuels commonly used. The content excluding Life Cycle Assessment (LCA) only takes only into account CO_2 emissions from combustion. The LCA content highlights the CO_2 emissions generated throughout the supply chain (extraction, transmission and distribution).

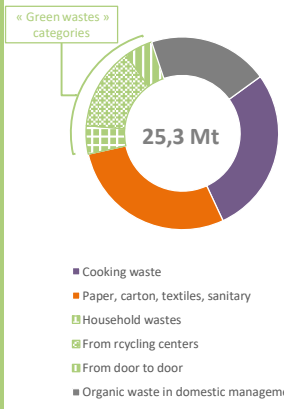
Analysis:

Natural gas plants have the lowest output rate of CO_2 per kilowatt-hour and emit 42% less CO_2 than coal plants.

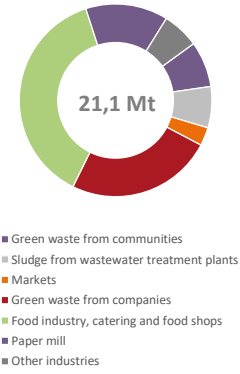
Among fuels, natural gas is the most interesting as its supply chain cycle has one of the lowest CO_2 emissions. It has, therefore, one of the best LCA ratios among all fossil energies.

Waste deposit that can be recovered in France

Organic wastes collected by the public service and in domestic management



Other organic wastes



Source: ADEME - Déchets chiffres-clés 2020

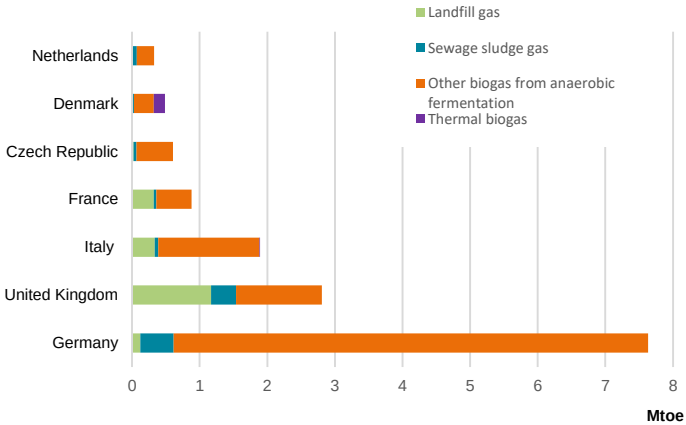
Description:

This graph represents the volumes of organic wastes (bio-waste or putrescible waste) collected by the public service (households, small businesses) as well as the volumes generated by "large producers". This waste can be the subject of organic recovery (composting) or energy (methanization) through collection and / or an appropriate sorting system.

Analysis:

Specific measures aims to implement a better collection of this waste with high recovery potential. In 2017, 125 local authorities set up separate collection of bio-waste for households and / or professionals. Almost 4 million inhabitants are affected. Since January the 1st, 2012, companies that produce or hold a large quantity of bio-waste have been required to sort it and have it recovered in suitable composting or methanization channels.
The law on food waste provides for the generalization of the sorting at the source of bio-waste by 2023.

Biogas production channels in Europe



Source: Eurobserv'ER (2019)

Description:

Biogas is produced from organic matter in the absence of oxygen. Production can take place in waste storage facilities, treatment plants or using organic waste from agriculture and the agro-food industry (on the graph, "Other biogases"). Thermal biogas is produced by applying pyrolysis or gasification of solid biomass (wood, forest residue, solid and fermentable household waste).

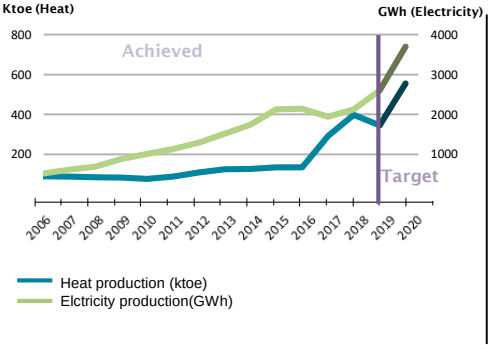
Analysis:

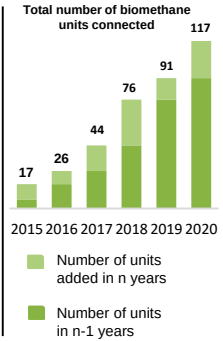
In 2018, Europe biogas production remained stable (16,8Mtoe). Thermal biogas production increased by 2 in 2 years.

Thanks to its proactive policy, Germany is the main producer of biogas in Europe with a production of 7 631 ktoe in 2018 (almost half of Europe's production). This production is essentially based on waste from agriculture and the agro-food industry. For its part, the United Kingdom produces a significant proportion of biogas in waste storage facilities: 1168 ktoe produced in 2018. These two examples illustrate the existence of a potentially large yet undeveloped production of biogas in Europe. France is still the 4th European country in 2017, with 0.90 Mtoe of biogas produced. Biogas is usually used to produce electricity. Biogas electricity output totaled 61 TWh in 2018.

New gases

Evolution of biogas production in Europe





Sources: SDES, PNA 2020 and GRTgaz (2020)

Description:

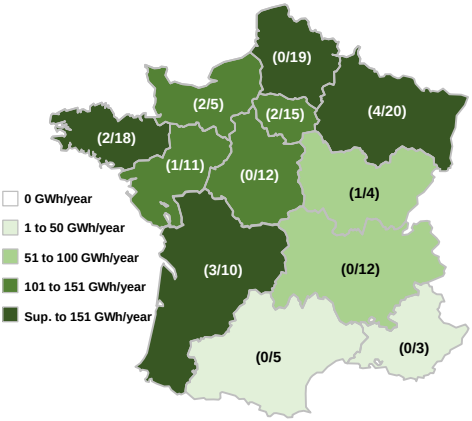
This indicator shows the evolution of biogas production in France since 2006 and the trajectory to follow in order to achieve the PNA 2020 objectives (National Action Plan for renewable energy). This indicator can be correlated with the number of biomethane injection units in France.

Analysis:

Electricity production based on biogas has slowed over the past three years, moving away from the target trajectory in order to achieve the 625 MWe installed capacities objective (and a production of 3,700 GWh). Moreover, heat production continues to get below the target trajectory. The objectives set by the multiannual programming of energy, aiming for a production of 900 ktoe by 2023 seem difficult to reach, unless an accelerated effort of the installation is made on the new production capacities. The number of biomethane units has increased between 2019 and 2020. From now on, there are 117 biomethane injection units. The projects being ever more numerous, heat production is expected to increase in the coming years.

The “Programmation pluriannuelle de l’énergie 2020” sets the objective that biogas should reach 7% of gas consumption by 2030 if the cost reductions targeted in the reference trajectory are achieved, and up to 10% in the event of greater cost reductions.

Biomethane units connected to the gas network in France



(0/0) : (Transport Unit/ Distribution Unit)

Distribution network units

Agricultural effluents : 98

Industrial effluents: 5

Urban waste: 4

Water treatment plants: 17

Non-hazardous waste landfill: 10

Transport network units

Agricultural effluents : 9

Industrial effluents: 5

Urban waste: 1

Source: Open Data Réseaux Energies (2020)

Description:

This map identifies all the biomethane units connected to the gas network in France in June 2020.

