Investment

in

exploration, production

and

refining

2017

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The authors

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Sources:

- Upstream oil sector, IFPEN based on data from:
  - global investments: Barclay's, DTI, NPD, DEA, figures published by various companies and countries, IFPEN forecasts.
  - geophysical market: IHS Energy, First Break, Spears & Associates, IFPEN.
  - drilling market: Baker Hughes, IHS Energy, Offshore Rig Locator, Spears & Associates, IFPEN.
  - offshore construction market: IHS Energy, Spears & Associates, IFPEN.
- Downstream oil sector: IFPEN based on HPI Market Data, IFPEN forecasts

SUMMARY

Based on surveys of expert opinion, in the absence of extraordinary geopolitical or economic circumstances, ***oil prices*** *could rise in the range of $55 to $70/barrel, compared with $54/barrel in 2017. This prospect for higher prices is consistent with the expected restabilization of the market and a favorable economic and financial climate. Shifts in oil prices are clearly possible, upward in the case of potentially weak investment in exploration/production, or downward if U.S. supply is greater than previously expected. The* ***wholesale price of natural gas****, which rose during 2017 in Europe, Japan and the United States, may again rise in 2018 due to steady demand and changes in the price of oil and coal.*

Following two years of significant declines (-24% in 2015, -28% in 2016) ***worldwide investment in exploration-production*** *(E&P) grew 4% in 2017 to reach $390 billion ($billion). Growth is focused in North America, where investment jumped by more than 30%, while it fell slightly in the rest of the world, especially in Europe. This can be attributed to independent oil companies, whose worldwide investment rose 23%, while the E&P budget for NOCs was stagnant and those for the major oil companies continued to sharply decline (-16%).*

Except for the U.S. onshore shale ***drilling*** *market, all Exploration and Production markets have continued to decline since 2015 with the drop in oil prices. The markets lost half their value over a three year period.*

Offshore drilling, when carried out in deep and ultra-deep water, continues to decline due to excessively high intrinsic costs. Only those projects that have considerably revised their costs (-30 to -40%) could be approved.

Investment by oil and gas operators concern existing fields, at the expense of development in new regions. Postponement and cancellation of major projects impacted the ***offshore construction*** *markets.*

The ***geophysical*** *market remained sluggish during 2017. Contractual surveys were rare, often replaced with more accessible multiclient surveys. This environment forced a reconfiguration of the sector through mergers and acquisitions.*

Will ***refining*** *projects start to increase, and halt the declines seen over the past four years? This is a question worth asking. Factors that favor investment in new projects include (1) the growing demand for oil products, whose center of gravity has shifted in recent years from industrialized countries to emerging markets, (2) margins that remain solid, (3) low industrial costs, and lastly (4) a reviving global economy. Tightening fuel standards, various rehabilitation programs, modernization and growth within the sector also create opportunities for investment, especially in regions with high demand.*

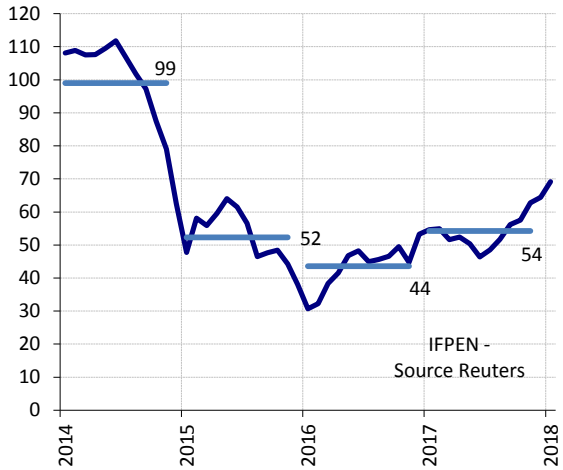
Despite the uncertainties - changing demand for oil products, margin volatility, rising industrial costs - the investment outlook remains intriguing.

1. Trends in oil and gas prices

1.1. Expected rise in oil prices in 2018

Based on surveys of expert opinion, in the absence of extraordinary geopolitical or economic circumstances, oil prices could rise in the range of $55 to $70/barrel, compared with $54/barrel in 2017. This prospect for higher prices is consistent with the expected restabilization of the market and a favorable economic and financial climate.

Figure 1: Monthly and annual Brent price between 2014 and 2017 in $/b



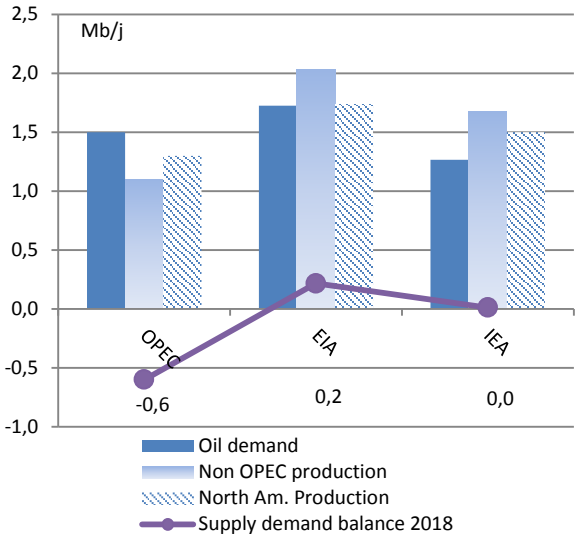
Global economic growth should be solid during 2018 as in 2017, if one believes the latest forecasts from the IMF and the OECD. This is evidenced by forecasts for relatively sustained global demand, ranging from 1.3 Mb/day (IEA) up to 1.5 Mb/day (OPEC). This is one of the factors that explains the relative pressures expected on price. The IMF raises various financial and geopolitical risks that could undermine these economic forecasts. Downward corrections in the financial markets could result, which generally have a negative impact on oil prices.

As usual, anticipated oil prices for 2018 reflect the interplay of market forces (adjustment of supply and demand). On the supply side, there are two key factors: first, OPEC's supply management strategy, implemented in January 2017 and extended through the end of 2018, and second, U.S. oil production. U.S. production, propelled by shale oil, is currently showing mixed signals. After reaching a peak of 9.8 Mb/day at the end of 2017, up 0.8 Mb/day over one year, it has showed signs of stagnation since the end of November 2017 before resuming its climb. As in 2017, uncertainty regarding future potential can create highly volatile oil prices. More broadly, global uncertainty about future supply, due to potentially weak investment in exploration/production, could place significant pressure on prices in anticipation of tensions.

