

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.

But even if our ‘LNG tightness’ indicator reached sub 1\$/Mbtu, it has never been low and/or long lasting enough to force production to shut 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.

Quarterly Focus: A review of IOC production, reserves & strategy

After providing a detailed analysis of 2018 hydrocarbon production and reserves for major oil & gas companies, we look at the major challenges IOCs are now facing in a fast energy transition post-COP21.

The world has never been addicted to oil so much as to cheap energy. With renewable energy cheaper, the world energy addiction is moving into renewables. Hence, we doubt that fossil-based companies that are dependent on resource prices could continue to thrive when the world moves away from fossil fuels. In our quest for a net-zero carbon emission world, the power of influence is shifting away from energy producers.

But the energy transition path is still uncertain. The German energy transition may soon be looked on in academic books as a very sub-optimal possible path, because the nuclear to coal switching did not allow Germany to even match the average EU CO₂ emission per total primary energy used. On the other hand, the French Gilets Jaunes are a stark reminder that most consumers are not prepared to pay more to pollute less.

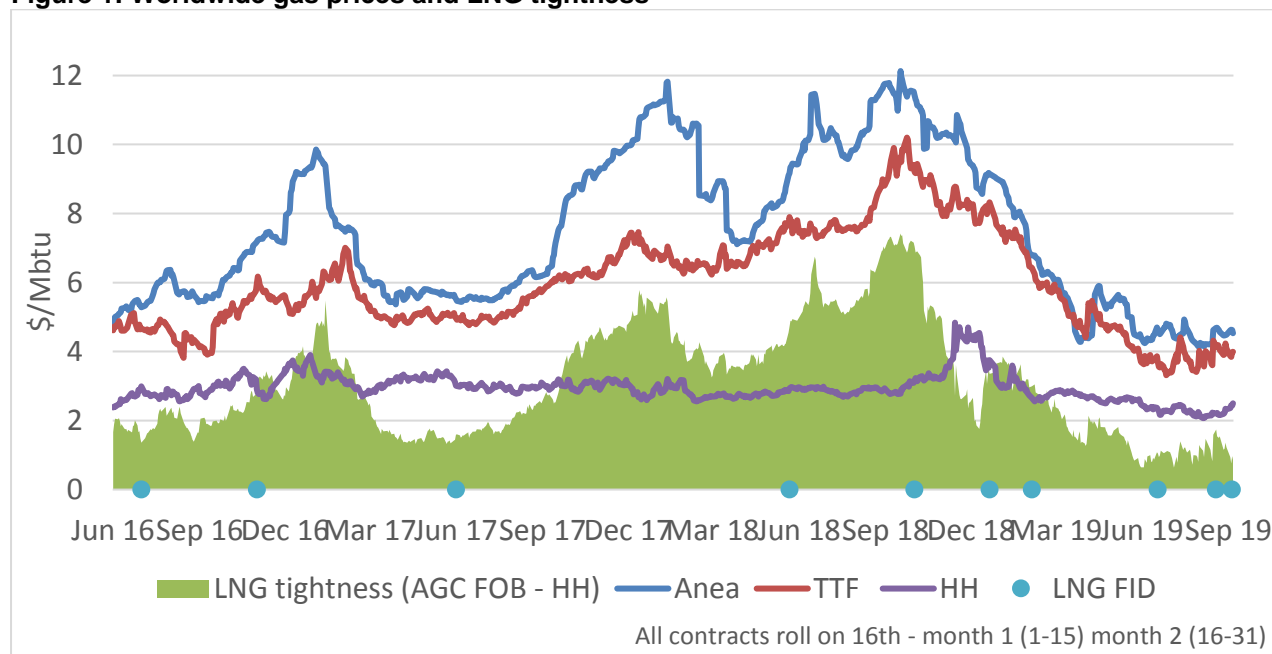
Oil and gas companies will continue to face two major risks: an economic risk if they are not able to provide the cheapest energy and a licence to operate risk. Some will disappear as Anadarko did this year, some will survive either by moving faster into a net-zero carbon emission world by acquisition or technology. This race focused on cheap-to-produce energy should benefit all consumers. Any over-expensive technology, even if renewable is bound to lose this race. Energy producers need to focus on providing low cost solutions for the benefit of all consumers.

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. But even though it has occasionally dipped below 1\$/Mbtu, it has never been low and/or long lasting enough to force production to shut anywhere. We have therefore not yet seen a price war between LNG and pipeline gas, in particular in Europe, thanks to

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/>

huge EU storage capacity. In fact, Algerian pipe exports are down due to the un-competitiveness of their out-of-the-money oil-indexed contracts and Norway has gone through a heavy maintenance period.

Gazprom Export's Electronic Sales Platform (ESP) is providing added flexibility. Buyers can select either to call for more contracted gas (above the 70% minimum Take or Pay) or bid on the ESP if offering a cheaper alternative, while Gazprom provides the volumes required to balance the market. This mechanism allows Gazprom to continue to push for long-term contracts (to finance the upstream capex and the booking of transport capacity) without losing market share. This is why Gazprom's volumes exported to the EU are flat Y-o-Y.⁵

In order to ensure reliable operation, Gazprom announced a target to have "at least 11.39 bcm in Europe by the next withdrawal season",⁶ in line with its target to store at least 5% of annual export supplies. With a proprietary capacity of 4.8 bcm, this means that Gazprom wants to fill an extra 6.6 bcm as 2019 will be "a very special European gas year"⁷ that will start with Nord Stream 2 officially not in operation.⁸

On 3 June, Cheniere took FID on Sabine Pass train 6 and provided an updated liquefaction capacity for all its trains. The 4.5 mtpa initial capacity, has been debottlenecked and the new range is from 4.7 to 5 mtpa.⁹ Interestingly, this latest FID was taken with only 1.8 mtpa of long term contracted volumes. With only 38% of the capacity long term contracted, this is way lower than the 66% achieved when taking FID on Corpus Christi train 3 in May 2018. This is perhaps a sign that long term contracts are more and more difficult to sign and/or that the LNG business is moving towards commoditization.

With an aggregate 11.1 mtpa of long-term sales (representing 86% of the plant's nameplate capacity), Anadarko announced FID for its two initial LNG trains in Mozambique with a total nameplate capacity of 12.9 mtpa on 18 June 2019. Anadarko disclosed a capex estimate of about \$20bn¹⁰ that we have used, although the press reported \$25bn at the FID ceremony.¹¹ Following the merger with Occidental, this project will be operated by Total.

On 19 August, Venture Global announced the FID and closing of the project financing for its Calcasieu Pass 10 mtpa LNG facility and associated TransCameron pipeline in Louisiana.¹² It has secured long-term offtake contracts with Shell (2 mtpa), Edison (1 mtpa), Galp (1 mtpa), BP (2 mtpa), Repsol (1 mtpa) and PGNiG (1 mtpa). 80% of the facility is therefore contracted under 20-year SPAs.

On 5 September, Novatek announced the FID of its \$21.3bn Arctic LNG 2 project. It will consist of 3 trains with an overall capacity of 19.8 mtpa. This is the third project (after Canada LNG and Golden Pass) to be FIDed without any long term contracts.

