February 2017

The Forthcoming LNG Supply Wave: A Case of 'Crying Wolf'?

Introduction

Many readers will be familiar with Aesop's Fable 'The Boy Who Cried Wolf'. The tale concerns a shepherd boy who repeatedly tricks nearby villagers into thinking wolves are attacking his flock. When one actually does appear and the boy again calls for help, the villagers believe that it is another false alarm and the sheep (and in some versions the boy) are eaten by the wolf.

Since 2015 analysts and researchers have announced the imminent arrival of a surge of LNG into the European gas market, as supply projects from mainly Australia and the USA come onstream and LNG in excess of Asian requirements arrives at European import terminals. To date this has not happened, in fact 2016's European region[1] LNG imports were down 3.3% on 2015. This short paper examines the reasons for this and presents an updated view on the growth of global LNG supply and its impact on Europe under two Asian Demand Scenarios.

Historic Analogue

We have been here before. Some ten years ago the market was anticipating a surge in supply from a range of new LNG projects, most notably in Qatar, but also including those in Indonesia (Tangguh), Nigeria, Norway, Peru and Yemen. Between 2008 and 2012 global LNG liquefaction capacity grew by some 115 bcma, but as shown in Figure 1, forecasts of this growth based in the years 2004 to 2009 were subject to slippage. The 'actual' trend is shown in red.

The factors which account for the difference between the early (invariably optimistic) projections and the eventual outcome and levels of LNG supplied are briefly listed below:

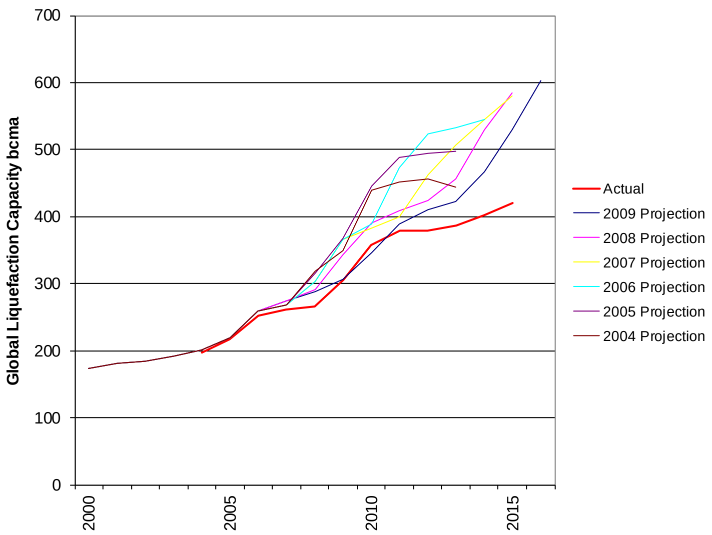
- Project construction schedule slippage (often associated with cost escalation above budget). Note that the time from FID to project completion is typically 5 years, before unforeseen slippage.
- Commissioning problems[2] - a smooth commissioning process could see LNG liquefaction plant achieving 90% of nameplate capacity within 9 months of project completion (sometimes quicker)[3]. Often, however, the plant suffers unscheduled shutdowns and may remain offline for weeks during which modifications are carried out before commissioning is attempted again.
- Feedgas supply issues can constrain supply below nameplate capacity until upstream issues are resolved. This can be a temporary or long term problem.

[1] Including Turkey
[2] In this context commissioning refers to the period of facility start-up which ends with the attainment of full nameplate capacity.
[3] Note: LNG cargoes may be exported early in the commissioning phase; the issue is the time taken to achieve nameplate capacity.

Howard Rogers

- Projects fail to achieve FID and so fall off the back-end of the projections.

Figure 1: The Slippage of LNG Capacity Projections 2004 to 2009



Source: 'LNG Trade-flows in the Atlantic Basin: Trends and Discontinuities', H Rogers, OIES, NG41, https://www.oxfordenergy.org/publications/lng-trade-flows-in-the-atlantic-basin-trends-and-discontinuities-2/, P. 35

Recent LNG market developments

While we still await two months of actuals from the EIA and IEA respectively for USA and European gas demand and production, full year 2016 LNG data is available. Table 1 shows a summary LNG balance and a European region balance, including LNG imports.

Table 1: Global LNG and European Balance 2014 - 2016[4] Bcm

	2014	2015	2016
Global LNG Supply	**329**	**331**	**350**
Asian Demand	245	236	253
South America Demand	17	17	12
Middle East Demand	5	14	24
Other Demand	13	13	12
LNG Available for Europe	**49**	**51**	**50**
Europe Gas Demand	**476**	**496**	**517**
Production	255	248	246
Storage Inventory Change	- 7	6	1
Russian Pipeline Imports	**148**	**160**	**172**
Other Pipeline Imports	32	30	49
LNG Required	**49**	**51**	**50**

Sources: IEA, EIA, Platts LNG Service, BP Statistical Review of World Energy

[4] Note there is considerable scope for statistical difference in Russian and Other Pipeline Imports due to differing sources and calculation.

