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An unfolding energy crisis in Europe

Can Europe evade an outright crisis?

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Summary

- The EU has adopted a plan to reduce gas demand significantly in a bid to get through the winter without acute gas shortages
- The plan was watered down however, removing the solidarity clause for some member states
- Consequently, it cannot be ruled out that some countries, most likely Germany and Italy, will still face a shortage
- The upside potential of LNG imports is limited due to constraints from the supply and demand side. Switching to other fuels may offer some relief, but will not suffice bridging the shortage for every country
- In the instance of a shortage they might have to resort to gas rationing for parts of industry. The most likely candidates are the non-metallic minerals sector and the paper & printing

A matter of time?

It is no secret anymore: Russia has weaponized gas exports to the EU. As a result, prices have skyrocketed and fears of gas shortages this winter can no longer be dismissed as doom mongering. In this special we will (i) briefly outline the latest events and then (ii) dive into whether an energy shortage is likely to happen, before moving on to (iii) what industrial sectors are at risk of being shut down in case of actual energy shortages.

Russia to keep squeezing gas supplies

Step by step, Russia has been cutting off gas supplies to individual energy suppliers and entire countries over the past several months. Russian gas exports to Finland, the Netherlands, Bulgaria, Denmark and Poland have been halted completely. Cited reasons for the disruptions vary, with supply to some parties having been halted over unwillingness to pay for gas in roubles -as Russia has been requesting since April-, while supply to others has been reduced due to supposed maintenance issues at the key Nord Stream 1 pipeline (NS1, annual capacity of 55 bcm). But in reality, Russia is clearly using Europe's dependence on its gas supplies as an economic weapon.

Initially, policymakers, analysts and markets sighed in relief when the NS1 pipeline reopened after maintenance in July. Yet soon it became clear that flows only resumed at 40% of capacity, before dropping to a mere 20% just one week later. According to Russia they intend to honour their contractual obligations, but the excuses keep piling up. Russia states it cannot scale up gas supplies as it lacks a NS1 turbine that has been stranded in Germany after it was sent for repairs in Canada. According to Germany, the turbine is ready to be sent to Russia, but the latter says it lacks certain "documentation".

In our view, gas flows through the NS1 pipeline are unlikely to return to full capacity, in fact, they might even be further reduced, even if the turbine is being send to Russia. Yet, we don't expect Russia to shut off its gas supplies entirely. Geopolitically and economically this is Putin's optimal strategy. This way, Putin can i) tinker with the gas flows to create a maximum level of chaos and unpredictability; ii) still use halting gas exports as a geopolitical threat; and iii) still make a pretty profit along the way (as prices are being kept high at a certain volume).

Europe tries to prepare for winter

In response, the EU has also adopted legislation requiring EU underground gas storage to be filled to 80% of capacity by 1 November 2022. Thanks to aggressive buying (and certainly not due to a surplus of supply), member states have been able to fill their underground storages to around 73%, despite the fact that storages were extremely low at the start of the year (figure 1). But it will be difficult (and costly) to continue to fill storage at this pace.

Consequently, both the International Energy Agency (IEA) and the European Commission (EC) issued a warning. The IEA's chief stated that Europe must immediately start to prepare for a complete severance of Russian gas, whilst the European Commission presented the report 'Save gas for a safe winter', which includes guidelines on how member states can best curb gas usage.

On July 26 member states agreed on the proposal, albeit in a watered-down form. Energy ministers pledged to aim for a 15% reduction in gas use between August 2022 and March 2023 (compared to their average consumption during that period in the past five years) on a voluntary basis. This target could be made binding, but that comes with a long list of opt-outs. Exemptions are included:

- for (i) islands such as Cyprus, but also the Iberian Peninsula, which are not directly or only partially connected to the European energy grid;
- countries that are heavily reliant on gas for electricity production or gas as a feedstock for industry;
- countries that have overshot their gas storage targets;
- and for countries that can show that their export capacities are used to re-direct gas to other member states to the fullest.

Moreover, the European Council, i.e. member states, rather than the European Commission, decides if and when reduction targets will be made binding.