With 5 projects FIDed so far in 2019, representing a record 63 mtpa, we still expect at least another 10 mtpa of FIDs in the remainder of 2019 to balance growing demand post-2023. With 7 mtpa/month FIDed so far in 2019, we can say that even the actual record low prices did not stop the industry going forward in addressing the post-2022 supply-demand imbalance. It slowed the process but did not stop it.

If we only look at the total capex per unit of LNG production capacity, we have to compare US projects which are for now unbundled (i.e. upstream and pipeline transport are not integrated in the LNG projects, in green

⁵ For a monthly analysis, please go the <https://www.naturalgasworld.com/eu-storage-stocks-limit-gazproms-exports-72650>

⁶ <http://www.gazprom.com/press/news/2019/june/article481849/>

⁷ Please refer to our Quarterly Gas Review 4, December 2018 available at <https://www.oxfordenergy.org/publications/quarterly-gas-review-issue-4/>

⁸ <https://www.reuters.com/article/us-gazprom-nordstream-2-miller/gazprom-chief-says-slight-changes-to-nord-stream-2-timings-possible-ifax-idUSKCN1SP0CS>

⁹ Slide 18 of the investor presentation. For consistency we updated the capacity from 4.5 to 4.7 mtpa.

¹⁰ In Anadarko April Investor Book pages 23-25

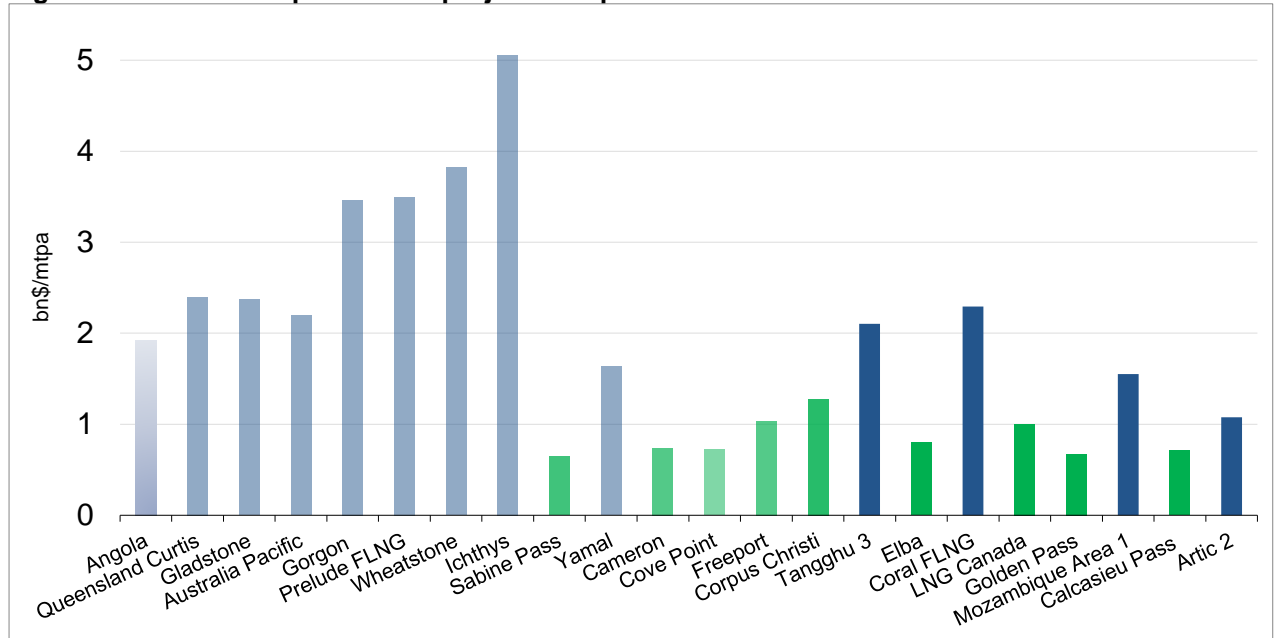
¹¹ <https://www.bloomberg.com/news/articles/2019-06-18/mozambique-s-gas-riches-near-as-anadarko-approves-lng-project>

¹² <http://venturegloballng.com/press/venture-global-announces-financial-close-for-calcasieu-pass-lng/#.XV4JzrpFw2w>



below) with the rest of the world (in blue below). Projects are listed according to the timing of the FID with shaded bars for those already in (full or partial) production.

Figure 2: Disclosed capex of LNG projects in operation and in construction



Source: thierrybros.com

In the Apache-Cheniere deal disclosed in June 2019,¹³ in exchange for gas, Apache gets “global gas markets prices - fixed liquefaction fee & certain other costs”. The structure of this deal is significant because it provided a mechanism for US-produced natural gas to reflect global LNG fundamentals. This should provide Apache with a better return than selling its gas in the US.

In June, the delivery of the first LNG cargo from the Vaca Muerta shale gas reserves via Tango FLNG¹⁴ marks the entry of Argentina into the select club of the now 20 LNG exporting nations.¹⁵

Also in June, Shell shipped its first LNG cargo from Prelude FLNG.¹⁶ With a May 2011 FID,¹⁷ this project has taken more than 7 years in construction and is one year late.¹⁸ With all plants now online, Australia is the largest worldwide LNG producer and should keep its leading position for the next few years.

In July, the second liquefaction train of Cheniere Energy’s Corpus Christi LNG export facility in Texas started. Freeport 1 shipped its first cargo in September.¹⁹

¹³ Cheniere June 2019 Investor Update – Slide 10

¹⁴ http://exmar.be/sites/default/files/media/tango_flng_fully_commissioned_06062019_0.pdf

¹⁵ Yemen is excluded because the plant is indefinitely off-line.

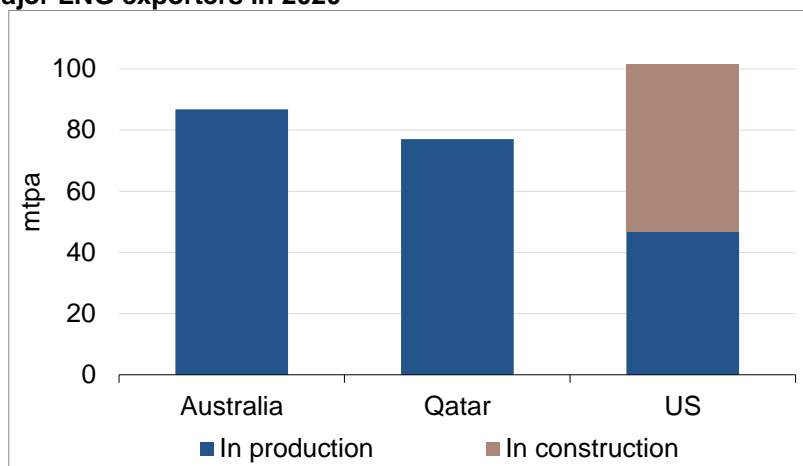
¹⁶ <https://www.shell.com/media/news-and-media-releases/2019/first-lng-cargo-shipped-from-prelude-flng.html>

¹⁷ <https://www.shell.com/media/news-and-media-releases/2011/fid-flng.html>

¹⁸ <https://www.theaustralian.com.au/news/bn-prelude-floating-plant-has-shell-fired-for-lng/news-story/ac91ce9c044be11681a5c6da79ddd057#&qid=null&pid=1> and http://www.inpex.com.au/media/2061/inpex_australia_brochure-spreads.pdf