While global LNG supply was little changed between 2014 and 2015, it increased by 6% in 2016 (i.e. by 19 bcma). This was consumed by markets in Asia (up 17 bcma) and the Middle East (up 10 bcma), with South American demand down 5 bcma. This left only 50 bcma of LNG available for Europe in 2016. In 2016 Europe's natural gas demand increased by an estimated 4.3% over 2015 due to cold weather and coal to gas switching in the power sector. With domestic production little changed, the additional European gas demand was met by increased pipeline imports – notably increased supplies from Russia and Algeria. In summary, 2016 did see the beginning of the much-anticipated LNG supply surge, but the supply increase was consumed by Asian and Middle Eastern markets before it reached Europe.

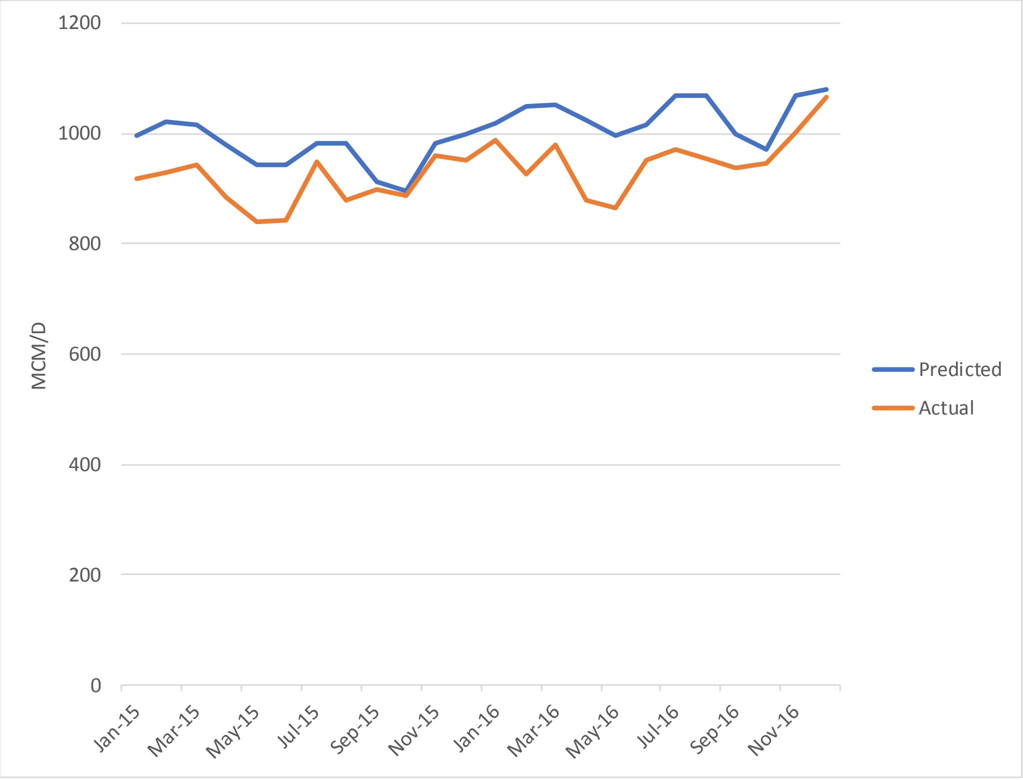
Looking Forward to 2021 - The LNG Project Supply Stack

In attempting to construct a global outlook for LNG supply from existing facilities and new projects under construction, there are a number of factors to take into account. We have already referred to the timing uncertainty in project completion and the challenges of commissioning and achieving design capacity and stable operation. For both new and existing projects the seasonal variation in ambient temperature and scheduled maintenance shutdowns will also introduce variability in output over time. By looking at historic data on a monthly basis, seasonal variation can be estimated. However, when comparing predicted and actual LNG monthly output data by exporting country, it is evident that patterns of under- or over-performance occur within the expected background 'noise' driven by cargo scheduling, the impact on journey time due to route switching and other operational issues.

Figure 2 shows monthly predicted and actual global LNG supply for 2015 and 2016. Actual supply was consistently below predicted but the gap varied. By end 2016, supply came close to the predicted value. This gap is broken down to individual country level in Figure 3.