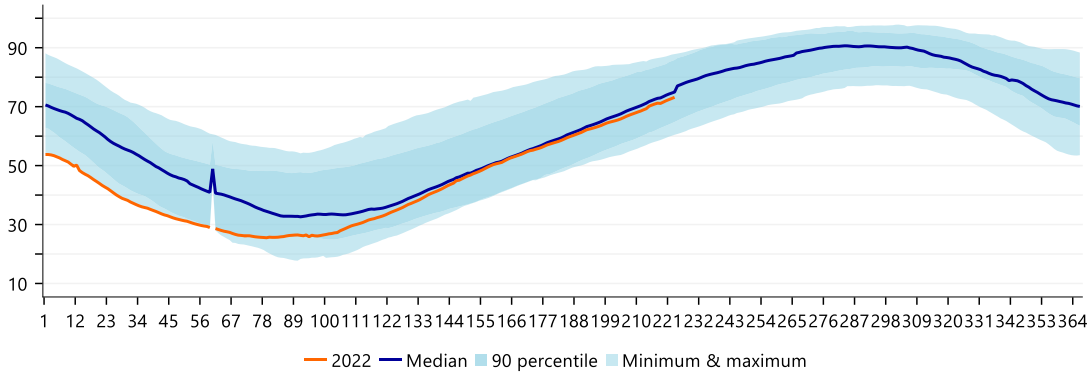
Is an energy deficit likely to happen?

Before the European Council triggers a so-called 'Union alert', which makes the gas reduction targets obligatory, there should be a 'substantial risk of a severe gas shortage or an exceptionally high gas demand'. So what are the odds of an actual gas shortage?

Storage levels are catching up with historical averages

The current amount of European gas inventories is in line with the historical average at this time of the year (figure 1), and on track to meet Europe's target of being 80% filled by November. At first sight this is clearly good news, but there are a few reasons to be cautious.

Figure 1: European gas inventories are still adequately filled for this time of year

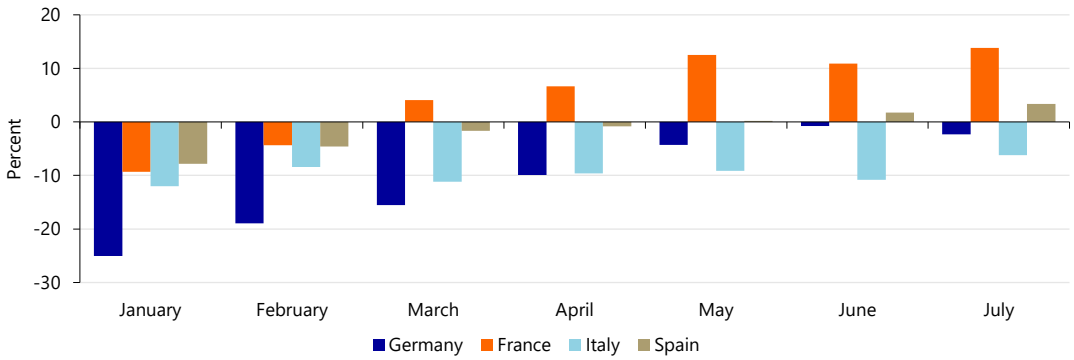


Source: Macrobond, Eurostat

For one, this European total masks differences among member states. France, for example, has managed to frontload stocking, while Germany and Italy are still somewhat behind the curve (figure 2). This matters because a lack of infrastructure does not allow gas be easily redistributed between all European countries (see below). Secondly, while storage tanks have filled up quite well over the past months, there is no guarantee that countries can continue to stock up. The most important pipeline for Germany, Nord Stream 1, currently operates at just 20% capacity (11bcm annually), which covers only 12% of Germany's annual consumption. Italy is also receiving less gas than its demand. And Russia could still reduce or completely stop gas supplies.

Finally, higher natural gas imports from Norway and LNG imports from the US and Qatar have helped cover the Russian shortages. It is unclear to what extent these larger import volumes can persist, particularly for LNG. Exporters of LNG are operating close to full capacity and part of these additional LNG imports were achieved by outbidding Asian customers, who reduced demand due to Covid restrictions. That Asian demand will likely come back at some point and could even accelerate.

Figure 2: European storage was underfilled for most countries, but countries are catching up



Source: Eurostat

How quickly will gas storages be depleted?