¹⁹ http://www.newsrouter.com/NewsRouter_Uploads/77/Freeport%20LNG%20Ships%20First%20LNG%20Commissioning%20Cargo.pdf

Figure 3: The 3 major LNG exporters in 2020



Source: GIIGNL, thierrybros.com

On 12 April, 2019 Nord Stream 2 triggered the three-month consultation period during which parties must seek an amicable settlement before a notice of arbitration can be served. As no amicable settlement has been reached, Nord Stream 2, as a Swiss investor, has now begun arbitration proceedings²⁰ against the EU pursuant to the investment protection guarantees of the Energy Charter Treaty. This arbitration will take place at a time when the EU is asserting its ‘right to regulate’ as part of Energy Charter Treaty reform.²¹ The Energy Charter Treaty is outdated because it is neither fuel- nor technology-neutral. The author has made the same claim regarding IEA strategic oil stocks.²² In a fast energy transition, old treaties favouring fossil fuels could become a liability for States because private companies could take advantage of the treaties to claim compensation when forced to dispose of what are now considered to be polluting assets.

Also, on 25 July Nord Stream 2²³ brought an action for annulment before the EU General Court. Nord Stream 2 requests that Directive (EU) 2019/692 amending the EU Gas Directive be annulled because of an infringement of the EU law principles of equal treatment and proportionality.

On 10 September the European Court of Justice in Luxembourg annulled the Commission’s 2016 decision that allowed Russia’s Gazprom to book all OPAL capacity. The court’s ruling means that Gazprom is now restricted to the entitled volumes under a 2009 decision exempting it from EU internal energy market rules approved by the European Commission and the German regulator. This is a clear win for Poland, Latvia and Lithuania against the EU Commission and Germany as the Court recognized that the 2016 decision was taken disregarding the solidarity principle. The Court applied article 194 of the Treaty on the Functioning of the European Union in a much broader way than EU energy directives that rely on a solidarity mechanism only for extraordinary situations. This means that Nord Stream 1 is now limited to 84% load factor on an annual level and is raising additional questions about Nord Stream 2...

Nord Stream and the Ukrainian transit would be the first issues the new EU Energy and Climate Change Commissioner would have to deal with when appointed in November 2019.

²⁰ <https://www.politico.eu/article/nord-stream-2-sues-the-eu-over-new-gas-rules/>

²¹ <https://www.consilium.europa.eu/en/press/press-releases/2019/07/15/council-adopts-negotiation-directives-for-modernisation-of-energy-charter-treaty/>

²² Please refer to page 18 of our Quarterly Gas Review 3, September 2018 available at <https://www.oxfordenergy.org/publications/quarterly-gas-review-issue-3/?v=11aedd0e4327>

²³ <https://www.nord-stream2.com/media-info/news-events/nord-stream-2-calls-on-court-of-justice-of-the-european-union-to-annul-discriminatory-measures-133/>

Record storage levels²⁴ 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. Therefore the next EU Commission may well stop using taxpayers' money to create gas 'winter packages' and leave the gas industry to responsibly address this issue. Failure to ensure security of supply in a fast energy transition world would be catastrophic for the whole gas industry.

With lower spare capacity and with an eye on reducing competition in China prior to the commissioning of Power of Siberia, Gazprom resumed in 2019 Turkmen imports²⁵ which it had halted in 2009.²⁶ With Power of Siberia due to start exporting Russian pipe gas to China on 1 December 2019²⁷ combined with Nord Stream 2 and Ukrainian transit unknowns in early 2020, we could again see TTF prices above Anea prices in Q1 2020.

²⁴ On 5 October according to GIE, EU storage were at 97.5% above the former all-time record of 97% achieved in October 2011.

²⁵ <http://www.gazprom.com/press/news/2019/july/article483669/>

²⁶ In a low demand and low prices world, Gazprom was better off using its own huge spare capacity than calling Turkmen gas for exports to the EU

²⁷ <http://www.gazprom.com/press/news/2019/april/article478797/>

2018 review of IOC production, reserves & strategy

As International Oil Companies (IOC) have all published their FY2018 results and their annual reports let us compare, as we did last year,²⁸ their levels of oil and gas production²⁹ at a time when Merger and Acquisition is in full swing with Occidental and Total taking over Anadarko. We have used the latest BP Statistical Review when looking at 2018 worldwide hydrocarbon production and reserves.

- Gazprom's hydrocarbon production increased by 4.8% thanks to a 5.6% growth in gas. Gazprom is the biggest listed hydrocarbon producer but more importantly, with gas representing 87% of its total production, it is the biggest worldwide gas producer.
- Rosneft's hydrocarbon production grew by 1.3% from 2017 to 2018. While liquid hydrocarbon production grew by 2.1%, gas production decreased by 1.7%. In Russia, Rosneft is a former oil company competing in both oil and gas with the former State gas company (Gazprom). Rosneft gas production represented 19% of total production.
- PetroChina hydrocarbon production increased by 2.3% as compared with last year (+0.4% for oil and +5.4% for gas). With domestic production increasing by 5.4% for gas and decreasing by 1.3% for oil, PetroChina is fully implementing Beijing's strategy to move away from dirty oil into cleaner gas. PetroChina's gas production now represents 40% of its total hydrocarbon production. With an overseas growth of 7.8% (compared with only 1.5% domestic), PetroChina is also implementing the Chinese security of supply concept based on equity oil and gas. Even if this oil and gas is sold on international markets, it is deemed more reliable in case of a security of supply issue as the oil could then be shipped directly to China. With 51,000 km of gas pipelines, PetroChina is the second largest grid operator in the world after Gazprom³⁰ (172,600 km). But with the aim of the Chinese authorities to follow the EU regulation to unbundle upstream and grid assets, PetroChina should focus even more on increasing its oil and gas production, while the newly unbundled transport operator would be in a perfect position to buy European assets that should soon be on sale. On 30 July 2019, China lifted restrictions on foreign investment in its conventional oil and gas upstream and city gas distribution sectors in an attempt to boost resource development and set the stage to break the monopoly of national oil companies. Foreign companies are now be able to operate fully owned entities in the country. This is aimed at boosting production of conventional oil and gas that has plateaued in recent years, forcing China to rely increasingly on energy imports. But attracting upstream investment to China could still be challenging, because oil majors have been diverting capex to high growth areas like US shale.
- As expected in our Gas Quarterly Review 2, ExxonMobil's hydrocarbon production was down again in 2018 (-3.8% in 2018, -1.7% in 2017, -1.1% in 2016) mostly due to gas (-7.9%). This drop in gas is concentrated in Europe (-15.1%) and pushes down gas share in total hydrocarbon production for ExxonMobil from 43% in 2017 to 41% in 2018. ExxonMobil is now focusing on the US Permian with an aggressive guidance "to reach more than 1 Mboe/d in 2024",³¹ about 0.8 Mboe/d more than net Permian production of an average of 210 kboe/d in 2018.³²
- Shell's hydrocarbon production was stable in 2018 (increasing by 0.1%). Shell production is evenly split between oil and gas and, following the acquisition of BG, Shell should continue to target more gas (+1.3% in 2018) than oil plays (-1.2%).
- Chevron's hydrocarbon production increased in 2018 by 7.4% thanks to the company mainly targeting oil in the US (+19% growth y-o-y in its US oil production). Chevron is the most "oily" big American oil &

²⁸ Available at <https://www.oxfordenergy.org/publications/quarterly-gas-review-analysis-prices-recent-events-issue-2/>

²⁹ Not all companies provide the exact same units for their reporting; the data here are as "raw" as possible vs those provided directly by the companies. The fact that 2016 was a leap year can also change some numbers if produced in yearly or daily format.