Against this background, outlooks for 2018 are somewhat variable, judging by the three leading organizations, IEA, the U.S. EIA and OPEC. In particular, OPEC expects a more moderate rise in U.S. production. Taking into account discrepancies between demand forecasts, assessment of the oil market reveals a balanced market in 2018 in the view of IEA and EIA, and on the contrary, a significant shortfall according to OPEC. The latter case would result in greater pressure on price.

It should be emphasized that the Saudi energy minister does not wish to see sharp price increases: *"We don't want any spikes in price that shock the market."* Thus, OPEC may react to tensions in the oil market. Conversely, a greater than expected increase in U.S. supply cannot be ruled out, which would require OPEC to limit its supply.

Figure 2: 2018 increase in worldwide demand for oil and production and supply/demand balance

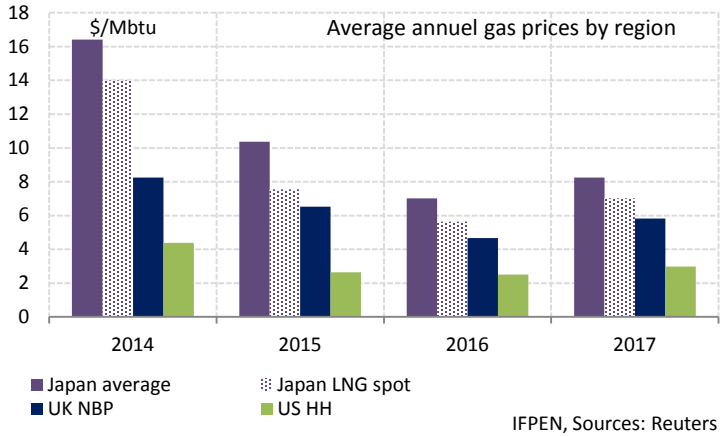


Faced with these uncertainties, there is a wide range of expectations for 2018 oil prices. The lower threshold is at $55/barrel, close to the 2017 average, while the upper threshold, reached in January 2018, is estimated at $70/barrel, at the level of marginal supply cost. These various milestones seem possible in 2018.

1.2. Rising market price for gas

The price of natural gas, which rose during 2017 in Europe, Japan and the United States, may again rise in 2018 due to steady demand and changes in the price of oil and coal.

Figure 3: Average annual price of natural gas by region between 2014 and 2017

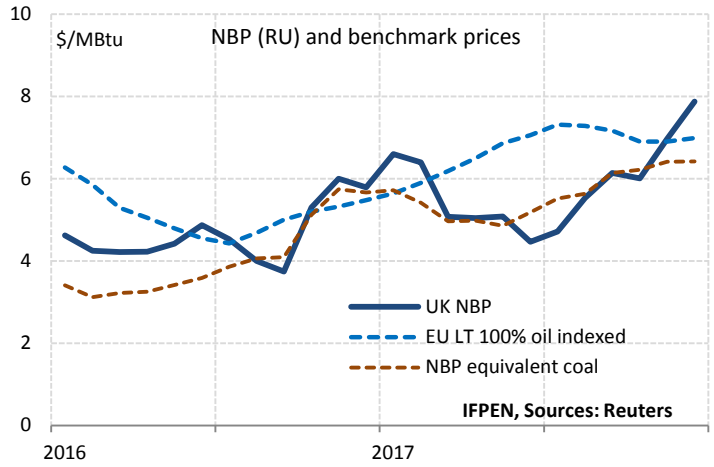


1.2.1. *Gas price in Europe (based on the British NBP benchmark)*

The NPB price, the base price for the spot-traded gas market in the United Kingdom, rose 25% in 2017 to reach $5.8/MBtu (€17.6/MWh, +22%).

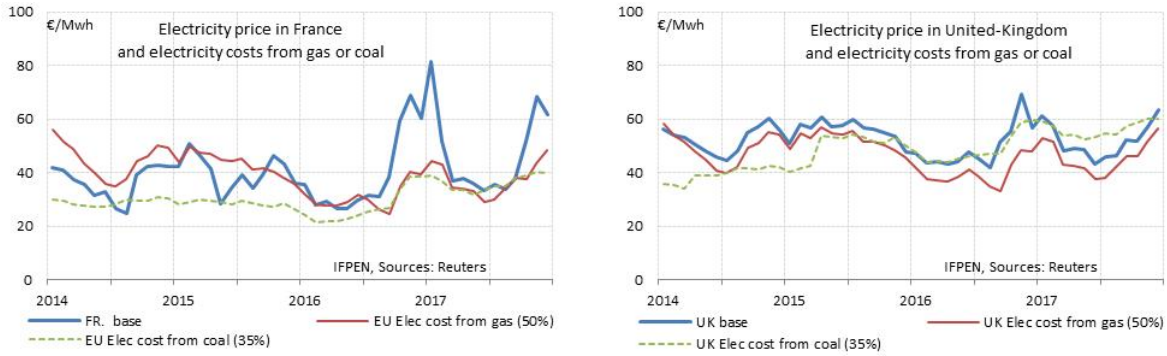
Several factors have contributed to this change. European demand for gas is especially buoyant, with growth estimated at more than 5% in 2017. This results not only from higher consumption in the winter months, but also the improved competitiveness of gas compared with coal in the electricity sector. This is even more pronounced in the United Kingdom due to Carbon Tax Support (CTS), set since April 2015 at £18/tCO2, or €21/tCO2. This contributes to a higher market price for electricity when compared to continental Europe, which favors the development of fossil fuel alternatives.

Figure 4: Monthly price of gas in the United Kingdom and benchmark prices (coal and oil base)



On average during 2017, production costs for electricity generated using gas and coal were below €40/MWh on the continent, compared with €46 and €56/MWh respectively in the United Kingdom. Thus, CTS favors gas over coal, and gives a higher benchmark for the price of electricity.

