



Quarterly Gas Review

Analysis of Prices and Recent Events

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Thanks to Argus Media, we updated our “LNG tightness” metric that measures the spread between the US Gulf Coast LNG FOB and the Henry Hub price. It is interesting to keep track of this ‘LNG tightness’ in a fast-changing energy world. Since December 2018, with global spare capacity increasing for the first time in the last 3 years, we are witnessing a sharp decrease in the indicator. We even achieved, in Q2 2019, sub-4.5\$/Mbtu for Asian spot LNG prices. Low LNG spot prices in Asia coupled with strong Brent prices are creating issues for end-users used to procuring forward cargo linked to oil prices. It is highly possible that with such a huge disparity between term and spot pricing, Asian buyers will be forced to do what European utilities did back in 2009-2013: renegotiate long-term contracts away from oil-indexation. This would further strengthen the JKM index as the LNG index, just as TTF became the reference index in Europe. A period of oversupply leads normally to behavioural changes to adapt to a new business model and the LNG market should not be an exception.

Nevertheless, the low level of our ‘LNG tightness’ indicator suggests that investors are worried about adequate returns and will carefully select the right projects to invest in. This explains why since our last Quarterly Gas Review, no project has taken a Final Investment Decision (FID).

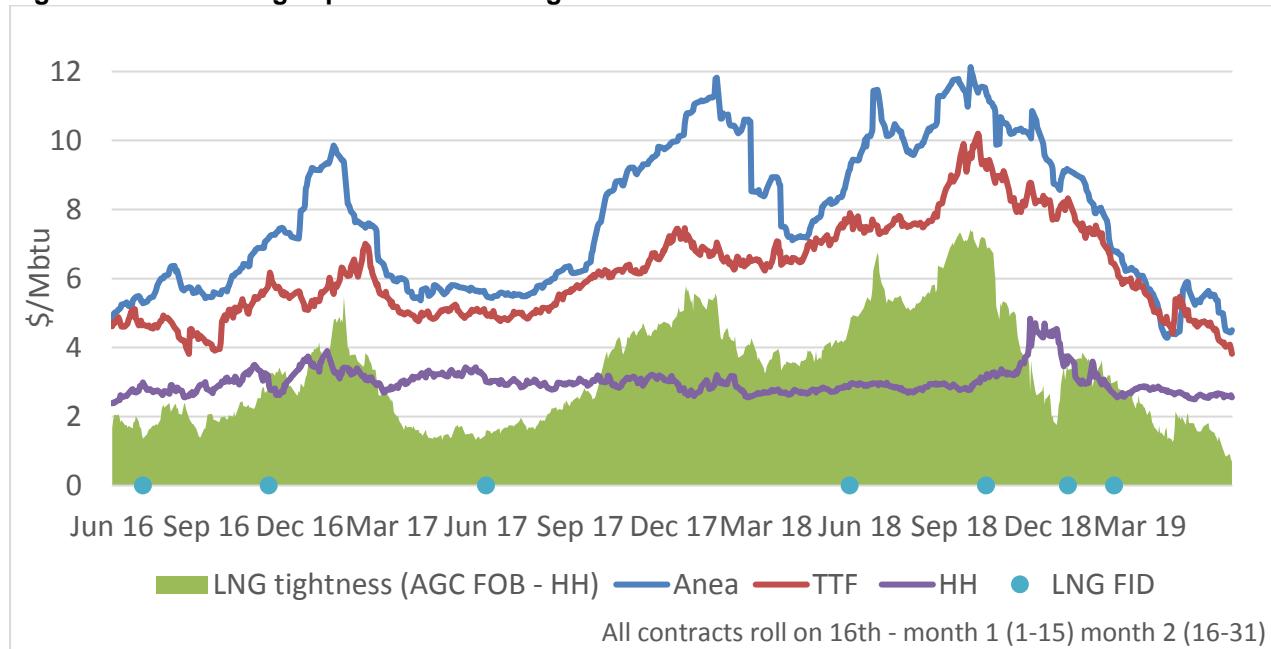
With the aim of checking if Continental Europe can become the global world energy storage operator (via LNG reloads), we have designed with Argus Media a ‘Global added value for European storage’ indicator by starting to measure the maximum LNG net back in NWE – maximum of (TTF + reload costs and NBP + reload costs) on an historical basis and using future curves. On the historical side we also added the effective monthly LNG reloads. We started in January 2017 and decided to extend the data for 6 months into the future to give us an idea of what kind of reloads we can expect in the coming months. In short, European storage has an added worldwide value if our ‘Global added value for European storage’ is positive. This is also indirectly linked to EU security of supply. A security of supply issue in Europe would increase TTF and NBP prices, making reloads uneconomical before new supplies were attracted.