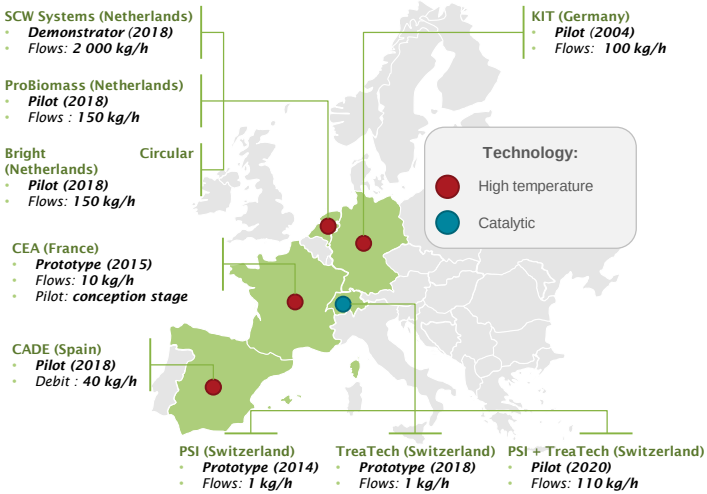
Analysis:

In June 2020, 149 units were injecting biomethane into the French gas network. Projects are mostly connected to the distribution grid, but also increasingly to the transport grid (the choice between both is made according to the Injection law of November 2019. Most facilities are agricultural (72% of injection units), followed by water treatment plants (11%), non-hazardous waste landfill and industrial facilities (7% each).

Even though facilities can have a considerable capacity (118GWh for the biggest one), half of facilities gave a capacity smaller than 14GWh/year (in particular, agricultural sites and water treatment plants tend to have smaller capacities). Eastern and Northern France are the most dynamic territories: Grand-Est and Ile-de-France both have around 4TWh of reserved capacities.

New gases

Evolution of biogas production from hydrothermal gasification in Europe



Source: GRTgaz 2020

Description:

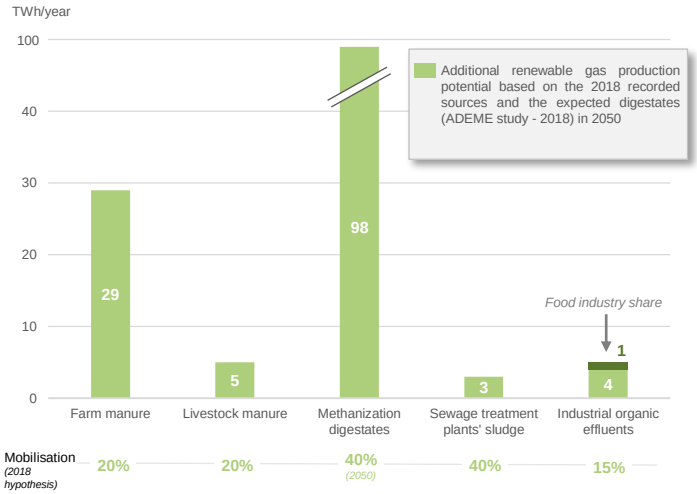
This map represents the situation of developers of hydrothermal gasification technology (high temperature and catalytic) in Europe having reached the stage of prototype, pilot or demonstrator and being able to operate continuously. The industrialization of this technology is expected by 2024/2025.

Analysis:

Hydrothermal gasification is a thermochemical conversion at high pressure (> 221 bar) and high temperature (> 374 ° C) transforming waste and residues of liquid biomass into renewable gas.

Initiated in Europe by KIT in Germany with the 1st pilot installation in the world treating 100 kg / h of input in 2004, several other European players are currently involved in the development of prototype, pilot and demonstrator installations. The Netherlands has the most developers, including SCW Systems, which produced the first demonstrator in the world which succeeded in injecting compliant renewable gas into the local transportation network (Gasunie) at the end of 2019.

Potential for additional production of renewable gas by hydrothermal gasification (Fr)



Source: Hydrothermal Gasification potential, GRTgaz (2019)

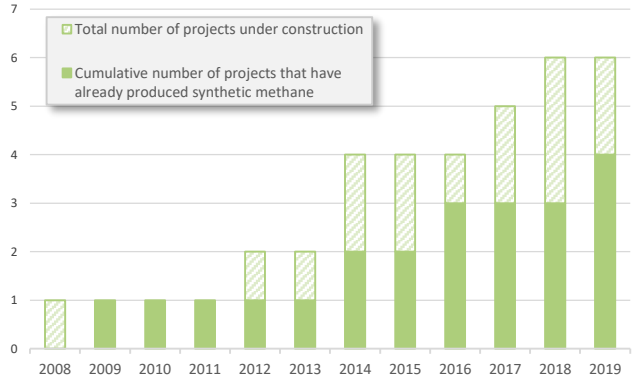
Description :

Despite a relatively low mobilization rates (20 to 40%) of the deposits taken into account in the study, hydrothermal gasification would allow to produce up to 140 TWh / year of renewable gas in addition to other renewable gas sectors (methanisation, pyrogasification…) that can be injected into the gas network by 2050.

Analyse :

Each year 340 million tons of little or poorly recovered liquid biomass residues and waste are generated in France. In addition to the opportunity of hydrothermal gasification to provide a strong reduction of waste generation and a significant production of gas able to be injected into the gas network, the technology allows to preserve water resources and recover mineral salts / nitrogen that can be used as agricultural fertilizers.

Methane production from pyrogasification projects in Europe



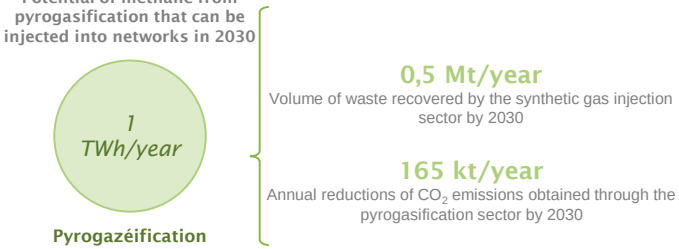
Source: Syngas injection taskforce (2020)

Description:

Pyrogasification is an innovative process for the production of renewable or low-carbon energy, non-intermittent, from dry biomass and / or various residual waste when these cannot be recovered in the form of material. The indicator shows the evolution of synthetic methane production projects in construction phase as well as those that have already produced synthetic methane in Europe, since 2008.

Analysis:

The methane injection sector from pyrogasification is booming with the emergence of pilot units and / or industrial demonstrators in Europe since 2008. Indeed, this upward dynamic of the sector in Europe is currently reflected through two projects under construction, one in France and the other in England. It is important to stress that not only are new projects emerging, but that those launched before also achieve their objective of producing methane (via pyrogasification) that can be injected into the gas network. As an example, we can cite a 20 MWbioCH4 demonstrator which, in 2014, injected biomethane into the Swedish gas network. These various projects and successes constitute a base thus allowing the development of commercial projects in Europe.