Over the past couple of months member states have substantially reduced their reliance on Russian gas. Still, a halt of Russian gas deliveries in the short run would have a significant impact on gas availability in the four largest member states.

We have made three projections of monthly gas storage levels. Taking the current storage levels as a starting point, combined with the supply[1] excluding imports from Russia and expected monthly gas consumption[2]. This scenario (blue in figure 3) indicates that Germany would be in a dire situation if Russia were to cut off its gas supply entirely. But the picture for Italy isn't pretty either, even though the size of its projected shortages are more manageable. As expected, Spain and France, which are not nearly as reliant on gas, and Russian gas in particular, are more resilient.

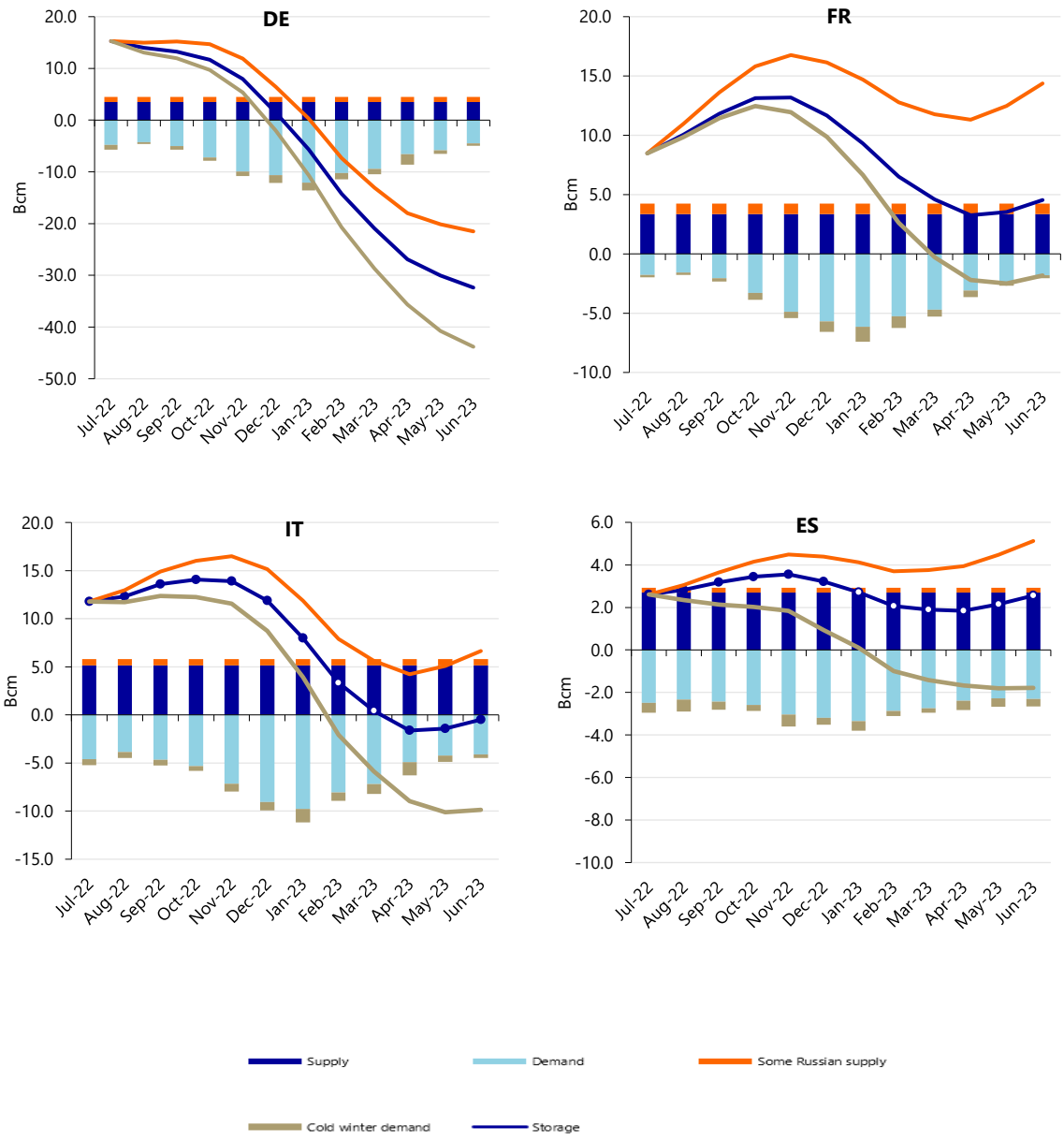
But even if Russia maintains its gas supplies at current levels, Germany would still face gas shortages. In this somewhat more benign scenario (orange), we instead assume that gas supplies are maintained at their current pace, Holding expected demand equal, only Italy would be out of the woods, while Germany is still projected to use more gas than it has available to it. Conversely, in the event of a very cold winter even France and Spain would run out of gas. For this scenario (brown) we assume that the coming winter would be equal to the coldest in the past decade, adding to gas demand.