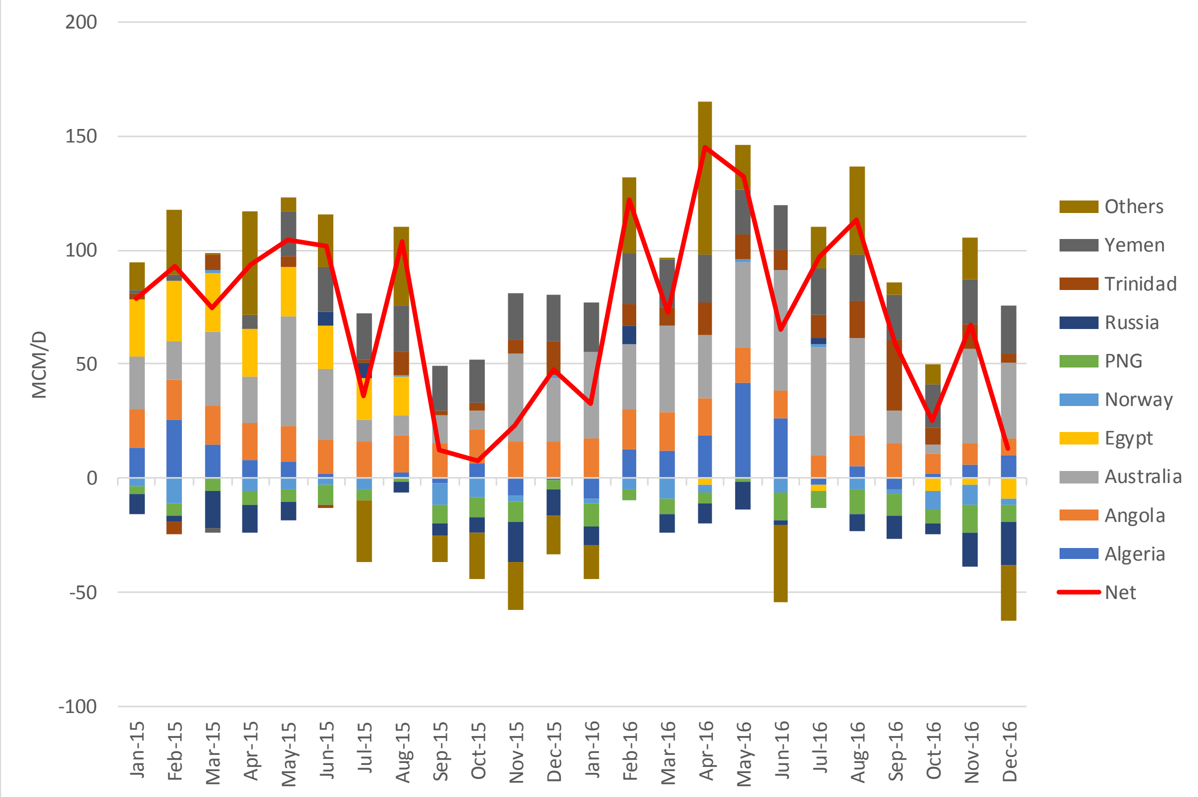
Underperformance is shown above the axis and overperformance below the axis. The net position is shown by the red line plot.

Figure 2: Global LNG Supply – Predicted and Actual for 2015 and 2016



Source: Platts Monthly LNG Service, Author's Analysis

Figure 3: Predicted and Actual LNG Supply for 2015 and 2016 at Supplier Country Level