Figure 5: Price and production costs for electricity generated by gas and coal, in France and the United Kingdom

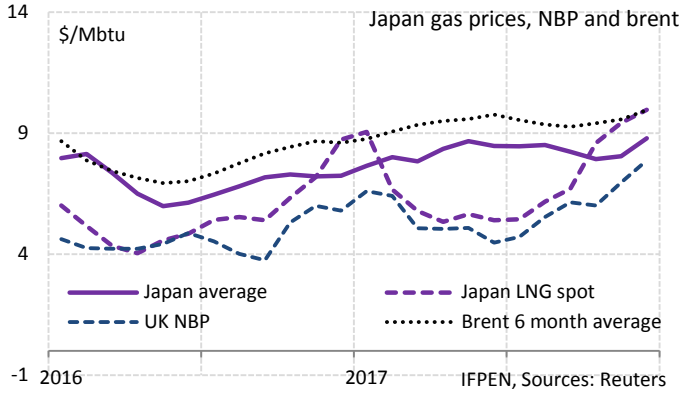


The upward trend in the price of gas also results from higher prices for oil (25% in 2017) and coal (40% in 2017). Oil prices directly influence the price of oil-indexed long-term contracts, and indirectly impact the price of liquified natural gas (LNG), setting a benchmark for gas spot prices, particularly in the winter. In summer, the market's lower benchmark seems to be defined by the production cost of coal-generated electricity (excluding CTS). Rising coal prices lead to an increase in the NBP benchmark price during the summer.

1.2.2. *Gas price in Japan*

The average import prices for gas in Japan was $8.2/MBtu in 2017. It rose 17%, due to the impact of oil prices on long-term contracts as well as rising spot prices. The spot price for LNG rose 25% to reach $7.0/MBtu. Steady demand for LNG in Asia, which rose around 10% in 2017, was the source of market tensions during the last two winters (2016/2017 and the end of 2017). The average import price in Japan may still increase during 2018 if oil prices remain above $60/barrel.

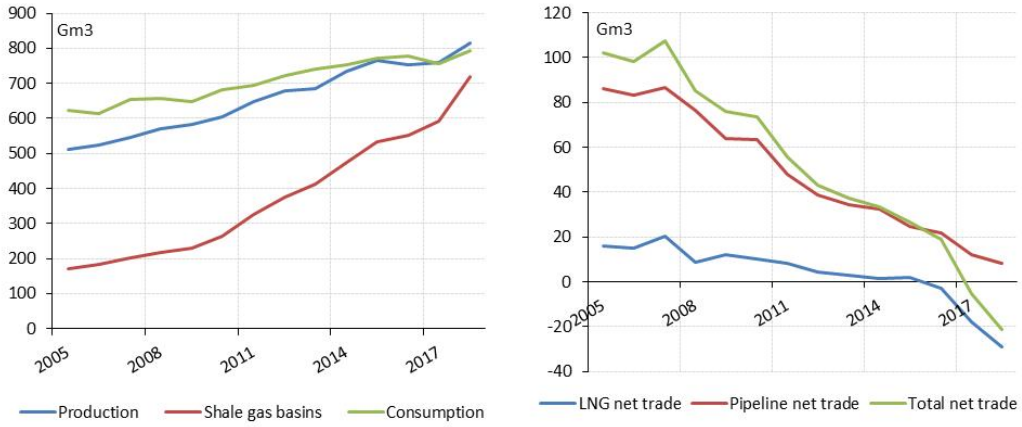
Figure 6: Monthly price of gas in Japan and benchmark prices (NBP and oil)



1.2.3. *Gas price in the United States (benchmark: "Henry Hub")*

After reaching historically low levels in 2015 ($2.6/MBtu) and 2016 ($2.5 /MBtu), the price of Henry Hub began to rise in 2017 to reach $3/MBtu, a gain of 19%. The markets expect further increases during 2018. This is explained in part by the especially cold winter in late December 2017/early January 2018, which drove prices upward in January (to $7/MBtu) which will adversely impact stock replenishment throughout the year.

Figure 7: Summary of the U.S. gas market: production, consumption and trading

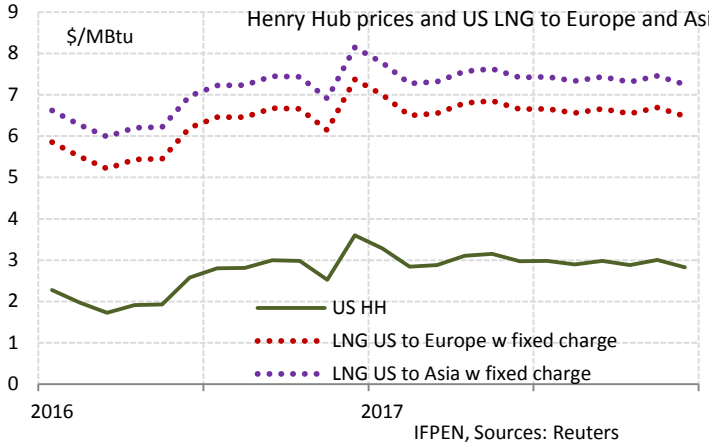


In addition to weather conditions, the share of gas associated with oil production in certain basins (including the Permian basin) will also be carefully watched. Downward pressure on the Henry Hub price cannot be ruled out if significant quantities are placed on the market.

Rising exports of LNG would also impact gas prices in the U.S. market. In 2018, net exports of LNG are estimated at nearly 30 Gm3, i.e. 8% of worldwide trade and just under 5% of global domestic consumption. The situation in the global LNG market, whether under tension or in surplus, will trigger the Henry Hub price either upwards or downwards.

Conversely, U.S. LNG will impact the global LNG market. U.S. LNG exports will reduce average import costs. This influence will occur through a volume effect, more gas becoming available on the market. It will also occur through a price effect, as U.S. prices are more favorable than gas prices indexed to oil when the oil price exceeds approximately $50/barrel.