Analysis of Prices and Recent Events

Our ‘LNG tightness’ indicator¹ graph designed with the kind assistance of Argus Media shows:

- TTF Month Ahead (Netherlands) which reflects hub pricing in Europe for both pipeline gas and LNG
- HH Month Ahead (US) which reflects pipeline gas pricing in North America
- ANEA Month Ahead which reflects DES LNG spot pricing in Northeast Asia as assessed by Argus
- The AGC² LNG FOB – HH spread, labelled ‘LNG tightness’: a low spread would suggest a close alignment of worldwide prices (due to higher US prices or increased global competition) while a high spread would suggest that LNG needs to be attracted to demand centres in Asia, Europe, Latin America or the Middle East. A prolonged high spread could also be indicative of the need to invest in new liquefaction capacity. This spread shows the sensitivity of the LNG market
- To better monitor when Final Investment Decisions (FIDs) are taken for LNG projects we also add them.³

Figure 1: Worldwide gas prices and LNG tightness



Source: Argus Media, thierrybros.com

Since December 2018 with global spare capacity increasing for the first time in the last 3 years,⁴ we are witnessing a sharp decrease of our “LNG tightness” indicator. This relaxed market even managed to push Asian spot prices below European prices, something never before seen in our graph, where data starts in June 2016, thus leading to a record arrival of LNG cargoes in Europe in April 2019. With Anea and TTF traded on two different supply-demand balances, the Asian Premium, as seen also in oil decades ago, could

¹ T. Bros, March 2018 available at <https://www.oxfordenergy.org/publications/quarterly-gas-review-analysis-prices-recent-events/>

² Since August 2018, Argus has renamed its US Gulf Coast LNG FOB to Argus Gulf Coast LNG FOB (AGC LNG FOB) to better distinguish the Argus physical price assessment from calculated values of Gulf Coast LNG.

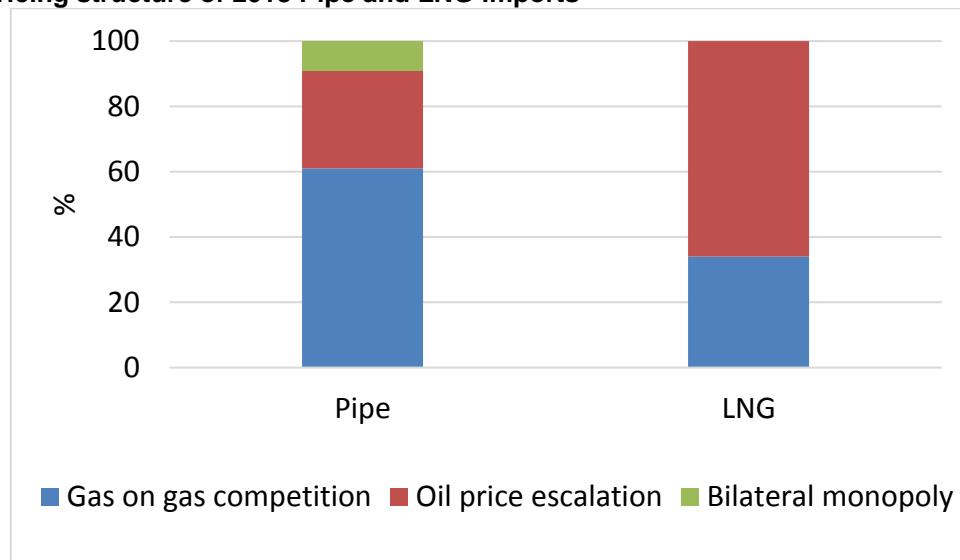
³ For detailed information please refer to Quarterly Gas Review – Issue 2 by T. Bros, June 2018 available at <https://www.oxfordenergy.org/publications/quarterly-gas-review-analysis-prices-recent-events-issue-2/>

⁴ For detailed analysis please refer to Quarterly Gas Review – Issue 5 by T. Bros, March 2019 available at <https://www.oxfordenergy.org/publications/quarterly-gas-review-issue-5/>

become old fashioned. The premium should now be wherever the supply is the tightest and the two markets could finally become completely separated. The post-Fukushima disaster that led to increased prices in Europe where spare production capacity was ample just because Asian prices were moving up didn't make much sense then and could only be explained by markets not being mature enough. This is now changing and the new normal could be to expect a volatile Anea-TTF spread, thus reinforcing the optionality value of spot LNG.

Asian spot LNG prices even fell below 4.5\$/Mbtu in Q2 2019. Low LNG spot prices in Asia coupled with strong Brent prices are creating issues for end-users used to procuring forward cargo linked to oil prices. It is highly possible that with such a huge disparity between term and spot, Asian buyers will be forced to do what European utilities did back in 2009-2013: renegotiate long-term contracts away from oil-indexation. Coupled with the arrival of trading houses⁵ like Gunvor, Trafigura and Vitol on the LNG market, this would further strengthen the JKM as the LNG index⁶ just as TTF became the reference index in Europe back then. In LNG, gas-on-gas competition increased in 2018 vs 2017 from 28 to 34% and this trend should accelerate in the coming years. We expect LNG to be sold more or less with the same mechanisms as pipeline imports as they compete in more and more consuming countries.

Figure 2: Pricing structure of 2018 Pipe and LNG imports



Source: IGU, thierrybros.com

A period of oversupply leads normally to behavioural changes to adapt to a new business model and the LNG market should not be an exception. The high spread between oil-indexation and spot prices, highlights the issue of managing price risk. The stark divergence of oil and LNG spot prices will soon present a challenge for market participants keen on signing or renewing term contracts based on oil prices. It is therefore strange to see that in a world where LNG supply is growing and where pure spot trading

⁵ In the 1970s, the trading houses broke away from long-term contracts by bringing liquidity into the oil market. In 2018, these 3 houses accounted for almost 9% of the LNG trade according to Bloomberg. Gunvor became the biggest independent LNG trader last year after delivering about 11 mt, a 60% jump from 2017. Vitol saw its LNG business grow to 7.8 mt in 2018, up from just 3 mt two years earlier.