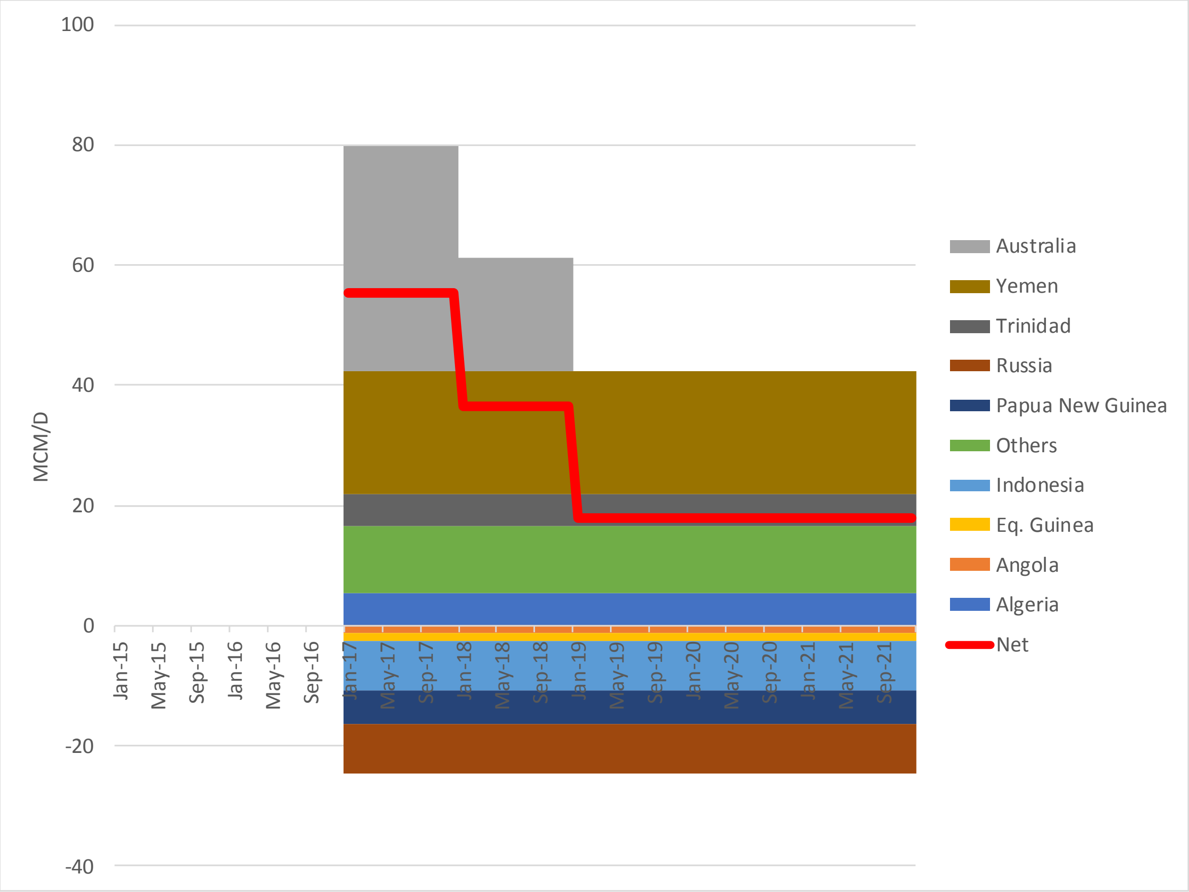
Source: Platts Monthly LNG Service, Author's Analysis

The key underperformers relative to prediction are Australia (due to lower output than expected from recently completed projects, notably the delay in commissioning Gorgon trains 1 and 2), Angola (the facility being offline for this period), Egypt (the prediction was changed to zero from September 2015, though the country did export some cargoes towards the end of 2016), Yemen (shut down throughout the period) and Algeria to varying degrees during the period. Frequent over-performers were PNG and Russia.

Despite the degree of variation in this picture over time, it serves to inform future assumptions on 'background' over- or under-performance. The assumptions shown in Figure 4 for 2017 to 2021 are notional. It has been assumed that Australia's underlying performance improves as existing trains are finally able to meet design outputs.

The next stage is to add a view of new project supply to the existing facility forecast. Table 2 sets out notional assumptions of project start-up timings based on media commentary and industry statements. This is very much a 'moveable feast' and these assumptions are constantly subject to challenge and revision. In addition, it is necessary to include estimates for the long term decline in output from LNG facilities such as the older liquefaction plant in Trinidad & Tobago, Malaysia and Indonesia, due to the maturity of their supplying fields and limited new prospectivity for viable gas discoveries in adjacent acreage.

Figure 4: Under and Overperformance of Country Level LNG Supply - Future Assumptions