³⁰ Gazprom 2018 annual report page 47 - <http://www.gazprom.com/f/posts/67/776998/gazprom-annual-report-2018-en.pdf>

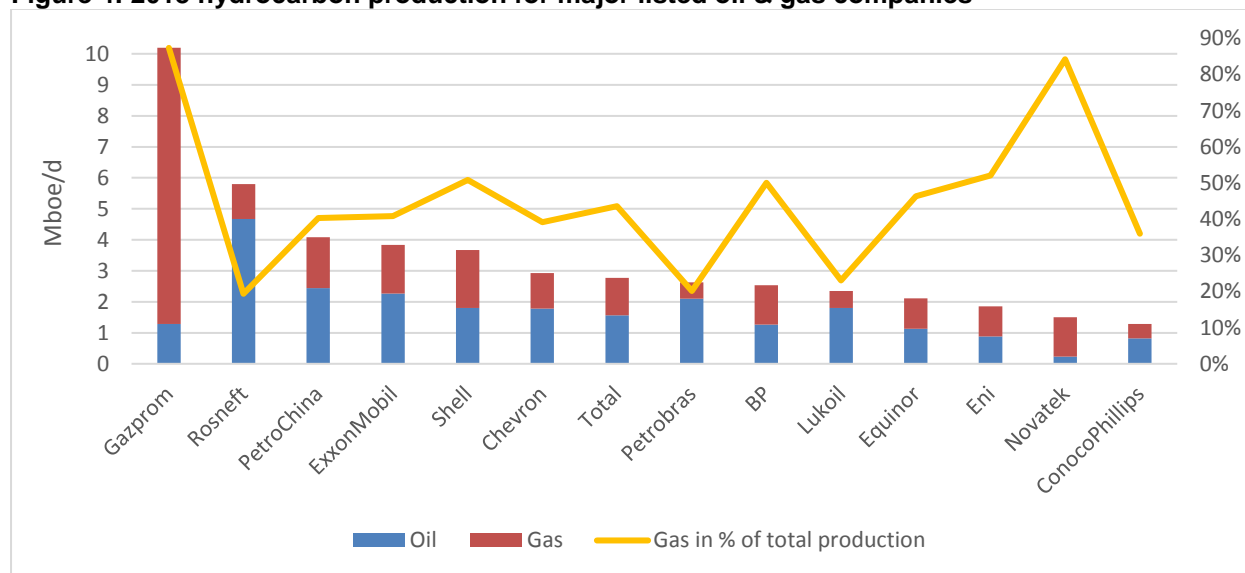
³¹ <https://corporate.exxonmobil.com/-/media/Global/Files/investor-relations/analyst-meetings/2019-ExxonMobil-Investor-Day.pdf> page 7 (up from 0.6 Mboe/d a year ago)

³² <https://corporate.exxonmobil.com/-/media/Global/Files/annual-report/2018-Financial-and-Operating-Review.pdf> page 32

gas company with gas representing only 39%. If it had taken over Anadarko, the combined company would have been within touching distance of ExxonMobil on metrics such as upstream production volumes. Failing this, with the \$1bn termination fee received from Anadarko we can expect Chevron to continue investing heavily in the US Permian to be in a position to exceed its 2023 production target.

- Total's hydrocarbon production was up by a massive 8.1% vs 2017 thanks to oil (+16.3%) while gas was slightly down. This growth is thanks mainly to the integration of Maersk Oil. With Yamal LNG and Ichthys LNG now operating, Total could move its gas share up from the 44% low witnessed in 2018.
- Petrobras' hydrocarbon production was down again in 2018 (-5%), overtaken in 2018 by Chevron and Total. Petrobras, the Brazilian national state oil company³³ is a relatively small gas company (only 20% of the hydrocarbon production is gas).
- BP's production is up by 3%, (without taking into account the 19.75% share it owns in Rosneft hydrocarbon production, to avoid double counting in this exercise). With gas up by 14.5% and oil down by 6.5%, BP has in 2018 crossed the threshold of becoming more a gas than an oil company.
- Lukoil's hydrocarbon production was up 3.4% on 2017 as gas production increased by 16.3%. Oil still accounts for 77% of Lukoil's total production.
- Equinor's hydrocarbon production grew by 1.4% in 2018 supported by a 3.9% increase in gas.
- Eni hydrocarbon production increased in 2018 (+3.2%) due only to oil (+4.1%). With gas representing 52% of the total 2018 production, ENI is the European company that is most geared to gas.
- Novatek's hydrocarbon production rebounded by 6.4% thanks to Yamal LNG start up and gas production increased by 7.6%.
- ConocoPhillips has, for the second year, experienced a massive hydrocarbon production drop of 6.8% mostly concentrated on gas (down 15.2%).

Figure 4: 2018 hydrocarbon production for major listed oil & gas companies



Source: company data, thierrybros.com

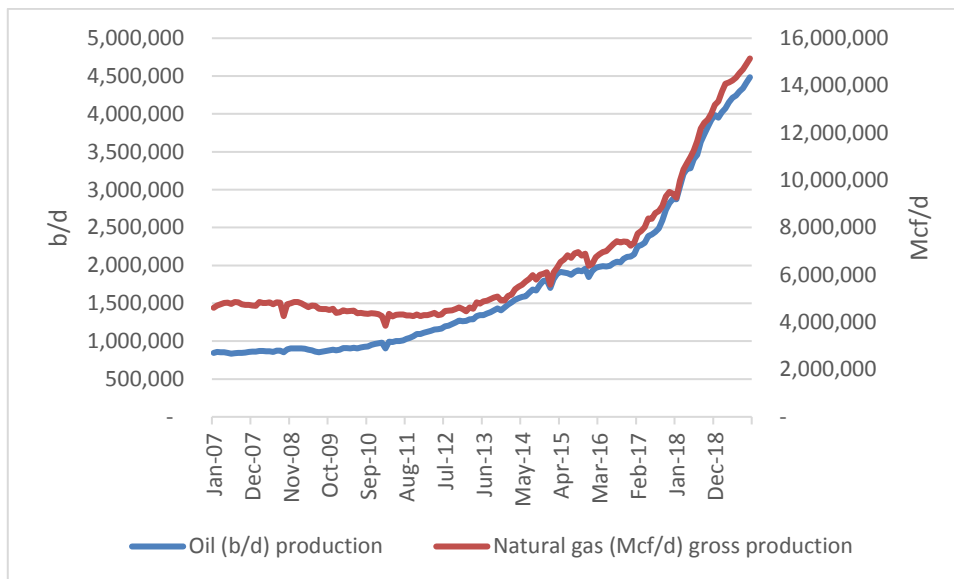
³³ The state has managed to achieve a majority voting right while only retaining 28.7% of the capital thanks to common shares, with voting rights, and preferred shares without voting rights.