Source: *GRTgaz (2020)*

Description:

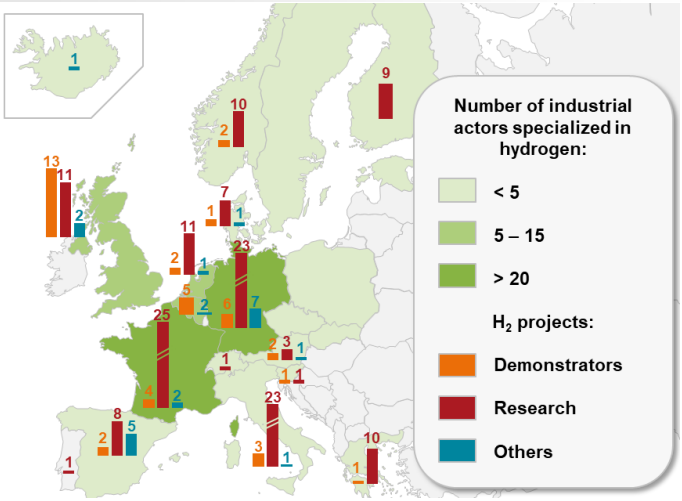
This indicator represents the potential of gas from pyrogasification that could be injected into the natural gas distribution and transport networks by 2030.

Analysis:

Pyrogasification has reached a stage of technological maturity sufficient to launch the first industrial installations in France. It relies on a dynamic French sector, driven by a network of innovative companies and SMEs. It also relies on the waste & environment actors (such as waste management unions, large companies) as well as major French industries, including gas infrastructure operators. By 2030, industry players consider that the injected gas from pyrogasification processes would make it possible to recover almost half a million tons of waste per year and inject 1 TWh/year of gas (and thus reduce CO_2 emissions of ~165,000 tons).
The large-scale development of pyrogasification for injection into networks allows to effectively address the challenge of waste management in the territories, while generating low-carbon energy, with high efficiency (between 70 and 80%), produced locally, storable and transferable, that can be easily switched with natural gas.

New gases

European projects for hydrogen development



Source: Hydrogen Europe (2020)

Description:

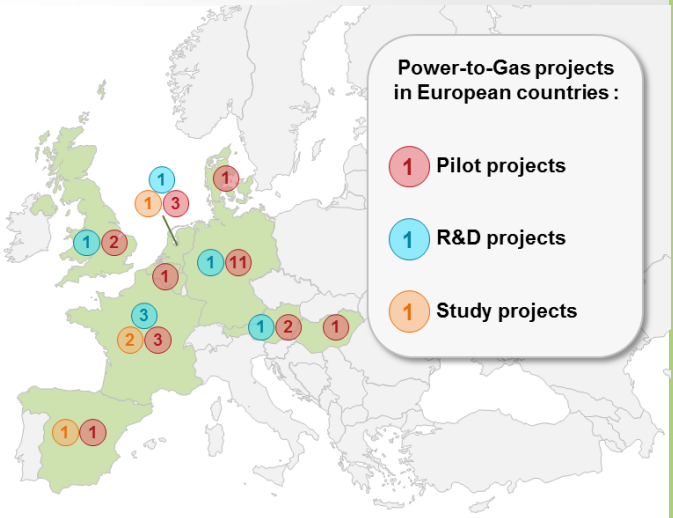
This map represents the number of European projects committed to the development of hydrogen (for industrial use, mobility, energy...). "Others" projects include communication initiatives and economic, social or technical studies favoring hydrogen technologies' deployment.

Analysis:

Currently, hydrogen is mainly used in fertilizers' production or petrochemical / refining processes (87% of global uses). Nevertheless, it is also an energy vector that can foster environmental transition by allowing energy storage, carbon free mobility, green chemistry or the production of synthetic methane.

Germany is the historic leader of hydrogen in Europe with major industrial actors (Daimler, Shell, Linde). However, in September 2020, France announced a huge investments ambition aiming, among other things, to strengthen its industrial sector, already led by international leaders.

Power-to-Gas projects in European countries



Source: EnergyLab study (Sia Partners 2018)

Description:

This map represents European Power-to-Gas (P2G) projects and studies. These projects and studies are either being implemented or already operational.

Pilot projects concern real size plants expected to be used as models for P2G industrialisation. R&D projects concern the development of technologies used for P2G while study projects gather technical, economic and feasibility studies.

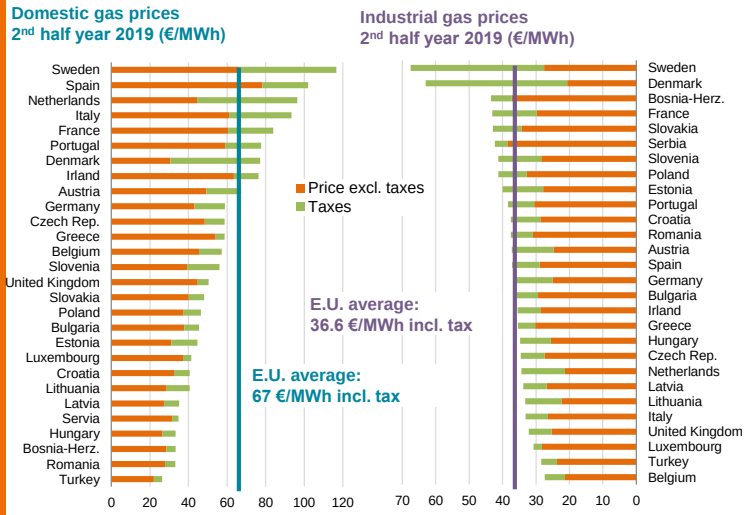
Analysis:

The Power-to-Gas technology is a technology at the junction between electricity and gas networks. It also supports the sustainable mobility development thanks to its complementarity with NGV.

Several European countries have launched pilot projects allowing an optimisation of P2G business models. Such an increasing profitability is progressively attracting specialised SME and public actors. Considering the number of projects and studies, French actors expect to become leaders on this technology, thanks to the support of regional and national initiatives.

Markets

Comparison of gas prices paid by European consumers



Source: Eurostat (2020)

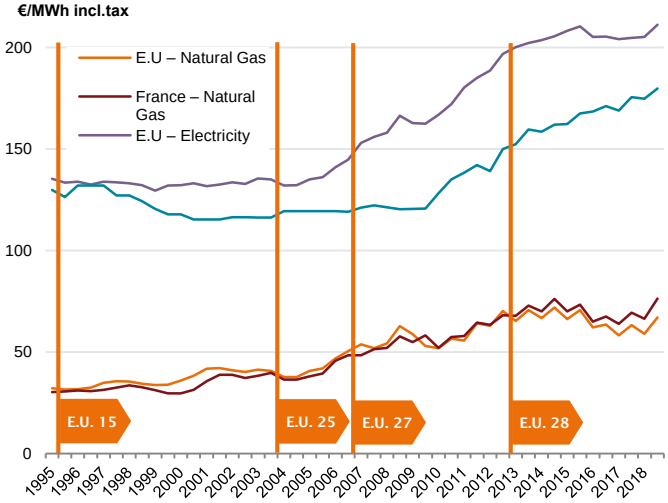
Description:

This benchmark compares prices in the domestic and industrial segments for the countries of the European Union. The prices are based on the average price invoiced at the end of the second semester of 2019 and for each country, the tax component is highlighted. The European average is weighted by volumes consumed in each country.