Source: Author's Assumptions

Table 2: Assumed Start-Up Timings for New LNG projects to 2021

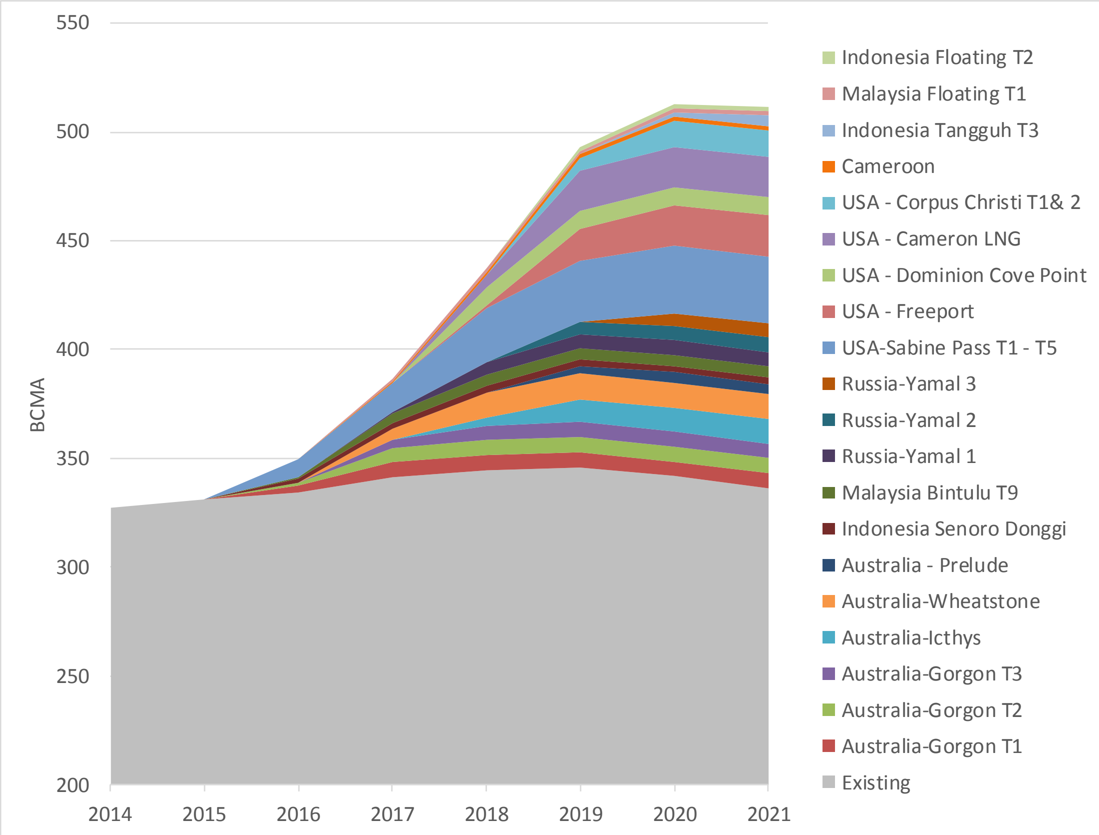
	Assumed Start Up Timings
Australia-Gorgon T3	2Q 2017
Australia-Icthys	3Q 2018
Australia-Wheatstone	2Q 2017
Australia - Prelude	1Q 2019
Russia-Yamal T1	4Q 2017
Russia-Yamal T2	4Q 2018
Russia-Yamal T3	4Q 2020
USA Sabine Pass T3	1Q 2017
USA Sabine Pass T4	1Q 2018
USA Sabine Pass T5	3Q 2019
USA - Corpus Christi T1	1Q 2019
USA - Corpus Christi T2	3Q 2019
USA - Corpus Christi T3	1Q 2020
USA - Freeport T1	3Q 2018
USA - Freeport T2	1Q 2019
USA - Freeport T3	3Q 2019
USA - Dominion Cove Point T1	1Q 2018
USA - Dominion Cove Point T2	2Q 2018
USA - Cameron LNG T1	2Q 2018
USA - Cameron LNG T2	3Q 2018
USA - Cameron LNG T3	4Q 2018
Cameroon	3Q 2017
Indonesia Tangguh T3	2Q 2020
Indonesia Floating T2	4Q 2018

Source: Energy Media and Industry Reports

The integrated outlook for global LNG is shown on an annual basis in Figure 5.

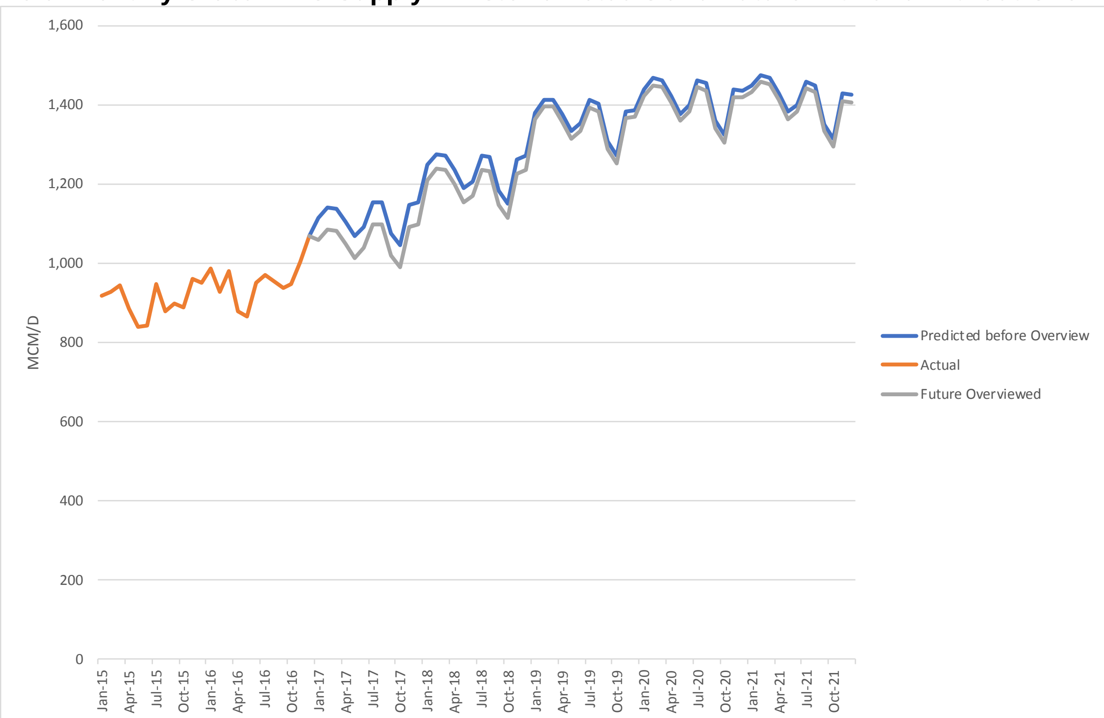
Figure 5 shows the global LNG supply consistent with the new project start-up assumptions in Table 2 and allowing for commissioning periods and location-specific seasonal performance variation. What it does not include is an allowance for further unscheduled shutdowns of new facilities which were a feature of 2016. This factor is however covered in the notional underperformance for Australia in Figure 4. The outlook for global LNG supply shown in Figure 5 depicts a sustained ramp-up in supply to above 500 bcma in 2020 from 350 bcma in 2016. Figure 6 shows the outlook on a monthly basis to 2021 and shows the significant increase in global LNG supply in the last quarter of 2016. The significance of the difference between predicted and overviewed performance is clear (see Figure 4). This difference reduces as the Australian projects are assumed to overcome commissioning problems by 2019. For 2018 and beyond, global LNG supply appears set for sustained and significant increases over recent levels. The question thus posed is ‘to what extent can demand for gas in the form of LNG absorb this ramp-up in supply’?