[1] Supply of gas is defined as total imports + domestic production – (re-)exports

[2] Consumption is based on the average consumption per month over the past eight years, adjusted for economic growth

These scenarios illustrate that there is a real risk of gas shortages in the Eurozone either this winter or in spring. Moreover, even if certain countries can prevent shortages domestically, they would still suffer an economic blow if industries in other countries have to shut down due to a lack of gas. And finally, this year storages have still been filled with a lot of Russian gas. This means that even if countries get through this winter with limited to no Russian gas, a large amount of alternative supply needs to be found to refill near-empty inventories ahead of the next winter. Hence, the need to save gas is real.

Figure 3: Gas storage for European member states[3]



[3] Because of the existence of intra-European gas contracts the ultimate exposure to sudden halt in Russian gas is not as clear cut as sketched in Figure 3. For example, if a French party has a contract for gas delivery from a German energy supplier, who in turn gets gas from Gazprom, it could be the German party that is exposed to a halt in Russian gas, since whatever the circumstances it has to deliver gas to their French customer. Yet if the German supplier could claim a force majeure -and stop delivering gas- or go bankrupt because it has to replace cheap

Nuclear crunch in France

Although, at face value, France appears to be out of the woods, the opposite is actually true. EDF, the state-owned utility company, is currently operating only 26 out of its 57 nuclear reactors. A number of reactors is undergoing maintenance after the discovery of cracked pipes. At the same time, some reactors are shut down because of a lack of cooling water, since water levels in French rivers have become dangerously low. Even though EDF has indicated they will restart at least some of their reactors before winter, prices for forward baseload power contracts have surged, now trading nearly 1,000% above their 2010-2020 average.

Given the fact that nuclear reactors account for roughly 70% of French power generation, this is a serious problem. EDF has already had to buy power from the UK to meet daily demand in the summer. In winter time, demand for power can almost double during peak hours, especially when the temperature drops. It is in Europe's and France's interest to resolve these issues before the start of winter.

The government has already taken a first step to solve the problem and announced that they will nationalize EDF at the cost of EUR 10bn in September. This should ensure that the debt-laden company has sufficient funds to continue to operate. However, there has not been any communication regarding the next step, although time is pressing.

Alternative extra-EU gas imports

In the analysis above, we have assumed that domestic production and non-Russian gas imports will not change. Domestic production cannot be increased easily due to a lack of gas fields, start-up times or a lack of political will. In Italy it has been suggested to double domestic production to about 6.5 bcm per year, but no conclusions have been reached yet.

However, there is some upside potential with regards to alternative imports[4]. The Norwegian government, for example, has promised to increase delivery to the EU by some 10 bcm this year – which is already in our data as extra flows have already started– and the country intends to increase gas production to raise exports to the EU over the coming years. There is huge potential but investments are required, it is no quick fix, and this supply is not guaranteed to come online given objections from climate activists and certain political parties. So while the pipeline between Norway and Germany has a spare capacity of some 9 bcm annually, this can only be used in the short term if flows originally intended for other countries (such as UK) are diverted to Germany.

Meanwhile, Italy has signed a purchase agreement with Algeria for some additional 4bcm this year and an additional 9bcm next year. Azerbaijan is expected to deliver an additional 2bcm of natural gas before year end and Egypt some additional 3bcm of LNG. All together this might just prevent a gas shortage from materializing if Russian supply were to come to a standstill. However, there is still plenty of uncertainty regarding extra supplies. Algeria's promise is especially uncertain given production constraints, political instability and increasing domestic demand. Plus, Algeria has made some deals with African parties, although these are unlikely to increase supply in the short run.