Analysis:

On average, the price of natural gas in the European Union was 36.6€/MWh for industrial consumers and 67€/MWh for domestic consumers at the end of 2019. On the industrial market, the average price has decreased by 2%, after rising by 11% between 2017 and 2018. In the domestic market, the price does not change much (+1%), after increasing by 5.8% in 2018.

Mainly due to taxation and geographic distance from producing countries, gas prices – tax included – may vary by up to 100% in some E.U. countries on both markets.



Source: Eurostat (2019)

Description:

This chart presents the evolution of prices on the domestic market in France and the EU-28 average, with an electricity/gas comparison.

Analysis:

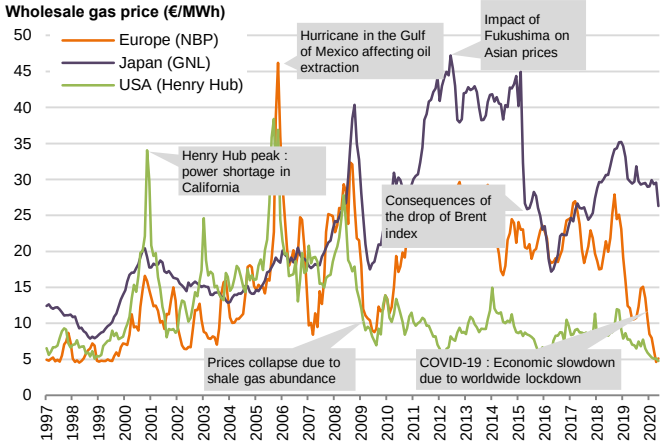
Unlike electricity, the price of natural gas for final household consumers in France follows the European trend.

The domestic price of electricity in France is one of the lowest in Europe because of its historic nuclear power strategy.

The domestic price for the natural gas MWh is lower than the electric MWh, mainly due to the yield differences all along the value chains.

Markets

Evolution of the prices of natural gas in the main market zones



Sources: SDES, World Data Bank, Energy Information Administration (2019)

Definition:

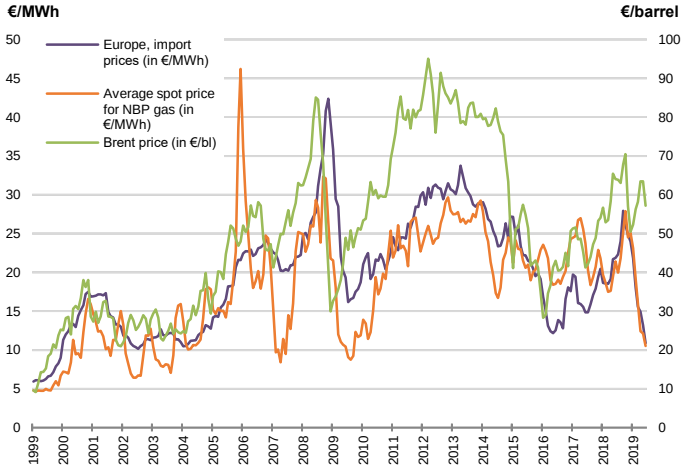
This graph presents the evolution of wholesale prices for the three main market zones: Western Europe, North America and Southeast Asia (including Japan).

Analysis:

Until 2009, general trends in the three zones where mostly in line. In 2009, a real divergence started. On one hand, the price of gas in Asia skyrocketed mainly because of the Fukushima nuclear disaster. On the other hand, the rise of unconventional natural gas exploitation in the United States explains the sustained drop in prices on the American continent since 2008. Under theses circumstances, the spread between these two countries has reached a record level (39.05€/MWh in 2012).

Since 2016, LNG prices in Asia have almost halved. This is due to the indexation of many long-terms contracts on oil prices, which have decreased by 50% in 6 months. Since the beginning of 2016, prices have increased, reflecting the oil barrel's price continuous rise. It can be explained by a re-balance of supply and demand. After an increase, the price of oil on the stock market is now low since October 2018. This is mainly due to an overabundant supply from Russia and the United States. OPEC, which drives down the price of a barrel and consequently the price of gas, the latter being indexed to the price of oil. The global COVID-19 sanitary crises has accelerated this oversupplied trend, causing European and US gas prices to fall and reach historically low levels.

Correlation between gas prices and oil products' prices



Sources: SDES, World Data Bank, Energy Information Administration (2019)

Description:

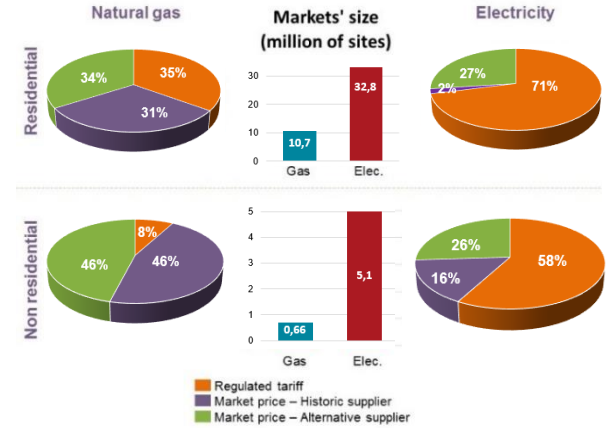
This graph shows the evolution of natural gas prices for long-term supply contracts in Europe (BAFA: import price in Germany), the market price for natural gas on the London stock exchange (NBP Spot) and the price of oil products represented by the Brent index (€/barrel).

Analysis:

This indicator underlines the strong correlation between the prices of natural gas and oil products. The prices of long-term natural gas supply contracts are indexed to the Brent price. The three to six months discrepancy in the long-term contract prices as compared to the Brent price is due to the smoothing of the indexing formulas.

After 3 years of relative stability (between 80 and 90 €/bl), the Brent index dropped drastically: it was halved between June 2014 and January 2015. The weak recovery in Brent prices in early 2016 was reflected in spot gas prices in the second half of 2016. After a rise in Brent oil prices in the first quarter of 2018, the latter has been declining again since the first half of 2019. This is also observed on the spot price of gas.

Gas and electricity markets opening in France



Source: CRE (2020)

Description:

Diagrams and charts above illustrate gas and electricity markets opening rates in France at the end of the 2020 first quarter (considering the number of supplied sites).

Analysis:

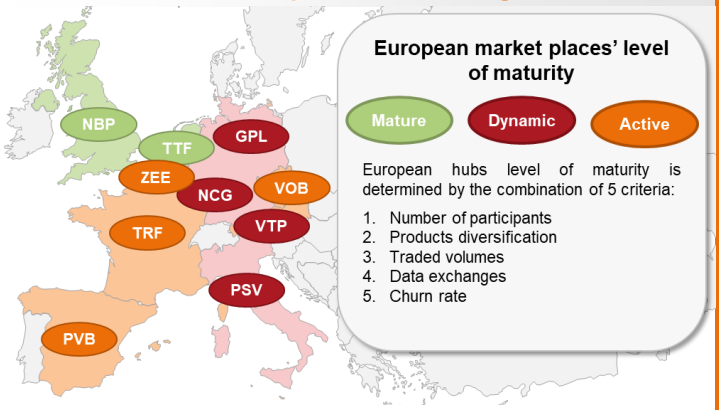
Electricity market and gas market have been opened up since 2004 for businesses and 2007 for households.