Figure 5: Global LNG Outlook (Annual) to 2021



Sources: Platts LNG Service, Author's Assumptions

Figure 6: Monthly Global LNG Supply – Historic Actuals and Future with and without Overview



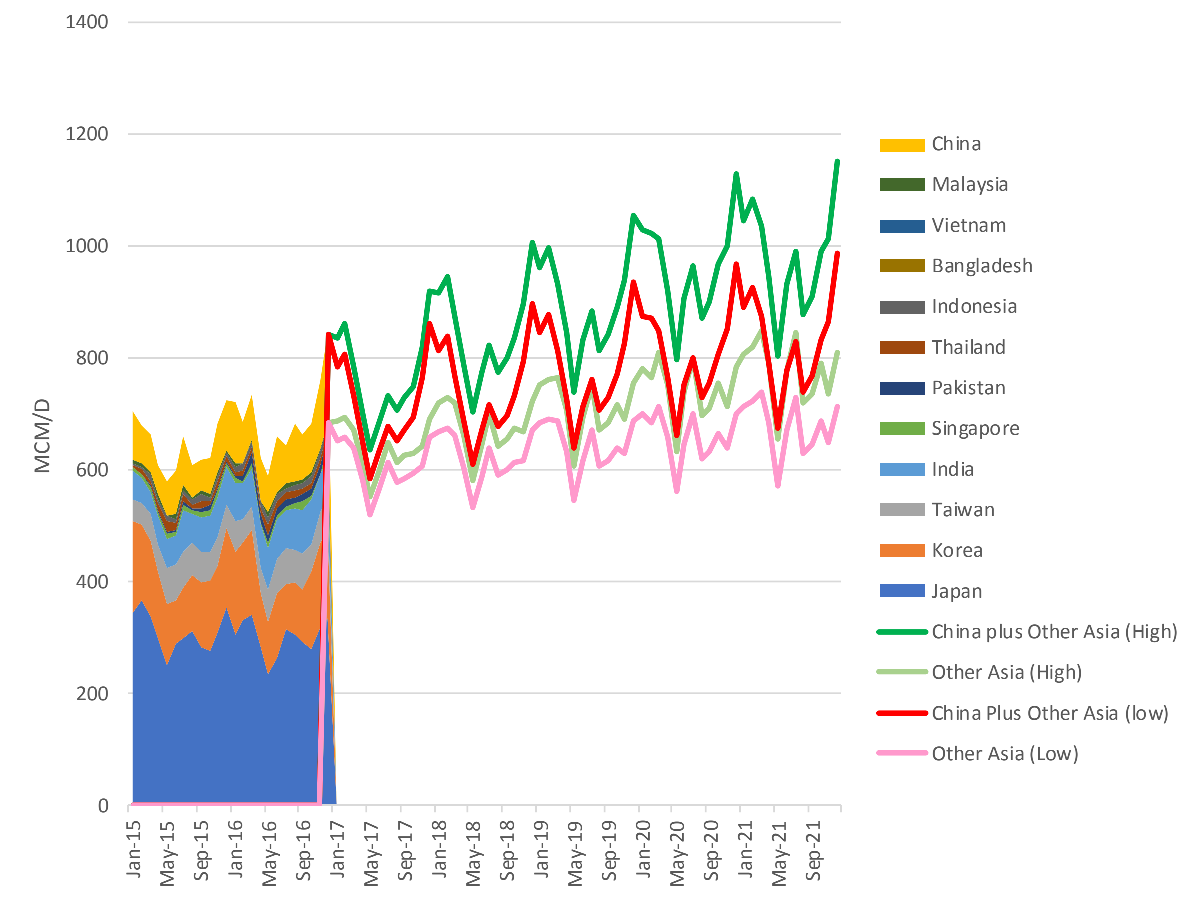
Sources: Platts LNG Service, Author's Assumptions