Figure 8: Monthly price of gas in the United States and delivery price of LNG in Japan and in Europe

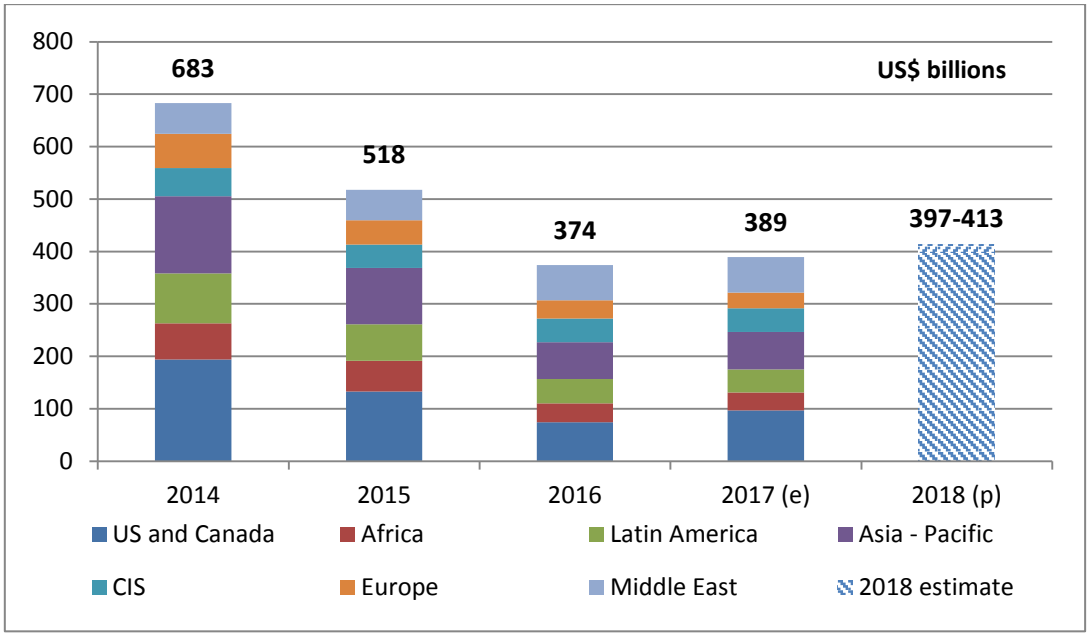


2. Investment in exploration-production - a modest recovery driven by North America

2.1. Strong growth in North America but slight drop in investment in the rest of the world

Following two years of precipitous declines (-24% in 2015, -28% in 2016) worldwide investment in exploration-production (E&P) rose slightly 4% in 2017 to reach $390 billion ($billion). This modest average growth conceals a broad disparity between North America, which reported strong growth (+31%), and the rest of the world, which posted continued decline (-3%), mainly due to Europe (where E&P budgets fell 14%), Africa and Latin America (-5% in each of these regions). Investments were stagnant elsewhere: -1% in the CIS, +1% in the Asia-Pacific region and the Middle East.

Figure 9: Trends in global E&P investment



2017 growth was almost entirely driven by independent oil companies, whose investments soared by 23%. Among these, North American independents[1] stood out with investments up by 60%. On the other hand, budgetary discipline remains in place at the major oil companies (BP, Chevron, ExxonMobil, Shell, Total) whose investments declined by 16%, while there was a slight increase (+2%) at the national oil companies (NOC).

Table 1: Investments by company type

	2016	2017	Part 2016	Part 2017	Evolution
Independents:	102	126	27	32	23%
International	*73*	*79*	*19*	*20*	*9%*
North- America	*29*	*46*	*8*	*12*	*60%*
NOC's	193	197	52	51	2%
Majors	80	67	21	17	-16%
Total	**374**	**389**	**100**	**100**	**4%**

[1] North American oil companies without international activity

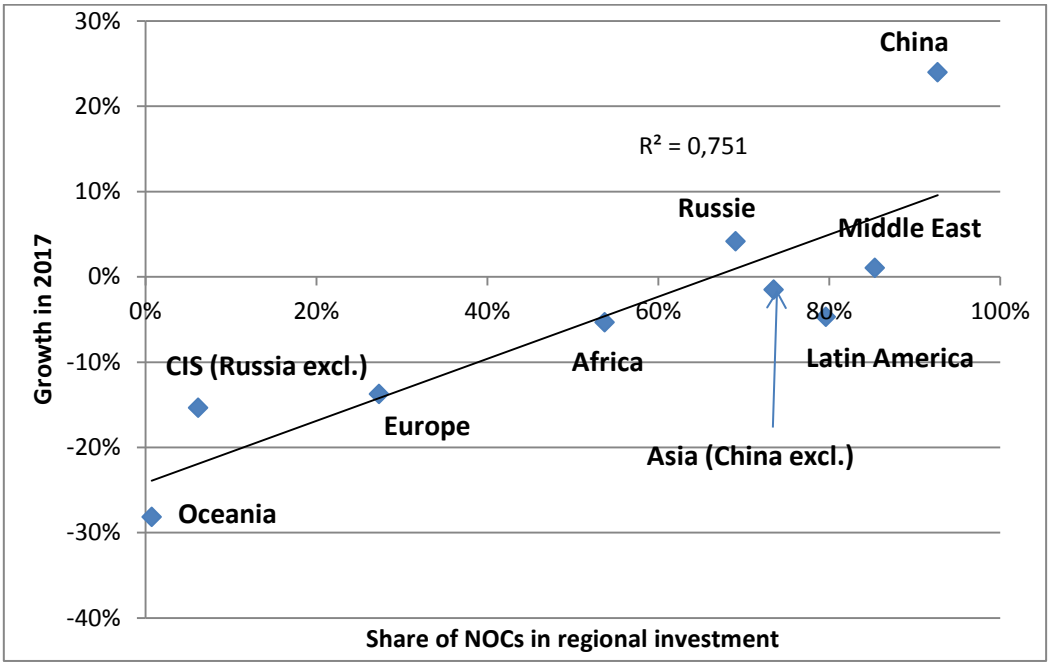
In 2018, and assuming oil prices that experts believe ranging between $55 and $70/barrel (according to the latest Reuters survey), global exploration-production investments should rise 2 to 6%, with growth again concentrated in North America.

2.2. Regional developments

Increased investment activity in 2017 only concerns North America. This rise, driven by the resumption of onshore drilling, is entirely due to independent companies which represented 77% of North American E&P investments in 2017. Among these independents, it is important to distinguish those whose business is limited to North America[2] from those with an international presence[3]. The first, which only operate onshore deposits (mainly shale oil), saw their investments literally soar in 2017, with a 60% rise compared with 2016. The second, which often operate offshore in the Gulf of Mexico and in the Canadian tar sands - sectors in which investment fell during 2017 - accordingly saw less growth in their investments (+23%[4]). Investments in NOCs in the North American upstream sector rose markedly on a percentage basis, but because they only represented a small fraction (4%) of CAPEX in the region, their contribution to 2017 growth was negligible in absolute terms. Finally, investment by major oil companies declined due to their substantial offshore presence in the Gulf of Mexico and/or in the Canadian tar sands.