Finally, the upward potential of LNG is limited due to supply and demand constraints. Starting with the latter, LNG terminals in northern Europe do not have much more spare capacity. Germany has no LNG terminals at all and import terminals in France, Belgium and the Netherlands

Russian gas with expensive gas at the spot market, the French buyer is -also- exposed. Despite this note, we believe the graphs give a good overview of the pain thresholds.

[4] Sources: Several European government websites.

have already been working at more than nameplate capacity to process the massive increase in LNG imports in the first half of the year (we will come back to the Netherlands below). This cannot easily be solved by the south. Italian terminals can still process a few more bcm in the second half of the year –hence the deal with Egypt– but that puts those terminals at full capacity as well. And although Portugal and Spain still have the capacity for an additional 10bcm through year end, the limited interconnectedness of Europe's gas infrastructure restricts redistribution across the continent – and particularly to Germany, which will probably face the biggest shortage.

Plans to construct new terminals (e.g. in Germany and Italy) will not be finalised in time for winter, although they could lessen the pressure further down the road. That hinges on other countries' export capacity, though. And this supply may be limited.

We have assumed that the increased LNG supply from the US and Qatar will continue. However, an estimated 10 to 15bcm of the additional 25bcm LNG imports in the first six months was originally meant for Asia, where demand dropped due to Covid-related restrictions. It's probably fair to assume that this situation will continue in the coming six months, but Asian demand is likely to come back on after that. Moreover, due to the fire at the Texas Freeport facility, Europe could well miss out on some 6bcm of LNG in the remainder of the year.

On the bright side, US export capacity is set to increase by 25bcm by the end of 2022 and another 25bcm by 2025. Nonetheless, the increase in global LNG demand is set to outpace the increase in supply over the coming years, so alleviation at this front should not be expected. So, while LNG imports will likely hold up over the winter, we see limited potential for a structural increase.

Altogether, even though there is some potential upside to supply, the infrastructure is lacking to get sizeable amounts of (liquified) gas to the right countries in the short run.

Down with demand!

A direct way to avert a gas crisis would be to "simply" reduce demand. Luckily, higher gas prices have that effect on consumers and businesses, but this may not be enough to fill the gap between supply and demand. The European Commission urges member states to reduce gas demand by at least 15% from August 2022 to March 2023 (that includes substitution effects) and has published a number of suggestions as to how member states can achieve this. These range from obvious measures, such as heating buildings to a lower temperature and using the AC less often, to more sophisticated measures, such as contract swaps between industrial consumers, allowing production to be carried out in less-affected regions in case of large shortages.

By the end of September member states are required to hand in an updated version of existing national emergency plans, including planned demand-reduction measures. There will probably be some extra focus on the German and Italian plans. Both countries have to cut demand by a hefty portion in order to compensate for a halt in Russian gas exports. In the worst case scenario Germany would have to cut gas consumption by 38% to avoid a shortage, whilst Italy would have to cut gas consumption by around 5%.

Comeback coal?

Germany, the Netherlands, Austria and France indicated that they may increase coal-fired power generation in the event of a gas crisis, even if it clearly isn't in line with European emission targets and the commitment to phase out coal by 2030. Coal won't be able to fill the gap left by gas, though. According to Ember, a climate think tank, there are just a couple of coal-fired plants on standby. Running on 65% capacity throughout 2023 these plants would generate roughly 60TWh of electricity, increasing the EU's power generation capacity by just 1.5% or enough to power the EU for one week.

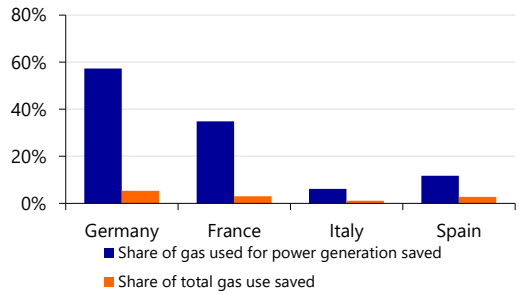
Even though a sizable part of the natural gas that is currently earmarked for electricity production can be replaced by coal (figure 4), we estimate that switching on the coal powered plants will only reduce total gas demand by a few percent. France mainly relies on nuclear energy for electricity production, and the share of natural gas in electricity production is relatively low in Germany too (figure 5). Plus, the low water levels in European rivers, particularly the Rhine, are hindering the transportation of coal from mines to power plants. But in times of crisis, every bit counts.