LNG demand outlook and Scenarios for Europe

With LNG supply set to grow in the period to 2021, the obvious next question is how much of this new supply will be absorbed by increased demand in the core regional Asian market, and consequently how much will 'overflow' into Europe? In the 2016/2017 winter period we have seen an unexpected 'tight' market in Europe and parts of Asia which increased LNG supply has been unable to ameliorate. Specifically, China has seen colder than normal winter temperatures and has increased its imports of LNG accordingly. South Korea has increased LNG imports to compensate for nuclear reactors taken temporarily offline. In Europe colder weather and high coal prices have boosted gas demand in the space heating and power sectors, exacerbated by the shutdown of significant French nuclear capacity.

As we move into 2017, the burning question is whether (in particular) China's recent increased LNG demand this winter is primarily a weather-related phenomenon or the start of a trend towards higher LNG demand based on displacing coal in power, industrial and space heating sectors. The absence of transparent prompt Chinese gas demand data prolongs the uncertainty on this issue. Figure 7 shows monthly LNG demand for all Asian markets to 2016 with high and low future scenarios[5].

Figure 7: Asian LNG Demand 2015 - 2021



Sources: Platts LNG Service, Author's Assumptions

Asian demand for LNG imports has been characteristically seasonal, exacerbated by the lack of underground storage capacity and the tendency to purchase winter LNG cargoes 'in addition' to LNG storage inventory at regas terminals. The role of natural gas and LNG in Asia and the development of demand over the next few years is key to understanding the impact on the European market of LNG

[5] See 'LNG Markets in Transition: The Great Reconfiguration', Ed. Anne-Sophie Corbeau and David Ledesma, OUP, 2016, Chapter 6, pp 327 – 285. (https://www.oxfordenergy.org/shop/lng-markets-in-transition-the-great-reconfiguration/)

volumes in excess of Asian and other regional market requirements. Europe's position as the 'market of last resort' is linked to the issue of competition between Russian pipeline gas and LNG in Europe. A 'low' Asian LNG demand scenario (as indicated in Figure 7) would leave significant volumes of LNG from existing and newly completed LNG export facilities competing with Russian pipeline gas in Europe. It is assumed that Russia would 'defend' a minimum of 150 bcma of pipeline gas exports to the European region, this corresponding to 85% of aggregate Annual Contract Quantities. This was not an issue in 2016 when colder weather and coal to gas switching in the power sector led to higher demand that only Russia and Algeria were able to meet. The global balance on this scenario is shown in Table 3.

Table 3: Global LNG Balance in a low Asian LNG demand scenario Bcm

	2014	2015	2016	2017	2018	2019	2020	2021
Global LNG Supply	**329**	**331**	**350**	**387**	**438**	**493**	**513**	**511**
Asian Demand	245	236	253	259	271	284	295	303
South America Demand	17	17	12	19	19	19	19	20
Middle East Demand	5	14	24	20	17	17	15	16
Other Demand	13	13	12	11	12	13	14	19
LNG Available for Europe	**49**	**51**	**50**	**78**	**118**	**160**	**169**	**153**
Europe Gas Demand	**476**	**496**	**517**	**508**	**508**	**508**	**508**	**508**
Production	255	248	246	242	234	226	217	208
Storage Invetory Change	-7	6	1	-5	-5	-	-2	-2
Russian Pipeline Imports	**148**	**160**	**172**	**157**	**150**	**150**	**150**	**150**
Other Pipeline Imports	32	30	49	36	31	29	32	35
LNG Required	**49**	**51**	**50**	**78**	**98**	**103**	**111**	**116**
LNG Surplus	**0**	**0**	**0**	**0**	**20**	**57**	**58**	**37**

Source: IEA, EIA, Platts LNG Service, BP Statistical Review of World Energy, Author's analysis

In this scenario, low demand for LNG in Asia leads to a 'surplus' of LNG supply (in the first instance) from 2018 to 2021. The market would clear through three secondary mechanisms, as European hub (and Asian spot LNG prices) fall in response to the supply surplus. The three mechanisms by which the market would clear in the period would be:

- Coal to gas switching in Europe (depending on the prevailing level of coal and CO_2 prices)
- Low-price 'induced' LNG demand in Asia from industrial customers which can access LNG cargoes at spot prices.
- US LNG export curtailment – when the spread between Henry Hub and European Hub Prices (and Asian spot LNG prices) is less than the variable cost of shipping and regas for players with the highest costs.