It is interesting to note that the top three listed companies in terms of hydrocarbon production are all state owned (two Russian and one Chinese) with ExxonMobil only coming in fourth position. In 2018, the growth in oil production mainly came from unconventional US fields.

The H1 results of companies operating in the US Permian and the guidance provided by ExxonMobil, Shell and Devon lead us to assume that this should continue for the foreseeable future. BP is transforming its US onshore oil and gas business with its 2018 purchase of unconventional assets from BHP. Current production is around 29 kboe/d (~70% liquids). BPX Energy has operated as a separate business since 2015. Its innovative approach to using new technology such as big-data analytics, augmented reality, drones and advanced drilling techniques, has helped the business achieve significant improvements in operational and financial performance.³⁴ This is now being applied in the newly acquired Permian acreages. On the other hand, BP is steadily reshaping its strategy by selling all its Alaska business, including the giant Prudhoe Bay oil field.³⁵

Figure 5: US Permian production, an unstoppable growth



Source: US DoE

In this basin alone, oil production moved from 1 Mb/d to 4 Mb/d between April 2011 and March 2019.

With the Occidental-Anadarko deal now finalised, Occidental should, in 2019, become a global energy player and enter our top 15 list. With an expected 1.3 mb/d (net of African divestiture),³⁶ the remaining question is would Occidental enter our ranking in last place or already ahead of ConocoPhillips?

The US Permian is so promising that ExxonMobil is selling all its remaining Norwegian upstream business after having already sold its operated assets in the area 2 years ago.³⁷ This clearly shows that ExxonMobil's priorities are not in Norway any longer but in the US where the company expects during the 2018-2024

³⁴ BP 2018 Annual Report page 24

³⁵ <https://www.bp.com/en/global/corporate/news-and-insights/press-releases/bp-to-sell-alaska-business-to-hilcorp.html>

³⁶ <https://www.aglobalenergyleader.com/en/home/>

³⁷ <https://www.reuters.com/article/us-exxon-mobil-norway-divestiture/exxon-mobil-seeks-bids-for-norwegian-offshore-assets-idUSKCN1TN05R>

period, to grow its Permian production by 0.8 Mboe/d.³⁸ This comes after the exiting of ConocoPhillips and Chevron respectively from UK North Sea in April and May 2019.³⁹ All three American companies are operating in the US, with Chevron the second largest Permian producer after Occidental aiming to grow production in the basin to 0.9 Mboe/d in 2023 compared with 0.4 Mboe/d in Q1 2019.⁴⁰ All three US companies are also perhaps not so happy with the new strategy of the Norwegian Sovereign Fund (Government Pension Fund Global) which has decided that it may not invest in oil and gas producers, coal companies or mining companies.⁴¹

Callon Petroleum will acquire Carrizo Oil & Gas⁴² in a \$3.2bn all-stock transaction to create a company with scaled development operations across a portfolio of core oil-weighted assets in both the Permian Basin and Eagle Ford Shale in the US. With year to date growth of 0.9 mb/d (oil) and 3 bcf/d (gross gas)⁴³ Y-o-Y, the Permian remains the engine of growth of world hydrocarbon production.

The Permian story could allow the reshuffling of the top three producers. With ExxonMobil investing heavily there while PetroChina has not yet cracked how to produce its domestic unconventional reserves, we could soon see ExxonMobil regaining its third position, lost in 2017. To avoid this, China will extend its subsidies for unconventional gas for another three years⁴⁴ allowing PetroChina to provide increased targets for its unconventional production during H1 results.⁴⁵

It is interesting to see that since 1980, the share of gas in total hydrocarbon production has been increased from 28.4% to 42.6%. Gas accounted for 18.5% of the total primary energy mix in 1980 and has since increased to 24%.

³⁸ <https://corporate.exxonmobil.com/-/media/Global/Files/annual-report/2018-Financial-and-Operating-Review.pdf> page 32

³⁹ <https://www.bbc.com/news/uk-scotland-scotland-business-48457991>

⁴⁰ <https://chevroncorp.gcs-web.com/static-files/59b93d7d-7af8-46ca-bc4d-593dfbcabb60> slide 7

⁴¹ <https://www.nbim.no/en/publications/submissions-to-ministry/2018/the-government-pension-fund-globals-environment-related-investment-mandates/>

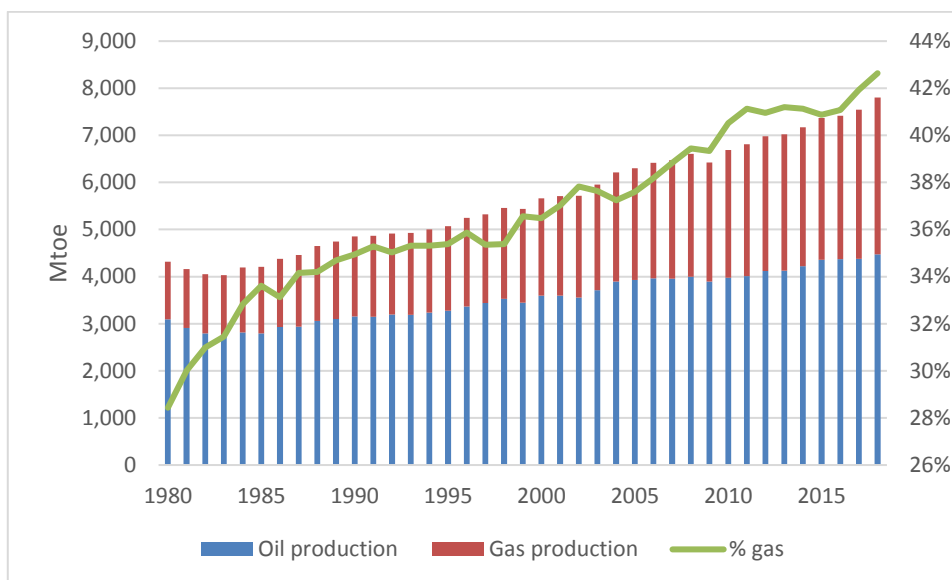
⁴² <https://www.callon.com/news/news-releases/detail/287/callon-to-acquire-carrizo-in-all-stock-transaction>

⁴³ <https://www.eia.gov/petroleum/drilling/#tabs-summary-2>

⁴⁴ <https://af.reuters.com/article/commoditiesNews/idAFL3N25P2YG>

⁴⁵ Unconventional gas production will reach 41 bcm this year, a third of the national gas output, and rise to 46 bcm in 2020, about 37% of the total domestic production.

Figure 6: Oil & Gas production



Source: BP Statistical Review, thierrybros.com

Zooming into gas

In terms of gas production, Gazprom stays the undisputed leader with a 13% worldwide market share. It is followed by Novatek (8.6% thanks to Yamal LNG ramp up), Gazprom (5.6%) and PetroChina (+5.4%). Only BP and Chevron witnessed a double-digit production growth between 2017 and 2018 (with respectively 14.6% and 14.2%).