Other alternatives

Germany could replace some of its natural gas consumption by nuclear power as well. It is currently revisiting the idea of phasing out 4 gigawatts of nuclear power, which equates to roughly 3bcm of natural gas. Whilst the government rejected the idea of extending the life of these reactors at the start of the war, it is now up for discussion again. Talks are that the Greens (who historically fiercely object to the notion of nuclear power) are willing prioritize practical considerations above ideology.

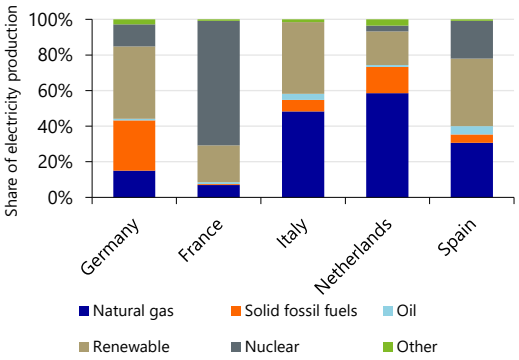
Additionally, companies could choose to switch from using natural gas to using gasoline or oil. While this could alleviate some of the pressure on natural gas reserves, it is no easy fix for the situation. A sizeable share of oil and gasoline comes (or used to come) from Russia and prices have risen substantially as well, since Russian oil (products) have been placed on the EU's boycott list. Moreover, these fuels are highly polluting, which is at odds with the green ambitions of Europe.

Figure 4: There is some potential in firing up coal plants



Source: Eurostat, RaboResearch

Figure 5: Some countries can save gas by switching to coal for producing electricity



Source: Eurostat

Redistributing European gas towards deficit countries

In the event of a shortage in any specific country, member states with surplus gas inventories may be able to export some of their surplus storage. This, however, is highly dependent on the available infrastructure. The easiest way to transfer surplus natural gas is through existing pipelines. The Netherlands, for example, could still export up to 17bcm in natural gas to Germany on an annual basis. For now, it does not look like the Netherlands will actually have that big of a surplus (let alone the political will to part with strategic buffers), but if the Netherlands were to ramp up natural gas production in Slochteren (which peaked at an annual production of more than 50bcm a few years back, but is now only producing around 4.5bcm), it could help out its neighbour in need. After a number of local earthquakes, which can be traced back to gas production in the region, it is unlikely that such a decision will be taken lightly however. The Netherlands is also expanding the capacity of LNG terminals by an amount equal to 12bcm of natural gas, which could be transported to Germany through these pipelines as well.

Extreme times call for extreme measures

But what if the demand reduction and alternative power sources fall short of the reduction targets? As noted above, if an individual country runs out of gas, other member states may be able to provide (limited) support. But what if there is an overall shortage in Europe and countries have to fend for themselves?

Criteria for rationing

In this scenario member states could resort to the extreme case of gas rationing. Critical services and industries would be prioritized in this case, but **industries that are gas intensive, produce non-essential goods and operate in relatively simple value chains, could be shut down** (figure 6). The EC has not mentioned any specific industries, although rumour has it that the glass and ceramic industry and parts of the chemical industry are on the short list. Based on the abovementioned criteria we can make an educated guess as to which industries are most likely to be shut down in the event of an emergency.

Figure 6: Priorities for saving gas

Source: European Commission

Which industries are most gas intensive?

Industries can consume gas directly, either for i) heating (e.g. blast furnaces) or ii) in chemical processes, and iii) indirectly (for example by using electricity that is generated by a natural gas plant). It takes time to, or is impossible, to switch from natural gas to alternative sources for heating, and it is simply impossible substitute natural gas for some chemical processes. So the only way that an industry can save gas is through its indirect consumption. But for that, industries are fully dependent on power plants.