In other regions, changes in investment is well-correlated to the influence of NOCs in the region. NOCs have maintained, and even slightly increased their investments in 2017, while the major oil companies sharply reduced them (-20% excluding North America).

Figure 10: Growth in E&P investment based on significance of NOCs



In Europe, investments in the United Kingdom fell sharply by 22%[5]. This decline was expected since, following a peak in 2014, investment in the British North Sea entered terminal decline as reserves approach exhaustion. This decline should continue at an average rate of 13%[6] per year until 2022

[2] Referred to as "North American independents"
[3] Known as "international independents"
[4] Investments by international independents in North America.
[5] In USD
[6] In constant 2016 pounds

according to OGA (Oil and Gas Authority - UK) projections. In Norway, investments fell by 9% in dollars (11% in Norwegian krone). After reaching record levels in 2013 and 2014, investments in Norway fell due to declining oil prices and the completion of numerous projects. They should remain relatively stable in 2018 before a modest upward shift in 2019, according to estimates by the Ministry of Petroleum and Energy.

In Africa, despite steady investment by NOCs, regional investment fell due to budget cuts by major oil companies and independents. However, the situation varies depending on the country. Egypt, which is the leading African nation in terms of E&P investment in 2017, benefits from the development of major gas projects (specifically Zohr and Atoll, respectively operated by ENI and BP), and posted strong CAPEX growth (up 67%)[7]. On the other hand, investments in sub-Saharan Africa fell sharply (¬17%)[8].

In Latin America, investments by Petrobras rose (+11%) following a significant decline in 2016, which resulted from a scandal that shook the Brazilian national company. Investments by Ecopetrol in Columbia jumped significantly (+138%) due to a strong pick-up in exploration. In Venezuela, investments by PDVSA fell by 10% under the effect of economic stagnation and the political crisis. PEMEX sharply reduced its investments in Mexico for the second consecutive year (-46% in 2017)[9]. Finally, in Argentina, investments by YPF fell 10%, but the CAPEX of private companies, representing 50 to 60% of E&P investment, trended upward, though this did not fully offset the declines in the national company's budget.

Investments fell slightly in the CIS, with the 4% increase posted in Russia failed to offset the declines in other countries within the region (-15%). In Azerbaijan, investments to develop Phase 2 of the Shah Deniz field, which still represent 2/3 of E&P investments in the country, peaked in 2015 and have declined since that time. Because development is almost completed - initial production is expected in 2018 - this decline is expected to continue. The same situation exists in Kazakhstan, where investment fell following completion of Phase 1 of the Kashagan field which, after more than a decade marked by delays and successive cost overruns, finally appears to be on track following its 2016 launch. Elsewhere, E&P CAPEX rose in Turkmenistan and Uzbekistan.

Investments stagnated in Asia-Oceania (+1%), but with sharp contrasts between Oceania, where they fell 28% following the completion of a number of major LNG projects, China, where they rose sharply by 24%, and the rest of Asia where investments fell slightly (-2%). In China, investments by Sinopec soared by 57%, those by Petrochina increased 10%, while CNOOC's budget declined (-3%). In South-East Asia, investments by PTT E&P rose markedly by over 50%, following an equivalent drop on a percentage basis in 2016, while Pertamina's investments were stable and Petronas lowered its CAPEX by 4% in E&P. In Oceania, two-thirds of the decline in investments is attributable to Chevron, which in 2017 completed the third phase of its Gorgon LNG project.

Trends remain stable in the Middle East, where investment rose modestly by 1% with differences among the countries. They rose in Iran, Saudi Arabia and Kuwait (+6% for NIOC, +4% for Saudi Aramco and +3% for KOC); were stagnant in Qatar; and fell in the Emirates and in Oman (-10% for ADNOC, -5% for PDO).

[7] Source Wood Mackenzie Upstream Data Tool, November 2017 - IFPEN analysis
[8] Ibid.
[9] Significant discoveries made by PEMEX and foreign companies in the Gulf of Mexico during 2017 foretell a return of investment to Mexico in the coming years.

3. Drilling and the global drilling market

3.1. Onshore and offshore drilling

SUMMARY: In 2017, after two years of decline, the number of wells sunk should increase by 22%, bringing the total number of wells to 64,000 worldwide, which remains significantly below the 100,000 wells achieved in 2014.

This rebound is mainly due to increased onshore drilling in North America for exploration and development of shale oil and gas.

Deep offshore drilling is still hampered by offshore drilling costs, which represent a large proportion of project costs. However, drilling rig utilization rates seem to have reached a low point, and some leasing rates have risen, particularly for jackups and shallow water offshore developments in the Gulf of Mexico.

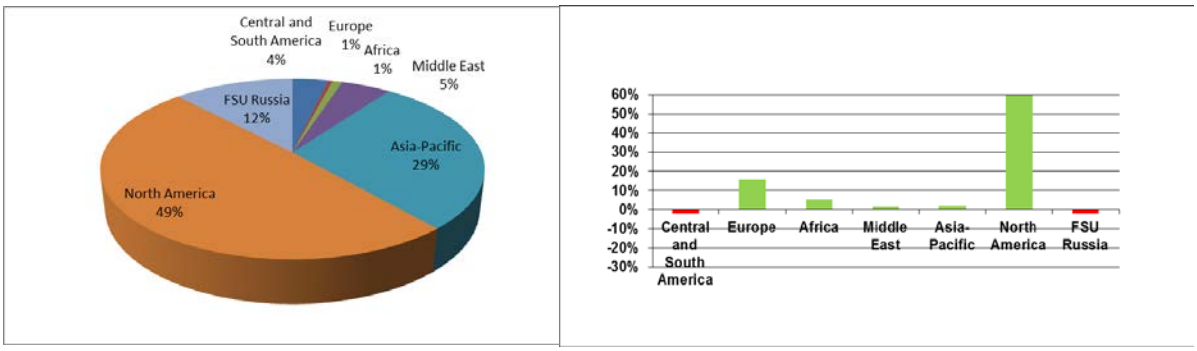
After falling by 36% in 2016, the worldwide drilling market and related services is expected to bounce back by 8% in 2017, reaching approximately $136 billion. The hydraulic fracking market is especially dynamic, especially in the United States, with a 63% increase over one year. The onshore drilling market is expected to grow by 21%, while offshore drilling should continue to decline (-29%).