- As well as producing 499 bcm of gas in 2018, Gazprom is the only listed company that invests in spare production capacity that we estimate at around 54 bcm (by taking the maximum daily production and comparing it to annual production) for 2018.⁴⁶ After trending down from 140 bcm in 2016 (90 bcm in 2017), this number should increase in 2019 with the commissioning of the Bovanenkovskoye⁴⁷ field's third production facility⁴⁸ in December 2018.
- Since 2016, the number 2 is now Shell.
- PetroChina with its gas production focus, has in 2018 overtaken ExxonMobil
- ExxonMobil's gas production growth in 2010 was the consequence of buying the American shale gas producer XTO. But since this acquisition, the trend is down, leaving ExxonMobil in 4th position. As oil is still much more profitable than gas, ExxonMobil stays more focused on oil and has not, as its European competitors have, shifted its focus to gas.
- BP revival post the 2010 Macondo disaster is on-going and the group managed to leap-frog from 7th to 5th in our 2018 ranking.
- Chevron's massive growth (14.2%) allows the company to move up from 9th to 6th, after entering our ranking in 2017.
- With 8.6% growth in gas production, Novatek goes up from 8th to 7th.

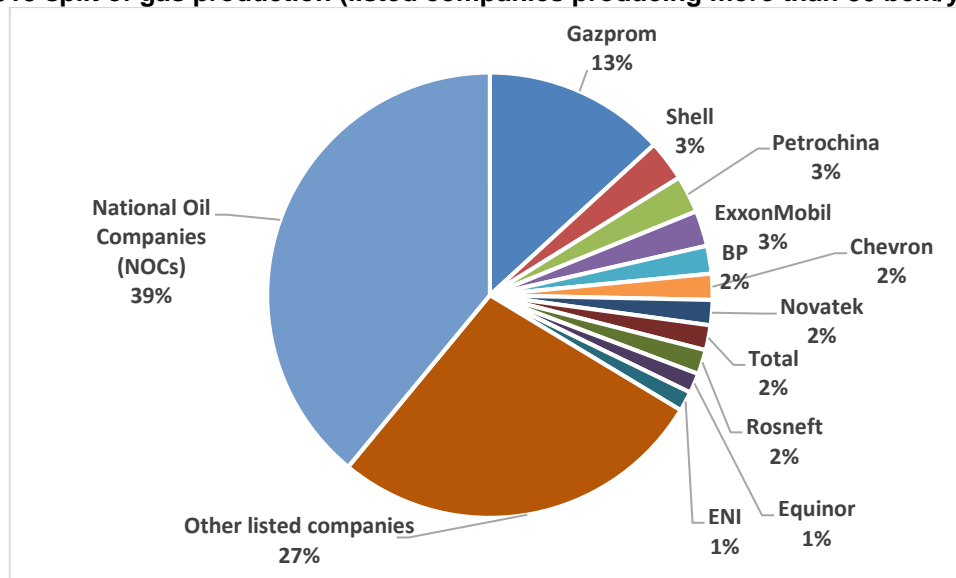
⁴⁶ In Russian bcm to keep in line with Gazprom's reporting.

⁴⁷ <http://www.gazprom.com/press/news/2018/december/article469885/>

⁴⁸ Designed production capacity: 115 bcm/y with three upstream facilities. Two have been already brought online: the first in 2012 (60 bcm/y), the second in 2014 (30 bcm/y). This leaves 25 bcm/y (Russian standards).

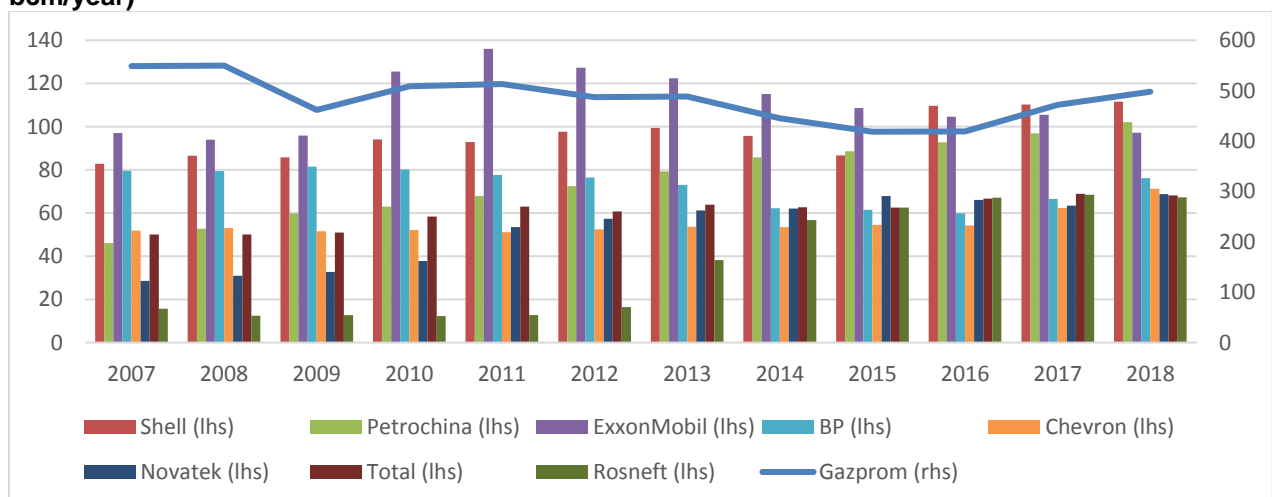
- Total and Rosneft witnessed a fall in gas production (respectively -0.9% and -1.7%) and hence in ranking (respectively to 8th and 9th). But “with its acquisition of Engie’s LNG assets Total is the second largest publicly-traded player in the LNG business, and its position will be strengthened with the 2019 start-up of the US Cameron LNG project” said CEO Patrick Pouyanne announcing Q4 2018 results. To reflect this ambition, from 2019, the group will report a new integrated “Gas, Renewables and Power segment,” which will also include the upstream gas and LNG activities, currently reported within the Exploration & Production segment.
- Equinor and ENI swap places at the end of our ranking.

Figure 7: 2018 split of gas production (listed companies producing more than 50 bcm/year)



Source: company data, thierrybros.com

Figure 8: 2007-2018 evolution of the top gas producers (listed companies producing more than 60 bcm/year)



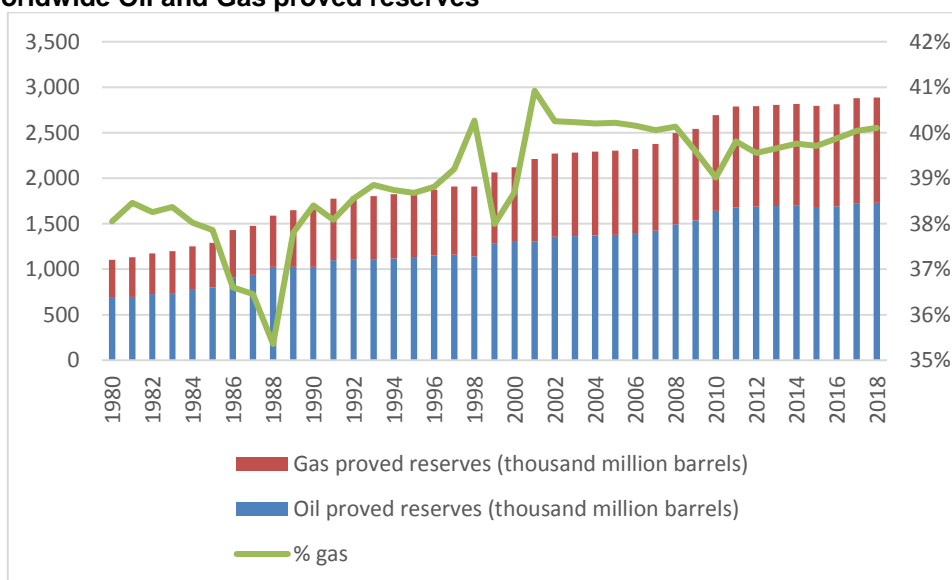
Source: company data (excluding TNK-BP and then Rosneft shares in BP), thierrybros.com

We have 3 directly or indirectly state-owned Russian companies controlling 16% of worldwide gas production.