⁶ Please refer for detailed analysis to Patrick Heather and Thierry Bros work in Quarterly Gas Review – Issue 5, March 2019 available at <https://www.oxfordenergy.org/publications/quarterly-gas-review-issue-5/>



represented 25% of global LNG trade in 2018,⁷ some recent deals are still linked to oil⁸ or even coal.⁹ The remaining questions would be how will sellers, and in particular the Australian sellers that have high costs, try to fight this change, as this could severely negatively impact the profitability of their high-capex projects, and who will be the laggards on the buyers' side, as they will be hit the hardest.

As part of the Trump administration's effort to drive Iran's exports to zero, the end of sanctions waivers for countries importing oil from Iran was announced on 22 April. This pushed Brent to a record level in 2019 and the Brent-indexed LNG price to above 10\$/Mbtu, double the spot price level. This wide price spread between long-term contract and spot is unsustainable and should create maximum pressure to renegotiate contracts as the market is well supplied. With JKM liquidity increasing, we believe that our annual churn ratio analysis provided with Patrick Heather will show a marked change for 2019 compared with 2018.¹⁰

It is interesting to point out that even if our 'LNG tightness' indicator reached sub 2\$/Mbtu, it has never been low and/or long enough to shut in production anywhere. We have therefore not yet seen a price war between LNG and pipeline gas, in particular in Europe, thanks to huge EU storage capacity (see part 2 of this paper for more on the collaboration between storage and supply).

But with the actual level of our 'LNG tightness' indicators, investors are worried about making adequate returns in future and will carefully select the right projects to invest in. This explains why since our last Quarterly Gas Review, in March 2019, no project has taken FID. Nevertheless, after the 15.6 mtpa Golden Pass FID in February 2019, we still expect another c.60 mtpa of FIDs in the remainder of 2019 to balance growing demand post-2023.

FID will not be taken on 4 mega trains (33 mtpa) in Qatar before 2020 as tenders for Engineering, Procurement and Construction (EPC) will only be awarded in January and February 2020;¹¹ this leaves more room for US, Mozambique and Russian competitors to take FID on their own projects this year.

Another unintended consequence of low TTF prices could be reduced capex in the North Sea, leading to an accelerated decline of European domestic supply in the years to come.

Consequences of the US Permian battle

On 12 April, Chevron announced agreement to acquire Anadarko¹² allowing the buyer to "gain another world-class resource base in Mozambique to support growing LNG demand." On 24 April, Occidental set forth the terms of a superior proposal by Occidental to acquire Anadarko for \$57bn¹³ forcing Anadarko to resume negotiations with Occidental.¹⁴ On 5 May, Occidental agreed to the contingent sale of Anadarko African assets to Total for \$8.8bn.¹⁵ On 9 May, Anadarko agreed to be acquired by Occidental.¹⁶ On 13 May, Anadarko announced that it had sealed another sale and purchase agreement from its Mozambique LNG project (two initial LNG trains with a total nameplate capacity of 12.9 mtpa) bringing the total long-term agreements to 11.1 mtpa¹⁷ (86% of capacity). Anadarko reiterated that its target was to announce FID for this project on 18 June 2019, even if it would soon be operated by Total.

⁷ GIIGNL 2019 report

⁸ NextDecade to sell 2 mtpa to Shell <https://investors.next-decade.com/news-releases/news-release-details/nextdecade-and-shell-execute-2-mtpa-20-year-lng-sale-and>

⁹ Shell to sell 0.5mtpa to Tokyo Gas https://www.tokyo-gas.co.jp/Press_e/20190405-01e.pdf

¹⁰ Please refer for detailed analysis to Patrick Heather and Thierry Bros work in Quarterly Gas Review – Issue 5, March 2019 available at <https://www.oxfordenergy.org/publications/quarterly-gas-review-issue-5/>

¹¹ 15 April and 7 May Press releases available at <https://qp.com.qa/en/MediaCentre/Pages/ViewNews.aspx?NType=News>

¹² <https://www.chevron.com/stories/chevron-announces-agreement-to-acquire-anadarko>

¹³ <https://www.oxy.com/News/Pages/Article.aspx?Article=6055.html>

¹⁴ <http://investors.anadarko.com/2019-04-29-Anadarko-Intends-To-Resume-Negotiations-With-Occidental>