3.1.1. Number of onshore wells drilled

During 2017, worldwide onshore drilling activity rebounded by 23%, especially in North America (+60%) due to development of shale oil and gas in the United States and Canada. To a lesser extent, onshore drilling in Europe also increased (+16%), though it concerned a very small number of wells (35), driven by drilling plans related to shale gas exploration programs in the United Kingdom and in Poland. However, this growth's sustainability is uncertain, given societal opposition.

All other geographic regions are up slightly (from +2% to +5%), except for South and Central America and the CIS, which were stagnant (-2%).

Figure 11: Distribution of onshore drilling in 2017 by region (a) and growth in one year (b).



(a) *(b)*

- **North American shale oil and gas**

After a sharp decline in shale drilling activity during 2015, following a decline in oil prices, 2016 was a pivotal year for stabilization and, according to the EIA, 2017 ended with more than 810 active rigs. Note that the maximum number of rigs active in shale basins at the end of 2014 had exceeded 1,500, then reached a low point of 320 in mid-2016.

Despite the fact that activity is down by 50% compared with the end of 2014, at the end of 2017 shale oil production had surpassed its record of 6 Mb/day, and shale gas production barely weakened, continuing to rise and exceeding 1.7 Gm3/day at the end of 2017.

Well architecture and completion changed over the course of several years, achieving greater production with fewer pads. Wells are drilled in record time, sometimes taking just 2 weeks. Drillers benefit from geological knowledge gained during earlier drilling, with shorter rig downtime leading to lower drilling costs. The number of fractures and their placements are optimized to reach a maximum number of sweet spots. This improves productivity by a factor of 2 or 3, depending on the basin. In December, the Permian basin had the largest number of active drilling rigs (398), 49% of the total.

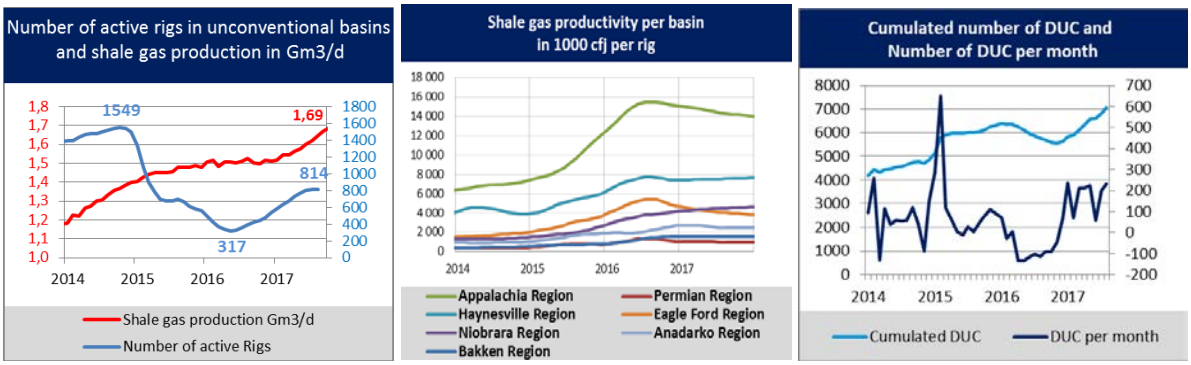
To make rig leasing profitable, more than 7,000 wells were drilled but not completed. When an uncompleted well is finally equipped for production, it lowers the number of DUCs. This means that the number of DUCs per month may become negative (see Figure 12c below); this is especially the case in periods when the price of WTI is rising. Given this surplus of wells ready to be equipped, there is a strong likelihood that production will rise in the future. However, infrastructure for offloading crude oil is a constraint.

Figure 12: Shale gas wells in the United States.

(a) Number of rigs for shale gas drilling and production;

(b) Change in gas well productivity per basin since 2014;

(c) Number of wells drilled but not completed (DUC - Drilled UnCompleted), cumulative and by month.



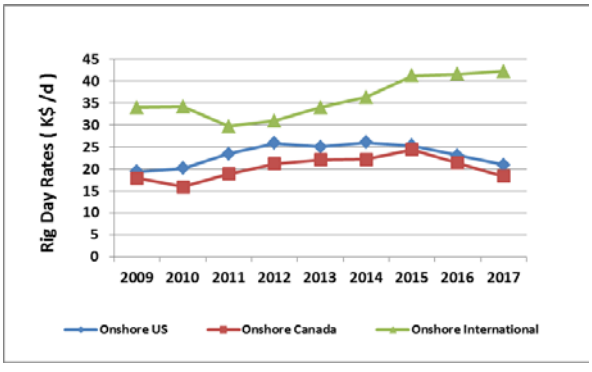
(a) *(b)* *(c)*

- **Onshore rig leasing rates**

Despite the uptick in North American drilling activity, in mid-2017 the rig leasing rate was approximately $21,000 per day and remain down over one year, by 14% in the United States and 27% in Canada. The drilling sector continues to face an oversupply of rigs in relation to demand.

Overseas (excluding North America), in mid-2017 leasing rates have stabilized (+1%), for the past two years, at around $42,000 per drilling day.