Reserves (listed companies with over 10 bboe of SEC proven reserves)

The worldwide hydrocarbon Reserve/Production ratio (R/P) has been calculated using worldwide 2018 data as stated in the June 2019 BP Statistical Review. In 2018, world proved reserves grew by a modest 0.2% with a worldwide R/P that is trending down to 51 years as production grew by 3.4%. Most of the oil and gas reserves are in the hands of 100% state-owned companies operating in OPEC countries, leaving listed companies with much lower R/P ratios.

Figure 9: Worldwide Oil and Gas proved reserves



Source: BP Statistical Review, thierrybros.com

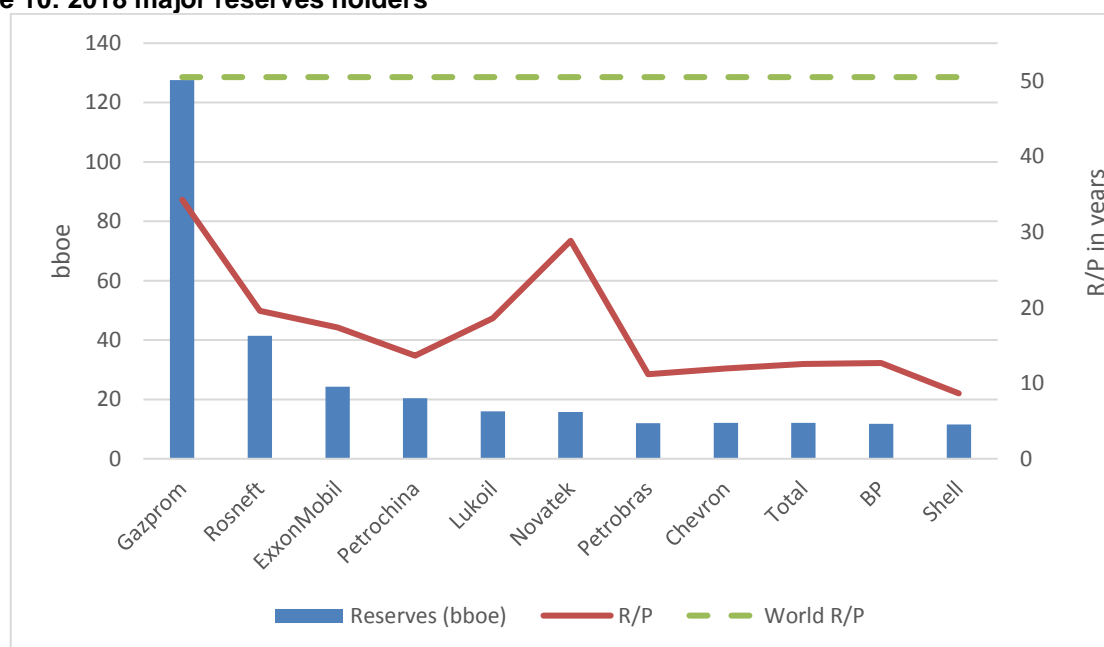
- Gazprom's proven hydrocarbon reserves decreased by 2.2% in 2018. With production up, its reserves life (2018 Reserves/2018 Production or R/P) went down from 37 to 34 years. These are still the highest reserves and R/P ratio of all major listed oil & gas companies. This high ratio explains why Gazprom is interested in maximizing production today to avoid sitting on stranded assets in the near future. This investment case, described by the company "from peak investment to higher free cash flow"⁴⁹, should allow Gazprom shareholders to benefit from higher dividends.
- Rosneft's hydrocarbon reserves increased by 3.8%. Its reserves life (R/P) totals 20 years. The exact split between oil and gas is not disclosed.
- After a massive 19.3% drop in from 2015 to 2016⁵⁰, the increase in Brent prices allowed ExxonMobil to increase its reserves by another 14.5% (after 6.2% growth in 2017). ExxonMobil has now 17 years of proven reserves. With an oil reserve growth (+35.5%) and a gas reserve drop (-10.6%), ExxonMobil reserves are more "oily" (64%), explaining why it is still focussing on oil for the years to come.
- PetroChina's proven reserves were flat in 2018 (+0.4%). Its reserves life (R/P) totals 14 years. It seems more focused on output than on reserves booking. With 63% of its reserves in gas, PetroChina should continue to grow its gas production.

⁴⁹ FY 2018 presentation – slide 13 available at <http://www.gazprom.com/f/posts/98/701327/gazprom-ifrs-4q2018-presentation.pdf>

⁵⁰ "As a result of very low prices during 2016, under the SEC definition of proved reserves, certain quantities of oil and natural gas that qualified as proved reserves in prior years did not qualify as proved reserves at year-end 2016." Source: Form 10-K ExxonMobil 2016

- Even though Lukoil's hydrocarbon reserves decreased by 0.5%, its R/P is still 19 years.
- Novatek's hydrocarbon reserves increased again by 4.4%; the company has a high R/P of 29 years.
- Petrobras's hydrocarbon reserves decreased again (-3.7%) with a reserves life of 11 years. It is interesting to note that during the "car wash" money laundering federal investigation that started in 2014, Petrobras proven reserves have shrunk by 28%. It has the lowest gas mix in its reserves (15%) and as the state-owned company with the smallest R/P it appears to be the least prepared to operate in a greener world where gas is growing faster than oil.
- Chevron's hydrocarbon reserves increased by 3.4% with a reserves life of 12 years. It is interesting to see that American companies (ExxonMobil and Chevron) are the least gassy in terms of reserves with respectively 36% and 44%, only exceeding Petrobras (15%). In a world where gas demand is expected to grow faster than oil, these companies may have to adapt their strategy sooner rather than later.
- Total's hydrocarbon reserves increased by 5% with 13 years reserves life.
- BP's hydrocarbon reserves (excluding its 19.75% share in Rosneft) increased by 11.4% with a reserves life of 13 years. By including Rosneft's share the reserve life is boosted by 2 years. This shows the importance for oil & gas companies of operating in fossil rich countries if they want to access reserves. It can either be conventional fields (in Russia mostly, as OPEC countries do not allow IOCs to book reserves) or like US companies reverting to domestic non-conventional basins as the improvements in technology now allow cost-effective production of this reserve.
- With another drop of its hydrocarbon reserves by 5.4% in 2018 (following the Dutch decision to close Groningen), Shell moved down 3 places. After consolidation with BG in 2016 Shell divested away from synthetic crude. It has the lowest R/P ratio of our sample with only 9 years. In a fast energy transition, this could be viewed positively as it should avoid stranded assets. But if the energy transition takes longer, Shell will need to acquire and/or find new reserves.