¹⁵ <https://www.oxy.com/News/Pages/Article.aspx?Article=6070.html>

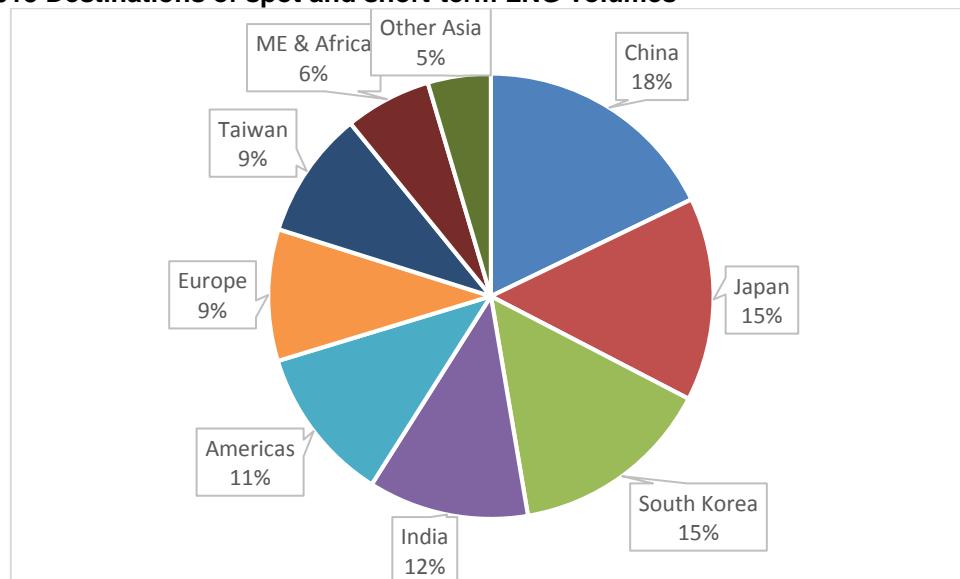
¹⁶ <http://investors.anadarko.com/2019-05-09-Anadarko-Agrees-To-Be-Acquired-By-Occidental>

¹⁷ <http://investors.anadarko.com/2019-05-13-Anadarko-Announces-LNG-Sale-and-Purchase-Agreement-with-JERA-And-CPC-Corporation-Taiwan>

The main prize however was not Mozambique LNG, but Anadarko US assets based in the Permian. This Permian battle is a testimony that oil companies view the US as the best growth opportunity in oil as sanctions squeeze supplies from Iran and Venezuela. This was also the rationale behind Devon focusing on “high-return US oil growth business”.¹⁸ But with this shale oil growth comes more associated shale gas. With gas prices negative in this area, the industry will have to build infrastructure (pipes and liquefaction plants) to boost apparent demand by exporting more US LNG.

In the on-going trade war, in May 2019, the US imposed further tariff hikes on Chinese goods. In retaliation, China increased tariffs on US LNG imports from the 10% that was implemented in September 2018 to 25% from 1 June. China is the fastest growing LNG market and should soon become the largest LNG importer and is already the biggest spot and short-term buyer of LNG since 2018.

Figure 3: 2018 Destinations of spot and short-term LNG volumes



Source: GIIGNL, thierrybros.com

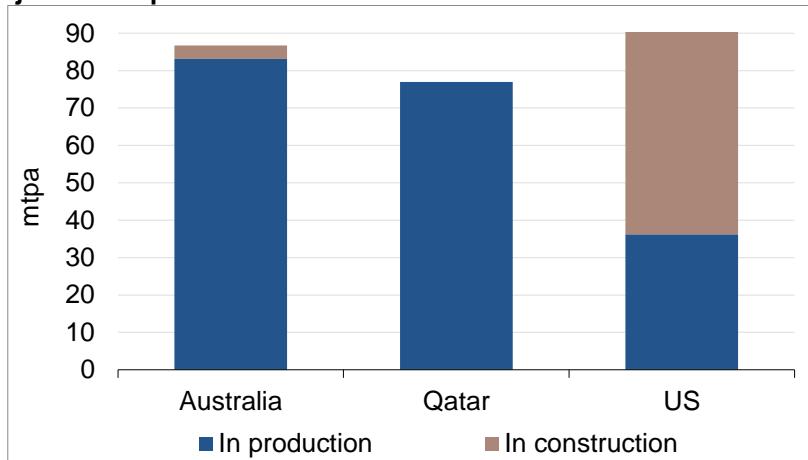
In May, Sempra Energy began production at its 4 mtpa train 1 at Cameron LNG, Louisiana.¹⁹ This is the fourth such US project to begin operations since 2016, when the US was looking at new demand for gas from its shale gas revolution.

Australia is now the largest worldwide LNG producer and should keep its leading position for the next few years. But contrary to Qatar and the US, over-investment in Australian liquefaction capacity relative to effective gas reserves, has pushed domestic gas prices up, leading to government intervention.

¹⁸ <https://www.devonenergy.com/news/2019/Devon-Energy-Announces-Strategic-Exit-of-Canadian-Business-for-CAD-38-Billion>

¹⁹ <http://investor.sempra.com/news-releases/news-release-details/cameron-lng-begins-production-train-1-liquefaction-export>