In this scenario one would expect arbitrage to keep European hub and Asian spot LNG prices tightly correlated and to maintain a 'compressed' spread between these markers and Henry Hub in the 2018 to 2021 period.

Alternatively, if Asia follows a 'high LNG demand' scenario then the prospect of an LNG glut is significantly diminished, as shown in Table 4.

Table 4: Global LNG Balance in a high Asian LNG demand scenario Bcm

	2014	2015	2016	2017	2018	2019	2020	2021
Global LNG Supply	**329**	**331**	**350**	**387**	**438**	**493**	**513**	**511**
Asian Demand	245	236	253	278	308	326	351	358
South America Demand	17	17	12	19	19	19	19	20
Middle East Demand	5	14	24	20	17	17	15	16
Other Demand	13	13	12	11	12	13	14	19
LNG Available for Europe	**49**	**51**	**50**	**58**	**80**	**118**	**113**	**98**
Europe Gas Demand	**476**	**496**	**517**	**508**	**508**	**508**	**508**	**508**
Production	255	248	246	242	234	226	217	208
Storage Withdrawal	-7	6	1	-5	-5	-	-2	-2
Russian Pipeline Imports	**148**	**160**	**172**	**174**	**162**	**150**	**150**	**161**
Other Pipeline Imports	32	30	49	40	37	35	40	42
LNG Required	**49**	**51**	**50**	**58**	**80**	**97**	**103**	**98**
LNG Surplus	**0**	**0**	**0**	**0**	**0**	**21**	**10**	**0**

Source: IEA, EIA, Platts LNG Service, BP Statistical Review of World Energy, Author's analysis

In this case, faster LNG demand growth in Asia absorbs growing supplies of new LNG, allowing Russian pipeline exports to Europe to stay above 150 bcma until 2019 and 2020.

The main drivers for higher demand growth relative to the 'Low demand scenario' are:

- Policy-supported switching to gas from coal in China and India for air quality and possibly CO_2 reduction reasons.
- A slower pace of nuclear restart and renewables implementation in Japan.
- Higher power demand growth and a commitment to phase out nuclear in Taiwan.
- Faster decline rates of domestic gas production, requiring accelerated LNG imports in Pakistan, Thailand, Bangladesh, Malaysia, Indonesia and Vietnam.

Given the less than firm commitment to the growth of gas in many Asian country energy policies, future LNG price levels will be important. While the lack of transparent competitive energy markets in most Asian countries generally blunts the immediate impact of LNG and gas prices on demand, price will certainly influence policy and prolonged periods (2 to 3 years) of high LNG prices would depress LNG demand growth, as it did in the aftermath of the hike in oil-indexed and spot LNG prices from 2011 onwards.

Table 4 shows a 'mini-glut' in 2019 and 2020 which would result in depressed European hub and Asian spot LNG prices for a much shorter period, with the market cleared in 2019 and 2020 probably without the need to curtail US LNG exports.

Given the typical lead time from FID to first LNG cargo of 5 years, upside on the global LNG supply picture shown above is limited and would be confined to:

- Faster than anticipated commissioning periods for existing projects coming onstream over the next five years,
- The successful completion of any new Floating LNG liquefaction projects, whose lead-time might be shorter.
- The successful development of the offshore Egypt Zohr field which has the possibility of negating Egypt's LNG import requirement, allowing a resumption of LNG exports by around 2020.

Conclusions

Figure 1 serves to remind us that although LNG supply surges tend to slip relative to early forecasts, they do (like the wolf in the fable) eventually arrive. Companies which have invested tens of billions of dollars in new LNG supply facilities do not abandon these projects half completed. Given the scale of the increase in LNG supply growth between 2017 and 2020, it is important to recognise the factors which will determine its shape and the impact it could have on regional markets. These are:

- Further project implementation slippage, which has been a feature to date for the Australian projects in particular but also to a lesser extent for the first US Gulf Coast project.
- Lengthy commissioning periods, including unscheduled shutdowns for problem rectification. This has been a challenge for the Gorgon project.
- Ongoing output variation in existing LNG supply projects. This includes the long-term decline in gas production in the case of some of the older LNG facilities, temporary loss of feedgas supply and general variation in actual versus predicted output for a variety of mainly technical reasons.

While the above factors influence the pace of growth on the supply side - the impact on Europe, the market of last resort for LNG, will be significantly determined by the pace of Asian LNG demand growth. This pace is uncertain. The high demand for LNG in Asia during winter 2016 – 2017 is certainly explained, at least in part, by factors such as colder than normal weather and nuclear outages in South Korea. Summer 2017 Asian demand levels will be a better indicator of which end of the high versus low Asian LNG demand spectrum we are heading towards. This in turn will determine the scale and duration of the LNG 'glut' between now and 2021 with significant implications for European hub and LNG spot prices.