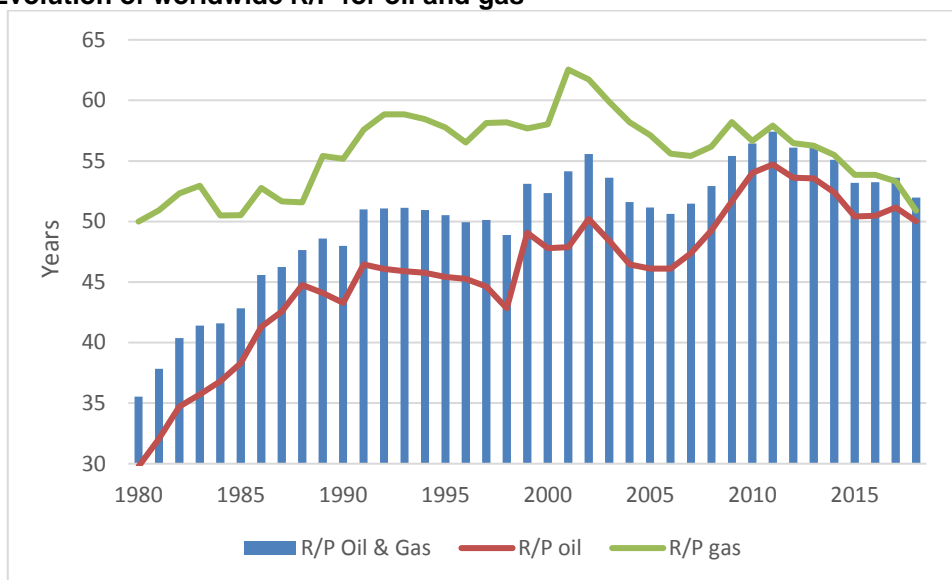
Figure 10: 2018 major reserves holders



Source: company data, BP Statistical Review, thierrybros.com

Most hydrocarbon resources are in the hands of state-owned companies. The top four listed companies that have the largest resources include two Russian and one Chinese (all three partially state-owned). But having vast hydrocarbon resources in a world facing an energy transition could become problematic in terms of valuation.

Figure 11: Evolution of worldwide R/P for oil and gas



Source: BP Statistical Review, thierrybros.com

Oil and gas producers seemed in 2018 not to be interested in booking additional reserves as they expected that in 50 years the demand for fossil fuel would be in decline. What is more striking is that, with gas the fastest growing fossil fuel (+5.3% from 2017 to 2018), the R/P ratio for gas is declining faster than for oil (-5 years for oil, -7 years for gas for the 2011-2018 period). But perhaps with the major worldwide oil company (State owned Saudi Aramco) now venturing into gas, this trend could be reverted in the years to come.

Is our energy transition to a net-zero carbon emission world going to take decades, as IOCs are expecting or only years, as some policy makers are suggesting? To help answer this question it is worth remembering that consumers are addicted to cheap energy, as the French Gilets Jaunes movement showed in 2018. Market forces are already excluding some too expensive energy options (Arctic oil, oil sands, coal in the US and the UK, and so on). Hence IOCs are concentrating on cheap to produce hydrocarbons to be able to compete with renewables which are getting cheaper each year.

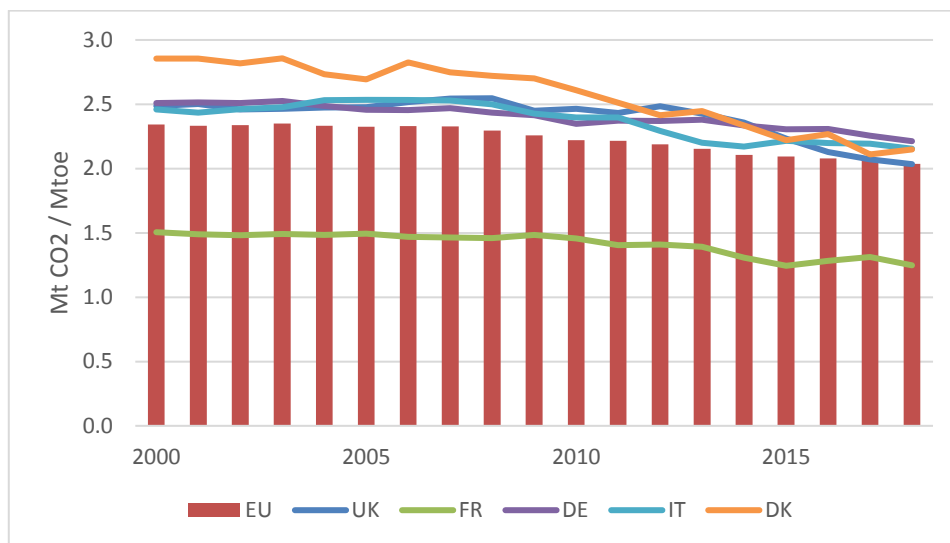
The technological race to provide consumers with cheap energy is in full swing. States should foster this race, stay fuel-neutral and intervene only on the CO₂ level by simply taxing it. However, badly implemented political interventions could lead to what we have seen in Germany:

- an on-going nuclear to coal switch for electoral purposes, which could be considered by future generations as a poor decision on a climate level as it is massively increasing the CO₂ emissions of the electricity produced;

- to be followed by a state planned 20-year coal retirement⁵¹ when it took less than 4 years to achieve this in the UK by simple market forces;
- with cross subsidies⁵² to provide domestic industries with an unfair advantage (cheap energy) at the expense of residential customers facing record electricity prices;
- and a complete weakening of the former big German utilities.

In short, the German energy transition will be regarded in future as a poor example as the nuclear to coal switching has not allowed Germany to even match the average EU CO₂ emission per total primary energy used. On the other hand, the French Gilets Jaunes are a stark reminder that most consumers are not prepared to pay more to pollute less. The first steps of decarbonisation (switching away from coal) are becoming easier and cheaper with time, but it is not actually possible to cost a decarbonisation scenario in full. With no idea of the cost it is impossible to assess whether such a scenario will be accepted by customers/taxpayers.

Fig 12: CO₂ emitted per total primary energy used



Source: BP Statistical Review, thierrybros.com

Oil and gas companies will continue to face two major risks: an economic risk if they are not able to provide the cheapest energy and a licence to operate risk. Some will disappear as Anadarko did this year, some will survive either by moving faster into a net-zero carbon emission world by acquisition or technology. This can explain why Shell, after focusing on gas with the BG deal, is now focusing on electricity by buying an Australian power retailer⁵³. A race focused on cheap-to-produce energy should benefit all consumers. Any over expensive technology, even if renewable, is bound to lose this race, as might be the case, for example, with a strategy to become an expensive major bio-methane producer.⁵⁴

⁵¹ Even if this was crafted for electoral purposes, the Angela Merkel coalition will not be around long enough to continue to benefit from this long coal retirement state planning.

⁵² Cross-subsidies are normally banned in the European Union to avoid exactly such an unfair advantage.

⁵³ <https://solarprojectfinancing.wordpress.com/2019/08/22/shell-offers-to-buy-australian-power-retailer-erm-for-417-2-mil/>

⁵⁴ Engie expects (<https://www.engie.com/en/businesses/gas/biogas/>) to reduce the cost of bio-methane to around 66 €/MWh in 2030 compared with an actual gas price of 10 €/MWh.