Figure 4: The 3 major LNG exporters in 2020

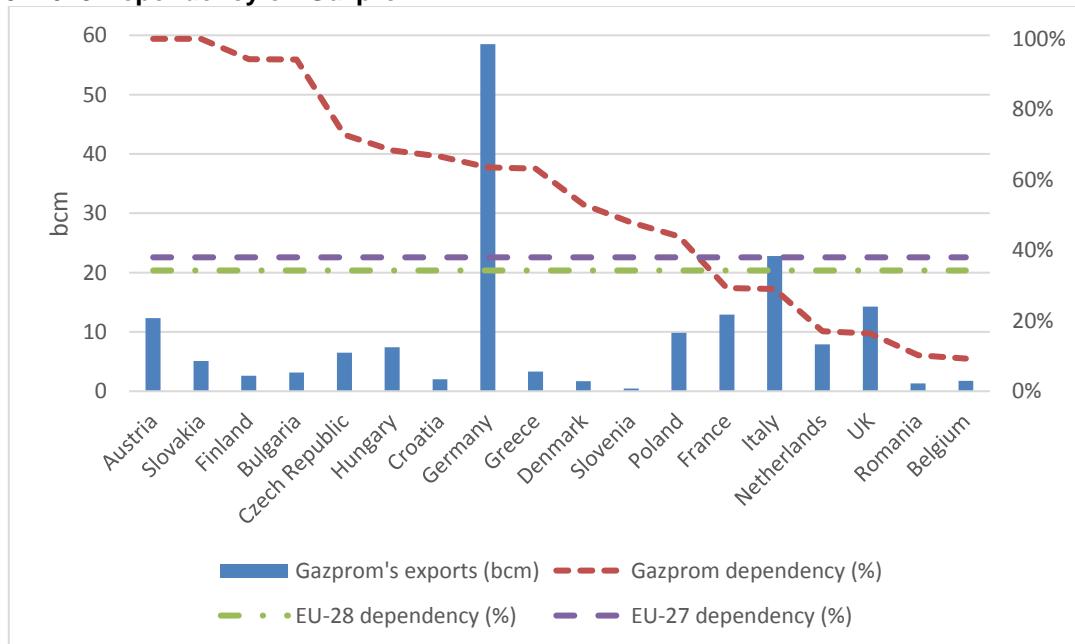


Source: GIIGNL, thierrybros.com

EU solidarity mechanism vs Germany growing dependency on Gazprom

Following publication of Gazprom Export's 2018 country-by-country volume,²⁰ we can update our dependency analysis. It is interesting to see that Germany had the highest Y-o-Y increase from 2017, with an added 5 bcm (+9.5% Y-o-Y), and was 64% dependent on Gazprom in 2018. It is interesting to mention that "due to data privacy regulations", the German federal authority BAFA stopped publishing gas import volumes by country in 2016. The German energy industry body AG Energiebilanzen can therefore only disclose this dependency in all other fossil fuels.²¹

Figure 5: 2018 Dependency on Gazprom



Source: Gazprom Export, JODI, thierrybros.com

²⁰ Available at <http://www.gazpromexport.ru/en/statistics/>

²¹ <https://www.cleanenergywire.org/factsheets/germanys-dependence-imported-fossil-fuels>

The author is therefore happy to share this analysis so that Germany can effectively realise how dependent the country is on Russia. It is ironic to see that Gazprom, a foreign company, is following EU transparency rules better than the German federal authority! Beside the unacceptably poor German regulator not being willing to disclose essential data, the real issue is about the EU solidarity mechanism. With a less diversified Germany should other Member States, in a gas supply disruption, reduce their industrial gas consumption to provide gas for residential customers in Germany? Is it acceptable that Germany, the wealthiest state in the EU, should rely on others to bear the cost of supply diversification to provide its security of supply? This is clearly an unlevel playing field where Germany is not contributing its fair share. It would be interesting to see if the next EU Commission would dare take legal action against Germany, a country that doesn't follow most of the Energy Union rules.

In a smart move, on 12 April, Nord Stream 2 CEO Matthias Warnig wrote to European Commission President Jean-Claude Juncker stating that if his pipeline is not eligible for a derogation from the new regulations, the measure would be discriminatory against Nord Stream 2, which is a Swiss investor, and that the EU may be breaking the international Energy Charter Treaty (ECT).²² The European Commission seems to have missed the 13 May deadline to provide an answer. On 17 April, Nord Stream 2 also filed an appeal against the 26 March decision of the Danish Energy Agency related to the North-western permit application requesting Nord Stream 2 to investigate and submit an environmental impact assessment.²³ It is unclear whether all these judicial procedures will help Nord Stream 2 to become more popular with Western policy makers and in particular with the next EU Commission. This reinforces our conclusion, that 2019 will be "a very special European gas year"²⁴ that will start with Nord Stream 2 officially not in operation.²⁵

The other two major pipelines from Russia, TurkStream to Turkey and Power of Siberia to China, are progressing well and should be operational by the end of 2019. This will allow Gazprom to secure direct deliveries to Turkey bypassing Ukraine and to China, a new and the fastest growing market.

Record storage levels and LNG could make up any shortfall in Q1 2020 as Nord Stream 2 will not be operational and there could be no signed transit deal with Ukraine. With Power of Siberia due to start exporting Russian pipe gas to China on 1 December 2019²⁶ while we have Nord Stream 2 and Ukrainian transit unknowns for early 2020, we could again see TTF prices above Anea prices in Q1 2020.

²² <https://www.politico.eu/wp-content/uploads/2019/04/Nord-Stream-2-ECT-letter-legal.pdf>

²³ <https://www.nord-stream2.com/media-info/news-events/nord-stream-2-files-appeal-against-the-decision-of-the-danish-energy-agency-124/>

²⁴ Please refer to our Quarterly Gas Review 4, December 2018 available at <https://www.oxfordenergy.org/publications/quarterly-gas-review-issue-4/>

²⁵ <https://www.reuters.com/article/us-gazprom-nordstream-2-miller/gazprom-chief-says-slight-changes-to-nord-stream-2-timings-possible-ifax-idUSKCN1SP0CS>

²⁶ <http://www.gazprom.com/press/news/2019/april/article478797/>

Global added value for European storage

Following our September 2018 Quarterly Focus²⁷ ('How Europe could profit from becoming the worldwide energy storage provider'), a joint Global Gas Centre – Snam workshop on "Gas Storage in an Energy Transition World", was organized in Milan on 12 April 2019 to allow the industry to provide further ideas. Together with Marzia Sesini²⁸, who provided the minutes of the workshop, we have decided to use them here.