The openness rate is significantly higher in the gas market, especially for businesses : 8% of professional consumers are using the regulated tariff.

In 2016, the end of regulated tariffs for professional consumers with a natural gas consumption higher than 30 MWh per year led to a huge switch toward market price contracts established with the historical supplier. This trend had slowed down between 2016 and 2018 benefiting to alternative suppliers. On July the 19th, 2017, the Council of State canceled a decree adopted in 2013 governing regulated tariffs for the sale of natural gas, however the latter would not be effective before 2023.

The growth of alternative suppliers' market share has been even more important within the residential market where new contracts are essentially established with this kind of new suppliers.

Maturity level of the major European marketplaces for natural gas trade



Sources: The Oxford Institute for Energy Studies (July 2020), CRE (2020)

Description:

This map represents the maturity level of the European major marketplaces for natural gas trade.

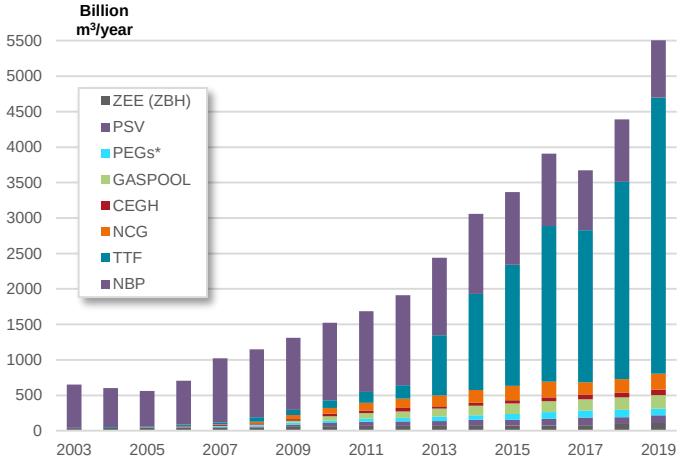
Analysis:

The long-term objective to implement a unique European market for natural gas needs a deeper harmonization of existing marketplaces. The maturity level of these marketplaces can be evaluated considering five drivers: number of participants, products diversification, traded volumes, data exchanges and Churn ratio.

Product diversification (day-ahead contracts, within-day contracts, OTC…) are significantly different from one place compared to another. However, the gap between traded volumes is the main reason to explain why English and Dutch marketplaces are currently considered as the only mature hubs in Europe. The only changes that have taken place over the last two years have been the creation of a unique trading area in France (November 2018) and the creation of a hub in Greece (July 2019). This unique area in France has allowed a unique price, made the market more competitive and increased security of supply.

Markets

Evolution of natural gas traded volumes on European marketplaces



Source: Gas in Focus consolidated data (2020)
** PEG Nord, PEG Sud et PEG TIGF (before 2015)*

Description:

This graph represents the volume of natural gas which is traded on the main European marketplaces. These markets allows the implementation of energy exchanges, which set common « spot » prices for the area.

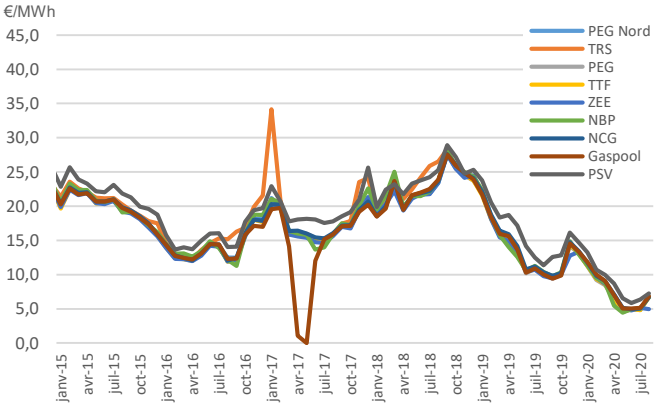
Analysis:

The volumes of gas traded on the various European hubs vary significantly from one country to another, with the most mature markets (United Kingdom and the Netherlands) representing more than 85.4% of the volumes traded in 2019.

Nevertheless at the European scale, the organized markets for natural gas (gas exchange) correspond to a small percentage of the volumes of gas traded on the wholesale market: the over-the-counter (OTC) market still includes the major part of European exchanges.

In France, the marketplace was organized around the Gas Exchange Point (PEG, which became the single TRF marketplace in November 2018) and the energy exchange is operated by Powernext.

Natural gas price evolutions in the main European marketplaces



Source : Data GRTGaz

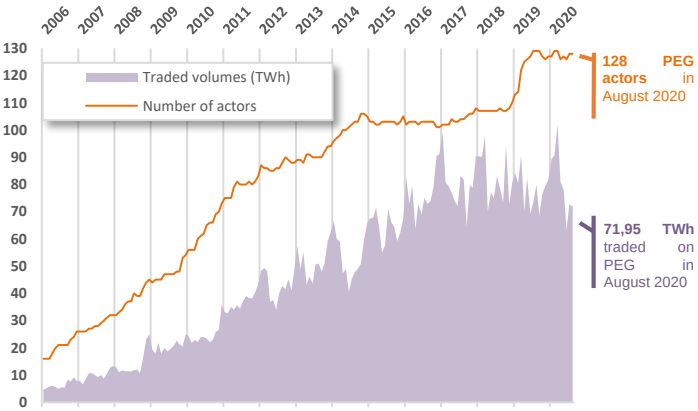
Description :

This chart shows the monthly evolution of gas prices in the main European marketplaces between January 2015 and August 2020. The PEG Nord and the TRS are the former French indicators that merged to become the PEG in November 2018. The TFF is the marketplace of the Netherlands, the EEZ is that of Belgium, the NBP is in the United Kingdom, NCG and Gaspool in Germany while the PSV is the indicator of the Italian market.

Analysis :

Overall, the price of gas in the different European marketplaces is very homogeneous, and evolution trends are correlated: i.e. they do not each evolve independently, they are linked. Nevertheless, two easily identifiable peaks can be observed: the first is a strong increase in the TRS (fusion of the PEG Sud and TIGF) at the end of 2016 due to too low LNG imports in the South of France, a risen price of oil and a temperature drop. The second is a strong fall over a few months in the Gaspool indicator. Finally, since 2018 the price of gas has been falling sharply, which can be explained by the fact that it is indexed to the price of oil, which has undergone the same variations. Initially this fall was caused by overproduction, then it was accentuated by the world coronavirus pandemic which caused a spectacular drop in demand.

Evolution of the « Points d'Échange de Gaz » (PEG) activity in France



Source: GRTgaz (2020)

Description:

This indicator illustrates the evolution of natural gas traded volumes on PEG between 2006 and August 2020. It also shows the number of actors operating on these marketplaces.