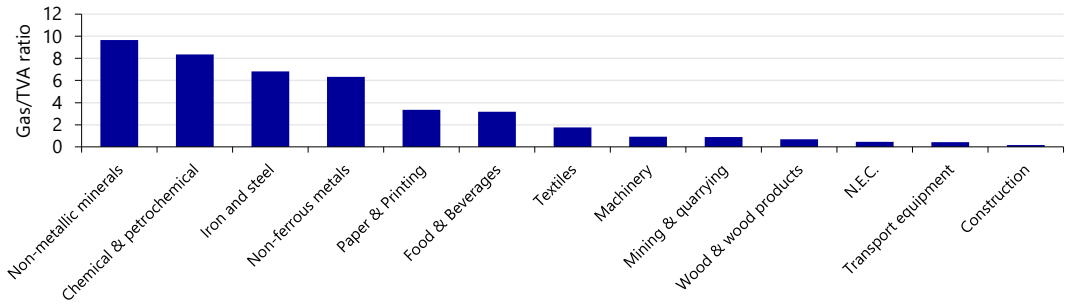
Looking at the natural gas consumption per industrial sector adjusted for the sectors' value added (figure 7), the subsector non-metallic minerals (which includes the manufacturing of glass, ceramics and concrete amongst others), tops the charts. In this sector natural gas is mostly used to heat furnaces, and it is therefore hard to save gas by switching to alternatives. It will take (some) time to transform gas furnaces to electric, oil or coal powered furnaces after all. Another sector that stands out is the chemical & petrochemical sector, which relies on natural gas both for heating and primarily for non-energy uses. This sector uses a lot of natural gas for non-energy uses; the production of fertilizers and methanol require natural gas for example. For this industrial subsector it will be relatively hard to switch to alternatives.

However, countries could choose to lower production of these goods. Given the fact that the EU27 is a net importer of nitrogenous fertilizers, it would have to find new trading partners to replace some of the lost production. Large net exporters are Russia (obviously not an option), China (unlikely to provide relief) and Canada. It is quite unlikely that Europe will be able to significantly reduce fertilizer production and replace it with imports however. Especially given the fact that Europe also needs to find alternative sources for the fertilizers that it used to import from

Russia. Trade data from June indicates that Europe was able to replace just 28% of lost Russian fertilizer imports by imports from alternative sources.

Likewise, countries could choose to import iron and steel, certain chemicals and non-ferrous metals instead of producing them.

Figure 7: There are large difference between industries when it comes to gas usage



Source: Eurostat, RaboResearch

Which industries are relatively stand-alone?

Next to their gas intensity, the interconnectedness of industries should also be considered. Whilst the basic metals sector might be one of the biggest consumers of natural gas relative to its value added, some of its products are key inputs for a number of different industries. So shutting down that sector without having additional imports to replace the domestic production, might be a bad idea.

In order to quantify the interconnectedness of these industries, we made a *network analysis* based on the input-output tables for the European industry. A relative score between 0 and 1 is assigned to each sector in the economy using eigenvector centrality. This score is based on the connection that each sector has with other parts of the economy and how important these other parts of the economy are, with 0 being the least connected and 1 being the most connected sector. For example, a sector would have a higher score when it has close connections to the wholesale and retail trade sector (a sector that is very interconnected with most parts of the economy) compared to a sector that is closely connected with the air transport sector (a sector that is relatively stand-alone).

In Figure 8 we have summarized the relative scores for manufacturing subsectors in Germany, France, Italy and Spain. A relatively large share of the German economy relies on orders from the motor vehicle industry –i.e. delivers inputs to that sector–, so the motor vehicle industry is unsurprisingly the most "central" manufacturing sector in Germany. Meanwhile, the textile industry is much more central to the Italian economy, than it is to the German economy. Once again, this does not come as a surprise, since the textile industry is much larger in Italy in a relative sense. That said, the food sector is by far the most central sector in Italy and even more so in Spain.

Overall, wood and cork products; computer, electronic and optical products; and the textile industry (except for Italy) are all relatively stand-alone. The computer, electronic and optical product sector might seem somewhat counterintuitive (their output is used in a wide range of products after all), but we do have to take into account that these sectors are relatively small in Europe and we import most of these critical inputs from Asia – even if there is a strategic ambition on a European level to change this.

Sectors such as paper & printing, non-metallic mineral products, and furniture rank somewhere in the middle, but compared the whole economy, they still score pretty low.