"The workshop stems from the question on whether or not closing the Underground Gas Storage (UGS) of Rough in the UK has been the optimal choice in terms of costs and opportunities for the natural gas infrastructural network and market. This calls for the need to look at the use of storage differently in a new world both from a market and a non-market base perspective. In an economy evolving towards a strong decarbonization the gas infrastructure and in particular gas storage holds the key for many challenges ahead (e.g.: renewables, energy storage, energy transport), and might be a crucial asset to the future of Europe's energy demand. During the workshop, the value of natural gas storage has been explored from different perspectives:

- I. from that of UGS as an existing asset for two main storage players in the EU arena, in Italy (Snam) and in France (Storengy/Engie). They posed the accent on the consumer centric market value of UGS looking into additional services that this resource can provide to the customers and the market;
- II. from that of LNG as an additional resource for storing natural gas and contributing to the flexibility of the Japanese energy system (Tokyo Gas); and
- III. from that of an asset that it is crucial for any growing network. Because storage development is 65% cheaper than full production (inclusive of pipeline), Gazprom's rule of thumb is to have a 5% storage in the export country as an integrated part of new major pipeline.

Looking at natural gas storage not only as a mean to enhance the experience in an even more and more consumer oriented market when in the form of UGS, but also as a way to increase flexibility and diversification in the supply network when in the form of LNG, has led to the question on whether a collaboration between UGS and LNG can be not only possible but also desirable and beneficial for a system that is currently faced with the threat of shutdown of its existing UGSs."

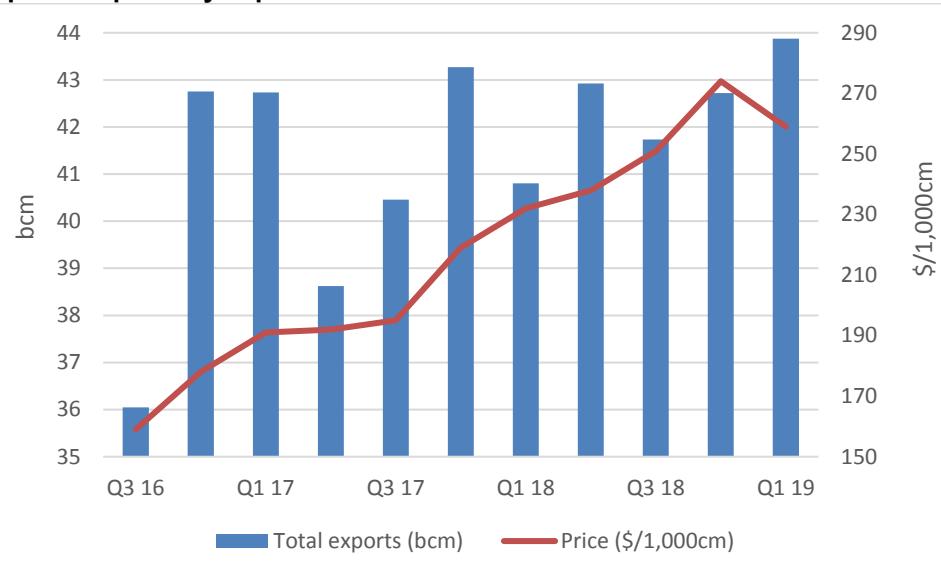
It has long been argued that pipe gas and LNG (in particular Russian pipe vs US LNG) could operate in a confrontational way. Recent data with record level of both pipe and LNG imports suggest this is not the case, thanks to European storage acting as a buffer. The conclusion that can be drawn from this real-life experience is that if TTF is above 4\$/Mbtu, all producers are willing to ship their gas to Europe as this covers at least, their operational costs. But if TTF prices were to go, this summer, c 3\$/Mbtu at a time storage could be nearly full, we could see US liquefaction trains and/or Norwegian production²⁹ curtailed.

²⁷ Please refer for detailed analysis in Quarterly Gas Review – Issue 3, September 2018 available at <https://www.oxfordenergy.org/publications/quarterly-gas-review-issue-3/>

²⁸ Marzia Sesini's research focuses on the economic feasibility and policy implications of EU shared and coordinated gas storage services which contribute to energy security within the EU. Marzia is a Ph.D. student at Imperial College London, a Visiting Doctoral Fellow at OIES, and an Academic Fellow at Bocconi University in Milan, Italy.