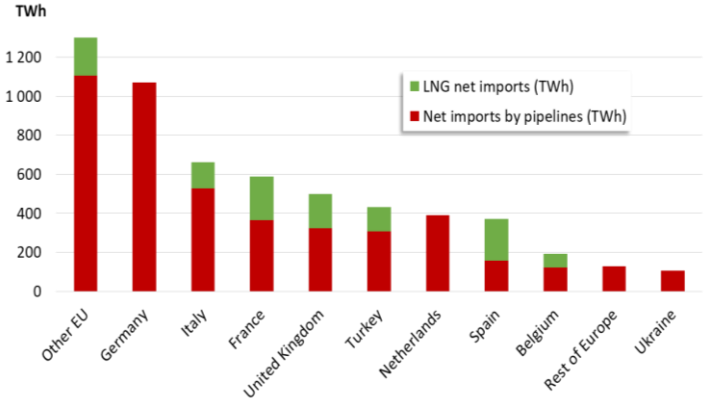
Analysis:

This indicator illustrates the evolution of natural gas traded volumes on PEG between 2006 and August 2020. It also shows the number of actors operating on these marketplaces.

Since 2006, the volumes traded have grown steadily (although marked by a strong seasonality). The number of actors taking part in these exchanges seemed to have reached a certain maturity since the end of 2014, but since the creation of a single trading area in November 2018, more than 20 new players have appeared on the market. This creation of zone has made it possible to increase the attractiveness of the French gas marketplace.

Since the beginning of the year 2020, the volumes of natural gas traded on the marketplaces have been significantly decreased by the global pandemic.

Gross imports of natural gas into Europe



Source: *BP Statistical Review of World Energy (2020)*

Description :

This graph represents European countries natural gas imports in 2019, based on their supply source: whether pipeline or liquefied natural gas (LNG).

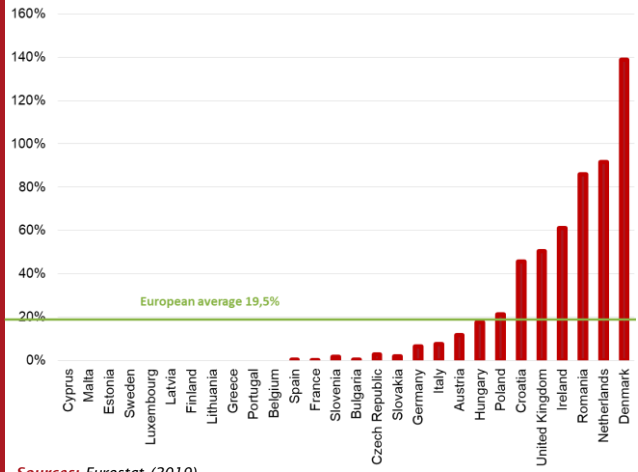
Analysis :

In 2019, European countries imported 5,540 TWh of natural gas, including 886 TWh of LNG (about 20% of their gross imports).

The share of LNG in European imports is 72% higher than in 2018. The IEA forecasts that the proportion of LNG in European imports should rise to 35% by 2030.

Due to their geographical positioning, Spain, France and the United Kingdom have significant regasification capacities that allow for large LNG imports. LNG accounts for 58%, 38% and 35% of their total external supply, respectively. There is a very strong increase in LNG imports in these three countries compared to 2018.

Natural gas and energy independence in Europe



Sources: *Eurostat (2019)*

Description:

Energy independence is defined as the ratio between primary natural gas production and the country's gross domestic consumption. This ratio defines a country's ability to cover its own natural gas needs.

A country whose ratio exceeds 100% is an exporting country : its national production exceeds the gross needs of consumers in the country.

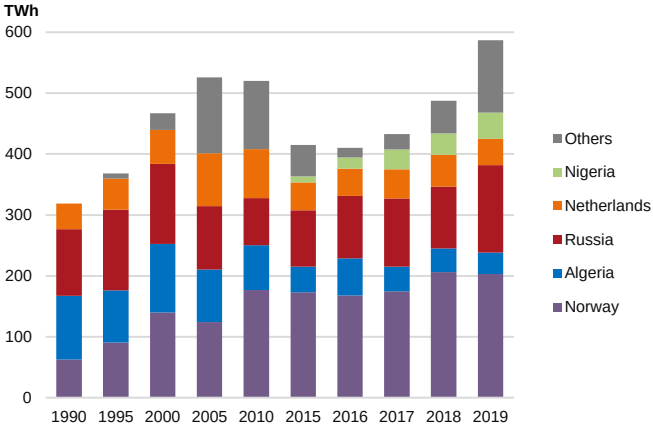
Analysis:

European Union average rate for natural gas supplies independence is around 19,5%.

Only one country is able to export the surplus of its production, it is Denmark. However it has volumes produced in Denmark are limited (5th European producer). This indicator underlines the importance of a diversified supply strategy in Europe to mitigate geopolitical risks threatening supplies.

As an example, in France where natural gas production for commercial purposes stopped in 2013, LNG terminals are expected to strengthen energy security through the diversification of importations.

Sources of natural gas imported in France



Source: SDES, BP Statistical Review of World Energy (June 2020)
Imports from Algeria are a mix of LNG and pipeline supplies

Description :

This chart represents France main suppliers for imported natural gas.
NB : The « Other » category includes, among others, Nigeria until 2015, the US, Egypt, Qatar, Peru, Trinidad and natural gas from the North Sea.

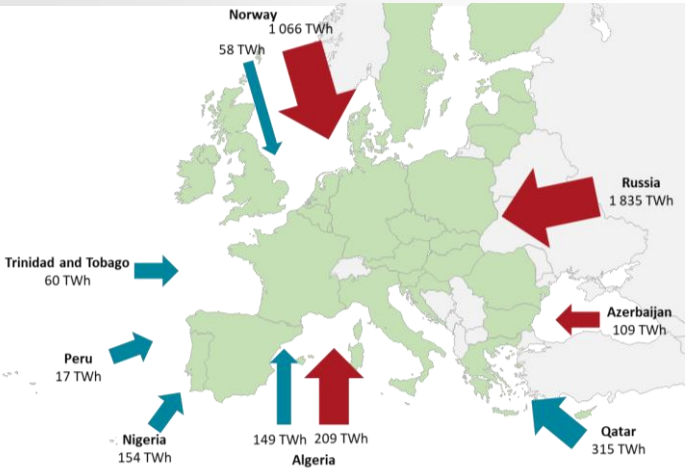
Analysis :

The French portfolio for natural gas supplies is diversified. This strategy aims to secure natural gas supplies. In 2019, imports have increased by 20%.

Representing 35% of gross imports, Norway is the main supplier for France. Imports from Russia have raised by 41% in 2019, the country is the second supplier in France.

LNG terminals' development has been strengthening the position of new exporting countries such as Nigeria, Qatar, Trinidad and Tobago

European Union natural gas main imports



Sources: *BP Statistical Review of World Energy (2020)*

Description:

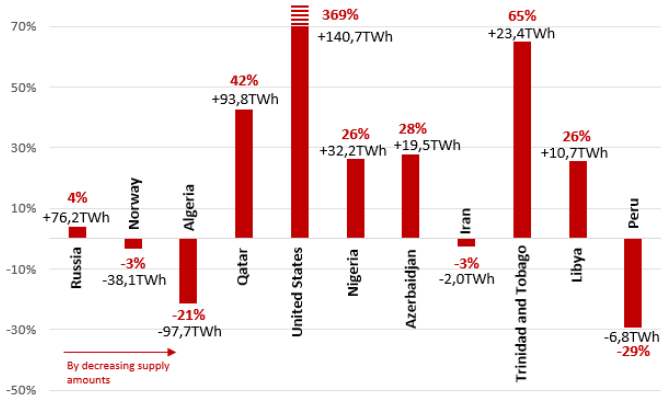
This map represents the EU-27's main natural gas imports flows based on their origin country in 2019. Blue arrows represent LNG flows, the red ones represent pipeline flows.