Admittedly, due to a lack of data availability, some sectors presented in Figure 7 group the production of a broad range of products. This could lead to over- or underestimation of the interconnectedness of some specific production within these sectors. Still, we believe it gives a good overview of sector interconnectedness. Moreover, if specific parts of a sector should require specific treatment, policymakers could always chose for opt-outs.

Figure 8: Eigenvector centrality for the European manufacturing sector

	Germany	*France*	*Italy*	*Spain*
Manufacture of motor vehicles, trailers and semi-trailers	0.84	0.04	0.14	0.18
Manufacture of machinery and equipment n.e.c.	0.37	0.03	0.27	0.06
Manufacture of food products	0.24	0.16	0.50	1.00
Manufacture of fabricated metal products, except machinery	0.24	0.05	0.24	0.13
Manufacture of basic metals	0.15	0.02	0.13	0.11
Manufacture of rubber and plastics products	0.15	0.03	0.11	0.09
Manufacture of chemicals and chemical products	0.15	0.05	0.11	0.16
Manufacture of electrical equipment	0.12	0.01	0.08	0.06
Manufacture of furniture, other manufacturing, repair and installation	0.11	0.05	0.14	0.07
Manufacture of other non-metallic mineral products	0.10	0.04	0.09	0.11
Manufacture of paper and printing products	0.09	0.04	0.10	0.09
Manufacture of computer, electronic and optical products	0.08	0.02	0.04	0.01
Manufacture of coke and refined petroleum products	0.07	0.02	0.08	0.07
Manufacture of basic pharmaceutical products	0.06	0.02	0.05	0.04
Manufacture of other transport equipment	0.04	0.04	0.06	0.04
Manufacture of wood and products of wood and cork	0.03	0.01	0.04	0.03
Manufacture of textiles	0.02	0.01	0.18	0.05

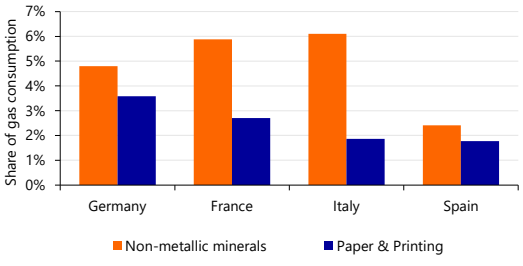
Source: Rabobank

Which industries are most likely to be shut off in case of a shortfall?

Putting everything together we note that i) for most member states it is unlikely that they will face an acute gas shortage, except for Germany and Italy ii) the most gas intensive industries are non-metallic minerals, the (petro-)chemical industry, the iron and steel industry and the non-ferrous metal industry. Since some of these industries provide essential goods, and it is hard to replace those goods by imports from abroad, this analysis suggests that shutting down the non-metallic mineral industry, or the paper & printing industry, probably has the lowest overall impact, whilst still reducing gas demand by a significant percentage.

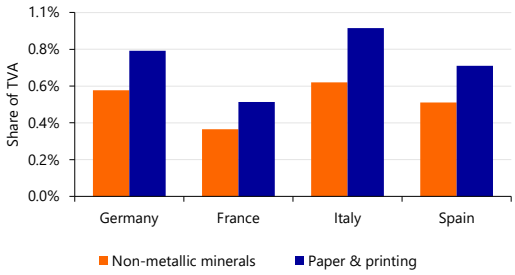
Whilst this should be a last resort, It would save a considerable amount of gas though (figure 9), which might be necessary to ensure that consumers and vital sectors are protected. Shutting down (a part) of these industries will be painful nonetheless (figure 10).

Figure 9: Shutting down industries would save a lot of natural gas



Source: Eurostat

Figure 6: … But it would certainly be painful



Source: Eurostat

Conclusion

The situation looks pretty grim for Europe. It is quite unlikely that Germany will be able to avoid a shortage without some drastic cuts to demand for gas. Some of this demand reduction will be voluntary –high prices for natural gas will simply make it uneconomical for some companies to produce– whilst some of it may be forced. European solidarity, either through supplying natural gas, or goods, such as nitrogenous fertilizers, that require a lot of gas to produce, would certainly help to soften the blow, but it is all but certain that the European economy will face some hardship this winter.

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