Figure 13: Daily rig leasing rate in North America in the rest of the world ($000/day)



3.1.2. Number of offshore wells

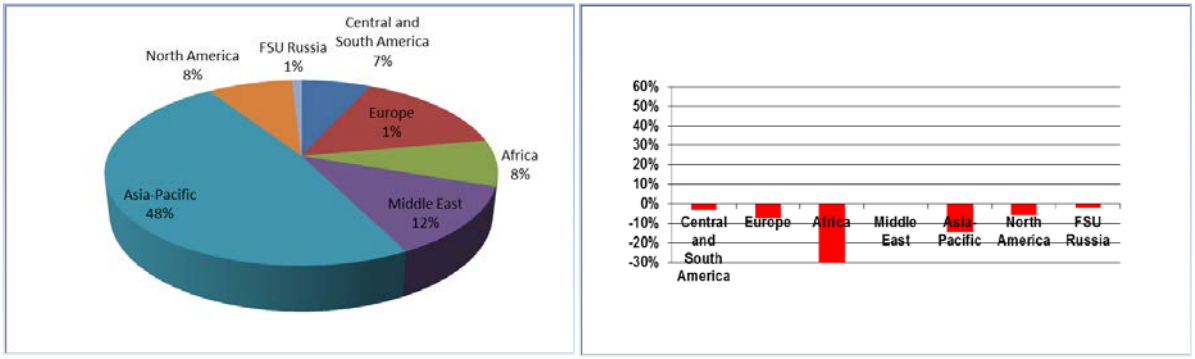
- **Number of offshore wells**

Offshore production costs, and specifically deep offshore, hinder the development of offshore drilling. It is estimated that 2,400 wells were drilled in 2017, down 12% over one year. Note that 2015 and 2016 were already marked by 10 to 20% declines in drilling activity. However, there has been a slowdown in the pace of decline, with oil prices returning to levels above $60, a price threshold commonly deemed necessary for profitable deep offshore projects.

During 2017, declines were seen across every geographic region. African offshore drilling was especially impacted (-31%) due to the cost of major deep and ultra-deep offshore projects, that were very capital-intensive and postponed for lack of investment.

The Asia-Pacific region, representing almost half of worldwide offshore drilling, also felt the effects. China, its main contributor, slowed its offshore development. Activity was stable in the Middle East, with its large fields and shallow water depth. Brazilian offshore drilling benefitted from highly productive wells, which limited the impact of cost overruns for pre-salt developments.

Figure 14: Offshore wells sunk in 2017 by region (a) and growth over one year (b).



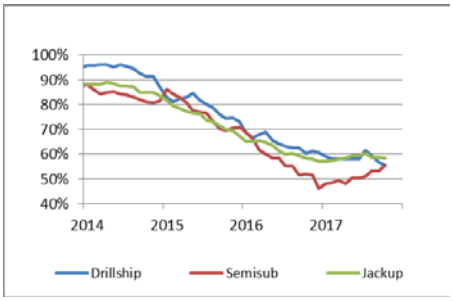
(a) *(b)*

- **Offshore drilling rig utilization rates**

Offshore construction continues to drive the market for new drilling rigs. However, given the weakness in activity and despite the dismantling of the oldest rigs, the global utilization rate for rigs (all types included) fell by 1% over one year, which constitutes a stabilization in comparison with the sharp declines seen in 2015 and 2016.

Note that the utilization rate was 90% on average in 2014, before the drop in oil prices. Since early 2017, drilling rig leasing rates have changed based on the type of drilling rig. The 58% rate for semi-submersibles rose 8% since the start of 2017. The 59% rate for jackups rose by 2%. Only the utilization rate for drillships, at 56%, continues to decline, falling a further 3% since the start of 2017.

Figure 15: Trends in utilization rates by type of drilling equipment since 2014.



Source: IHS Petrodata and IFPEN

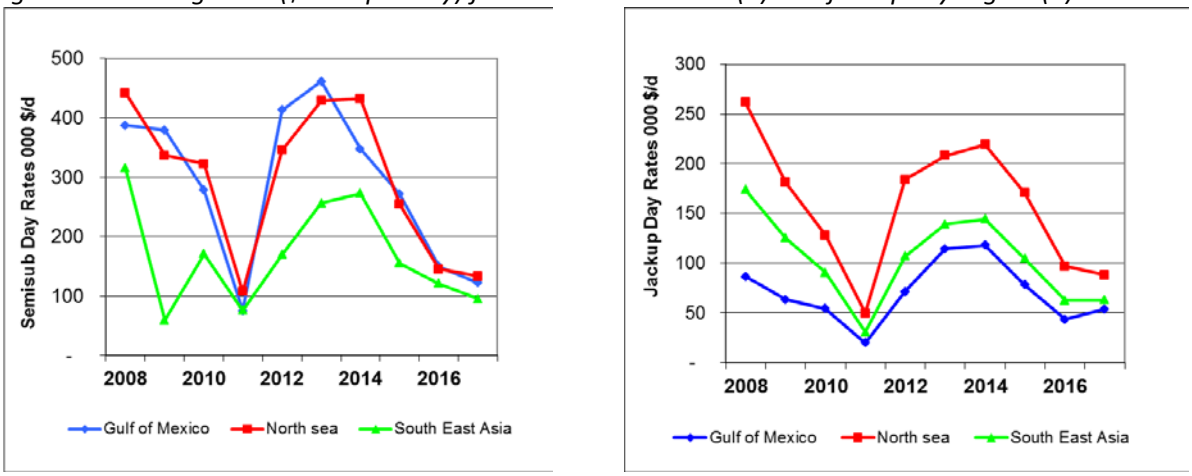
- **Offshore drilling rig leasing rates**

Since 2017, daily leasing rates have stabilized at very low levels for both semi-submersibles and jackups. 2011 levels which followed the Macondo crisis have been reached.

For jackups, daily leasing rates have also stabilized at low levels, at $63,000/day in South East Asia, while they rose by 23% in the Gulf of Mexico ($54,000/day) and fell 9% in the North Sea ($88,000/day). Clearly, this type of support for depths of 200 meters is less affected than semi-submersibles intended for use at greater depths.

For semi-submersibles, leasing rates continue to fall, by around 20% over one year in South East Asia and the Gulf of Mexico. More moderate declines were seen in North Sea, around 9%.

Figure 16: Leasing rates ($000s per day) for semi-submersibles (a) and jackups by region (b).