Analysis:

The European Union has adopted a diversification strategy for its natural gas supplies. This strategy is key to reduce its dependency toward exporting countries.

However, Russia and Norway remain Europe's main suppliers of natural gas, accounting for 32% and 20% of all its imports.

Evolution of the sources of gas supplied to the EU-28 in 2019 vs 2018



Source: *BP Statistical Review 2020 and 2019*

Description :

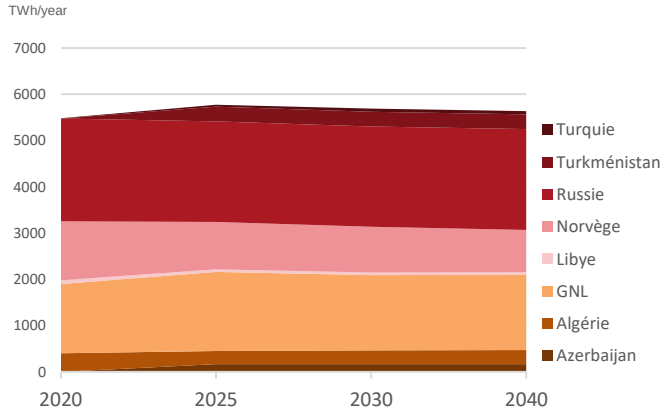
This graph presents the evolution of the sources of natural gas exported to the EU-28 between 2018 and 2019 (main producing countries).

Analysis :

European strategy of diversifying supplies led the EU-28 to seek new sources of natural gas. This year was marked by an important increase of LNG imports from the United States (+369%), they are now the 5th biggest importer of natural gas in the European Union. Imports via pipelines from Russia increase by 4% in 2019. Between 2018 and 2019, imports from Russia, Qatar, Norway, the United States, Nigeria, Azerbaijan, Trinidad and Tobago and Libya increased. while those from Norway, Algeria, Iran and Peru decreased. Imports from Peru represent the most important decrease (-30%). It will be interesting to look at the impact of the global lockdown due to the world sanitary on these imports.

Supply

European supply capacities forecasts up to 2040



Sources: *TYNDP 2020, ENTSOG/ENTSOE*

Description:

This graph represents ENTSOG's forecasts for European supply capacities of natural gas up until 2040. LNG supplies do not differentiate the exporting countries. Algerian supplies are mixed (LNG and pipeline supplies).

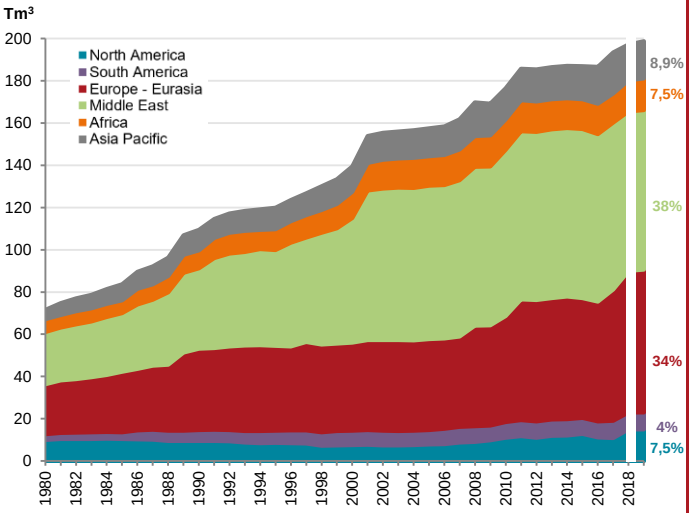
Analysis:

During the next 20 years, natural gas in Europe will mainly be supplied by Norway, Russia and through Liquefied Natural Gas (LNG) importations. The proportions of these three import sources depends on market fluctuations and adaptation to the production of low-carbon gas. European natural gas production (around 1,000TWh / year - not shown on this graph) should decrease with the end of production in the Netherlands scheduled for 2023 and the gradual depletion of Norwegian and British reserves.

Expectations to LNG are very important in European energy strategies because it allows a wide diversification of supplies' sources.

New infrastructures also contribute to a diversification of land supply routes by gas pipeline, as is the case with Azerbaijan or the future pipeline from Russia, Nord Stream II.

Evolution of conventional natural gas reserves



Source: BP Statistical Review 2020

Description:

Proven reserves are the quantities of known conventional natural gas deposits (see the Glossary), which, according to geological data and current technological progress, have a high probability of being exploitable in the future under existing technical and economic conditions.

Analysis:

Conventional gas reserves are large, with estimates continuing to change as new exploration or extraction techniques are developed.

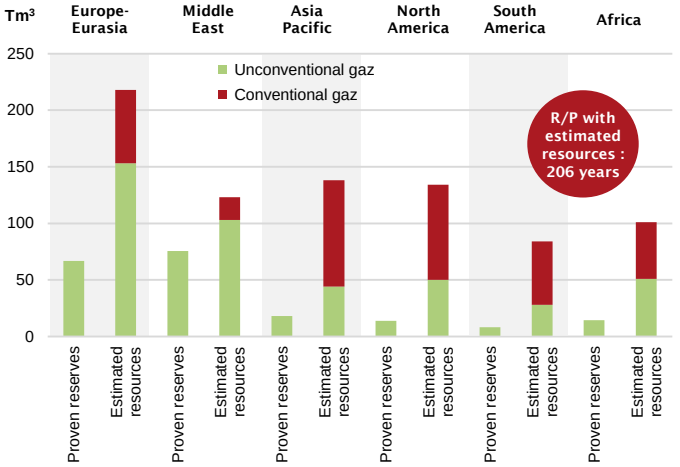
Resources are relatively well distributed across the world. Today, Russia, Qatar and Iran share close to 48% of the proven reserves.

Figures have been stable since 2011, with new discoveries (for example in North America) offsetting global consumption of older reserves.

A number of analysts believes that a major share of conventional natural gas is still to be discovered.

Supply

Global natural gas reserves (conventional and unconventional)



Sources: *World Energy Outlook, IEA 2019*

Description:

The Reserves-to-Production (R/P) ratio in years represents the availability of a non-renewable resource under current technical and economic conditions.

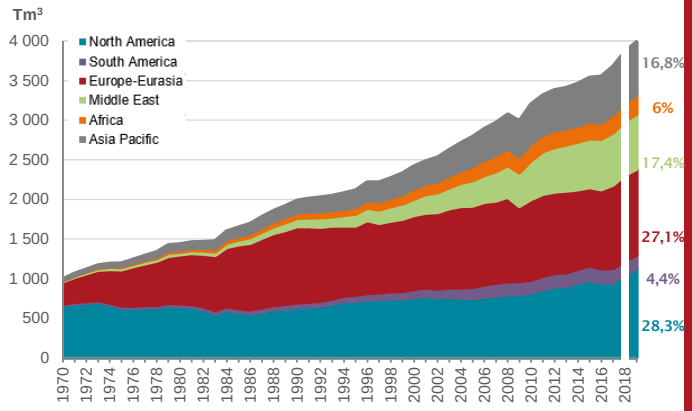
Estimated reserves cover unconventional natural gas deposits (see the Glossary), but also conventional natural gas deposits that are inoperable today with existing technologies.