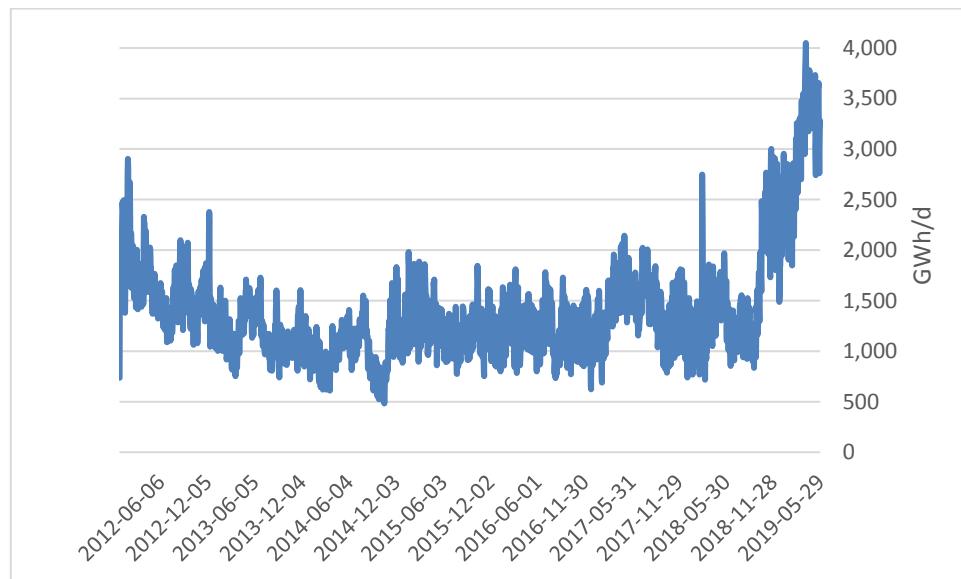
²⁹ Norway could either go for an "extended maintenance", face some "unexpected production hic ups" or "defer production to create future value" as in 2016 (Statoil 2016 Annual Report page 16).

Figure 6: Gazprom's quarterly exports to the EU



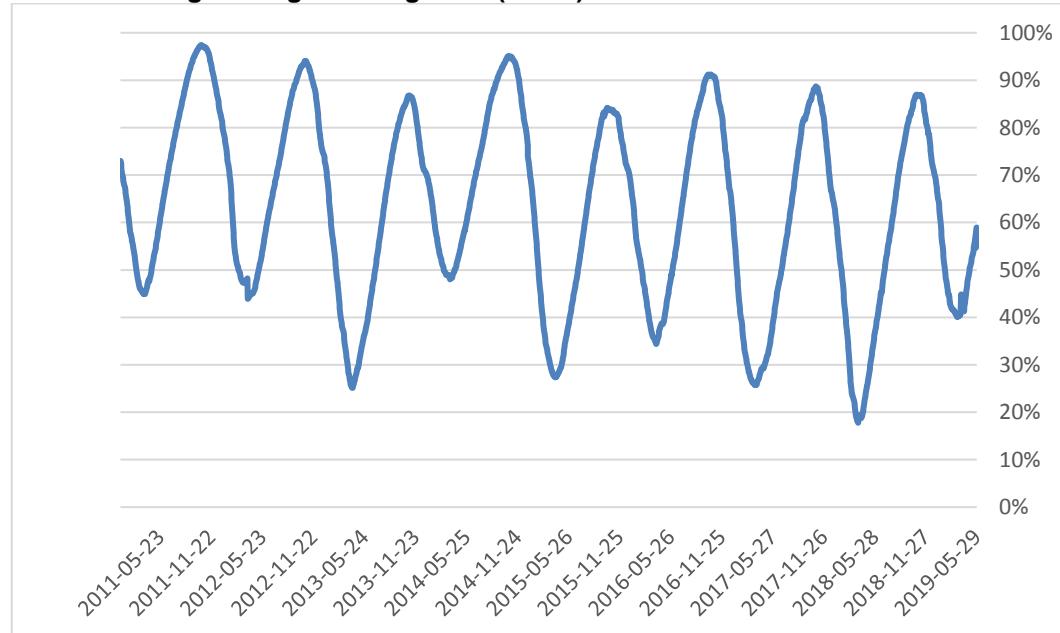
Source: Gazprom, Entsog, thierrybros.com

Figure 7: Daily LNG send-out for EU excluding Malta



Source: GIE, thierrybros.com

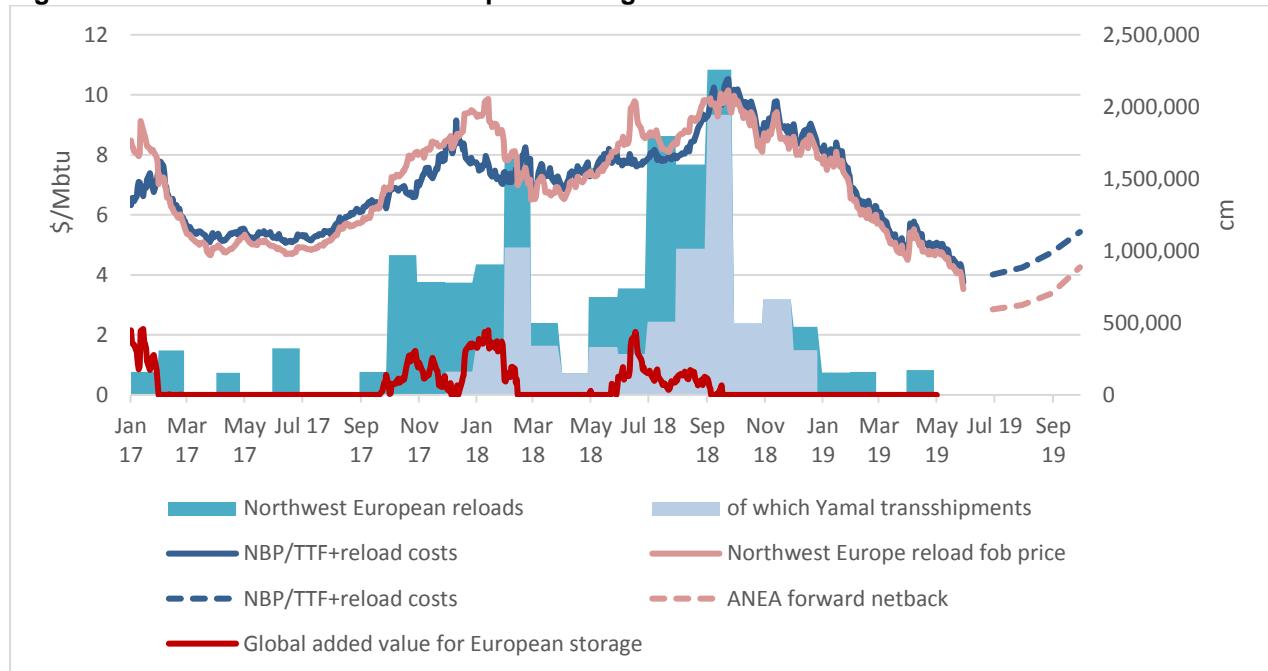
Figure 8: EU-28 underground gas storage use (% full)



Source: GIE, thierrybros.com

With the aim of checking if Continental Europe can become the global world energy storage operator (via LNG reloads), we designed with Argus Media a ‘Global added value for European storage’ indicator by starting to measure the maximum LNG netback in NWE – maximum of (TTF + reload costs and NBP + reload costs) on an historical basis and using future curves. On the historical side we also added the effective monthly LNG reloads. To take into account only the effective reloads and not bunkering, we only included reloads for ships above 135,000cm. We also excluded partial reloads inside Europe. We finally split Yamal re-loads that have to come into Europe in winter and all other reloads. We started in January 2017 and decided to extend the data 6 months into the future to give an idea of what kind of reloads we could expect in the coming months. In short, European storage has an added worldwide value if our ‘Global added value for European storage’ is positive. This means that traders with LNG in a regas plant in Europe could make an added profit by reloading it and sending it to another region instead of regasifying it locally. This is also indirectly linked to EU security of supply. A security of supply issue in Europe would increase TTF prices, making reloads uneconomical as a first resort before new supplies are attracted.

Figure 9: Global added value for European storage vs LNG reloads



Source: Argus Media, thierrybros.com

Both the ‘LNG tightness’ graph (figure 1) and the ‘Global added value for European storage’ graph (figure 9) take into account the volatility not only of gas prices but also of the shipping rates that happened to be very volatile recently.

Our analysis shows clearly that LNG reloads occur when the spread is positive, and this could also add value to European storage. This academic analysis doesn’t capture all additional value, as some non-Yamal reloads happen even when there is no positive spread in our graph, and this could be for the following reasons:

- some companies might have lower costs (e.g. if they have a ship already booked and available then the netback will be lower than that estimated in the graph);
- some companies might be able to be ahead of the game by being able to play some time-arbitrage (hence explaining why reloads could start or end before or after the spread is positive).

Europe might be short in energy, but it is long in its ability to store it. This is something that can be leveraged by reusing existing storage differently. In fact, Europe is the only place that could possibly take advantage of this collaboration, as LNG cargoes might come from all over the world, but they reload mostly in Europe. This strategy could also allow Europe to benefit from arbitrages while being more immune to price spikes in winter if its storages are full. In short, Europe (long in underground storage) should uniquely be able to benefit (both in tight & relaxed markets) from this added global storage value.

There is a need to shift perspective and look at gas storage differently in a world that is short of electricity storage, and also to develop a new market narrative related to using this readily available UGS asset as part of a new energy world strategy. We hope that ‘Global added value for European storage’ (designed with Argus Media) could be a first step in this direction.

With spot LNG at 25% of world LNG trade and 563 vessels,³⁰ we can assume that 7 bcm of floating storage exists on a daily basis. This floating storage is not available immediately for anyone but could be called in a week. So, in case of a security of supply issue in Europe, Europe could first maximize withdrawing from its underground storage (2 bcm/d) before being in a position to unload more spot cargoes to then increase regas send out (0.7 bcm/d). Europe could in theory take 10% of the total spot cargoes. And also, by providing reloadings, the EU even if not an LNG producer could be in a position to provide “European LNG”, a very interesting product at a time when trade wars and sanctions are limiting trades for some LNG producers.

In conclusion, the length in European storage and the commoditization of a growing LNG supply should allow the EU to stop worrying about security of supply and move away from its usual yearly “winter packages” exercises! The next (possibly green) EU energy commissioner (after the green wave witnessed during the May EU Parliamentary elections) should be relieved to be able to concentrate on more fundamental climate issues, leaving the gas industry to focus on delivering results, ie cost effective gas for the European citizens and the economy, in any circumstances! High storage levels would alleviate all potential issues such as delays in Nord Stream 2 and Ukrainian transit in Q1 2020 and further Groningen production cuts.

³⁰ GIIGNL data for 2018