Analysis:

Unconventional gas represents more than half of estimated resources, in particular in the United States where the sector has allowed the country to reduce its energy dependency rate.

It can also be noticed that the reserves in Asia Pacific and Europe-Eurasia, are thought to be larger than the North American reserves.

The R/P ratio is approximately 57 years, taking proven resources into account only. With estimated resources, the total climbs up to 206 years.



Source: *BP Statistical Review (2020)*

Description:

This graph illustrates the production of natural gas in thousands of billions of cubic meters (both conventional and unconventional).

Analysis:

Global production of natural gas has been rising constantly over the past 40 years. It was multiplied by 4 between 1970 and 2019.

In 2019, the largest worldwide producers were the United States and Russia, with respective shares of 23% and 17% of global production. Iran (6%), China and Qatar (4.5% each) follow. Global production growth is 3,4% between 2018-2019, driven especially by the American production (+7%). The EU (-6%) is still on a decreasing trend.

Two thirds of the global production takes place in 8 countries.

Glossary

Annual Benchmark Consumption ("CAR"): Annual benchmark consumption indicated by the Transmission or Distribution System Operator.

Energy content: The quantity of energy, expressed in MWh, contained in a given quantity of gas and determined on the basis of the Gross Calorific Value of the gas.

Gas B: A gas whose Gross Calorific Value falls between 9.5 and 10.5 kWh HCV/m^3 (n) and the Wobbe index between 11.8 and 13.0 kWh HCV/m^3 (n), i.e. 42.5 and 46,8 MJ/m^3 (n).

Gas H: A gas whose Gross Calorific Value falls between 10.7 and 12.8 kWh HCV/m^3 (n) and the Wobbe index between 13.4 and 15.7 kWh HCV/m^3 (n), i.e. 48.25 and 56.5 MJ/m^3 (n).

Conventional gas: Gas referred to as "conventional" migrated from the source rock to accumulate in an area where the rock is sufficiently porous and permeable, and covered by a watertight layer of rock that prevents the gas from continuing to migrate to the surface.

Unconventional gas: Unconventional gas is a natural gas that has been trapped in rock that is not very permeable and difficult to access. The extraction of this gas requires specific methods.

Kilowatt-hour (kWh): Unit in which the quantities of energy are expressed as defined in ISO 6976.

Distribution Pricing Option: The price for transmission over the distribution network, as set by regulations. For information, there are three options that do not require a subscription (T1, T2 and T3) and two with subscriptions (T4 and TP, referred to as the "proximity price").

Consumption point ("PDC"): The point in a Distribution or Transmission Network at which the Transmission or Distribution System Operator delivers the gas to a customer. It bears the number allocated by the Transmission or Distribution System Operator.

Point d'Échange de Gaz ("PEG"): A virtual point related to a Transmission System's Balancing Zone in which quantities of gas may be traded between suppliers who have entered into a transmission contract with the Transmission System Operator.

Transmission Distribution Interface Point ("PITD"): Point from which a Distribution System Operator transmits the gas pursuant to a Distribution Transmission Contract. Unless expressly stated otherwise, this refers to the upstream bridle of the Delivery Station between the Transmission Network and the Distribution Network.

Gross Calorific Value (or GCV): The quantity of heat in kWh produced by the full combustion of one (1) Nm^3 of Gas at 0 degrees Celsius and an absolute pressure of 1.01325 bars, with excess air at the same temperature and pressure as the gas, once the product of the combustion has been cooled to 0 degrees Celsius and the water provided by the combustion has been condensed to liquid state, the product of the combustion containing the same total mass of water vapour as the gas and air prior to combustion.

Distribution Network: All works, facilities and systems operated by or under the responsibility of a Distribution System Operator based on which the Distribution System Operator provides the service that is the subject of the Distribution Contract.

Transmission Network: All works, facilities and systems operated by or under the responsibility of a Transmission System Operator based on which the Transmission System Operator provides the service that is the subject of a Transmission Contract.

Season: Summer period that corresponds to the following months: April, May, June, July, August, September, October; the Winter Period corresponds to the following months: November, December, January, February, March.

Balancing Zone: all entry and exit points of a Transmission Network in which a supplier who has entered into a Transmission Contract with the Transmission System Operator must provide a balance as defined by the rules of the relevant Network's Operator.

Sources

ADEME: "Agence de l'Environnement et de la Maîtrise de l'Énergie" (environment and energy agency)

IEA: International Energy Agency

BP: British Petroleum

CRE: "Commission de Régulation de l'Énergie" (French energy regulating commission)

ENTSOG: European Network of Transmission System Operators for Gas

EurObserv'ER: "Observatoire des Énergies Renouvelables" (renewable energy observatory)

Eurostat: European Commission's statistical office

GIE: Gas Infrastructure Europe

GIIGNL: The International Group of Liquefied Natural Gas Importers

GRTgaz: Natural gas transmission system operator in France

GSE: Gas Storage Europe

GTG2007: "Groupe de Travail Gaz 2007" (2007 working group on gas)

IGU: International Gas Union

INSEE: "Institut National de la Statistique et des Études Économiques" (national institute for statistics and economic studies)

MEDDTL: French Ministry of Ecology, Sustainable Development, Transport and Housing

SDES: "Service de la Donnée et des Etudes Statistiques" (observation and statistics department)

SPEGNN: "Syndicat Professionnel des Entreprises Gazières Non Nationalisées" (non-nationalised gas companies union)

TEREGA: Natural gas transmission system operator in France (ex TIGF)

	1 Kwh	1 GJ	1 Therm	1 MBTU	1 m^3 of natural gas	1 boe	1 toe
1 Kwh	1	0,0036	0,0341	0,0034	0,0949	0,00059	0,000086
1 GJ	277,8	1	9,48	0,948	26,35	0,1634	0,0239
1 Therm	29,3	0,10551	1	0,1	2,78	0,0172	0,0025
1 Million of BTU (MBTU)	293,1	1,06	10	1	27,81	0,1724	0,0252
1 m^3 of natural gas	10,54	0,038	0,36	0,036	1	0,0062	0,0009
1 barrel of oil equivalent (boe)	1700,0	6,12	58,01	5,80	161,29	1	0,15
1 tonne of oil equivalent (toe)	11630	41,87	397	39,7	1103	6,8	1

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GRTgaz builds, operates and develops France's high-pressure natural gas transmission network which covers most of the country. GRTgaz delivers the natural gas provided by its customers to consumption points directly connected to the transmission system: the public distribution networks to supply households, communities and companies, large industrial consumers and power stations that use the natural gas to produce electricity. With over 32,000 km of gas pipelines and 28 compressor stations, GRTgaz is constantly investing to transport natural gas under the best safety and fluidity conditions, and to improve security of supply by providing access to evermore diversified sources.

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