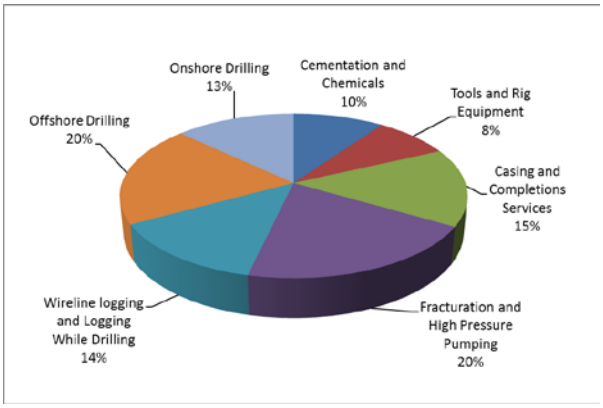
(a) *(b)*

3.2. The global drilling and services market

The global drilling and related services market has recovered and is estimated at $136 billion in 2017. After falling by 36% in 2016, it is expected to bounce back by 8% in 2017. Recall that the market reached a record high of $280 billion in 2014; in the three years since then, its value fell by half. Nevertheless, the various segments within this market react differently.

The 8% rebound in the global market stems from the increase in onshore drilling (+20%), fracking (+60%) and related services such as directional drilling (+20%). The main driver was the resumption of drilling in the United States at shale oil and gas basins.

Figure 17: *Estimated share of various segments of the global drilling market, 2017.*

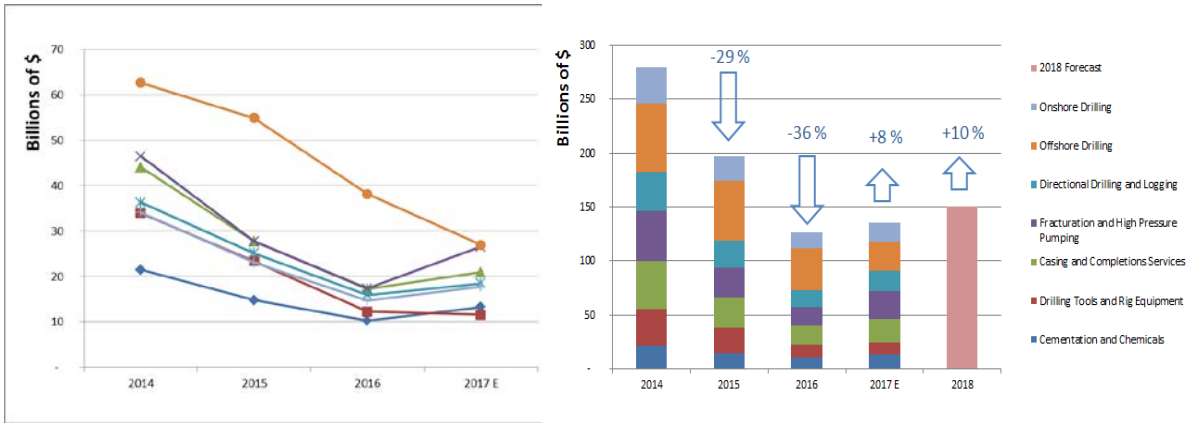


Sources: Spears & Associates, IFPEN

The cementation and well logging sectors rose by 16%. The drilling equipment and rig sector continued to decline (-5%), a sign that surplus capacity has not yet been reabsorbed.

Offshore drilling continued to fall in 2017 (-29%), at the same pace as in 2016 (-30%). Activity in this sector was heavily penalized by the intrinsic cost of deep offshore drilling compared with onshore projects. The offshore market, which represented 1/3 of the global market, only represented 20% in 2017.

Figure 18: *Business volume (billions of $) for drilling equipment and services worldwide.*



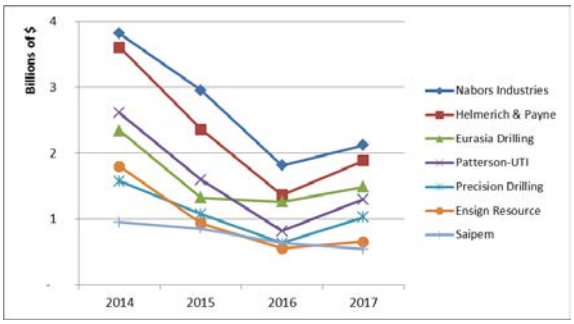
In 2018, IFPEN forecasts a market recovery on the order of 10%, consistent with the upturn in drilling operations already underway in the United States and the rise in the price of oil to over $60 a barrel in October 2017.

3.2.1. Onshore drilling: the leading players

Seven major groups account for 50% of the $18 billion onshore drilling sector. The leader is Nabors Industries with 12% of market share, closely followed by Helmerich & Payne (11%). Eurasia Drilling, which mainly operates in Asia, proved more resilient than its competitors and is in third position (8%).

Out of these seven companies, all returned to growth in 2017, except for Saipem (-14%). The increased turnover over one year was spectacular in some cases, such as Precision Drilling and Patterson-UTI which mainly operates in North America. Both companies had suffered considerably in 2016.

Table 2: (a) *Change in turnover since 2014 and (b) Estimated market share in 2017 for the leading players in the onshore drilling sector.*



(a)

Onshore Drilling	2017 Market share estimated	Cumulated share	Change of turnover %
Nabors Industries	11,9%	11,9%	17%
Helmerich & Payne	10,6%	22,5%	38%
Eurasia Drilling	8,3%	30,9%	18%
Patterson-UTI	7,3%	38,2%	59%
Precision Drilling	5,8%	43,9%	63%
Ensign Resource	3,7%	47,6%	19%
Saipem	3,0%	50,7%	-14%

Sources: IFPEN, Spears & Associates (b)

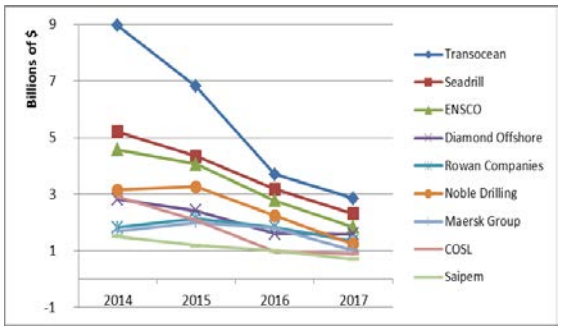
3.2.2. Offshore drilling: the leading players

Half of the $27 billion offshore drilling market is controlled by 9 major companies. The leader is Transocean, with 11% of the global market. Transocean's market share jumped 11% in 2017 following its August 2017 acquisition of its Norwegian competitor, Songa Offshore, for $1.2 billion. Its competitors Seadrill and ENSCO remain just behind, with 9% and 7% of the market respectively. Seadrill, which is facing financial difficulties, announced in September that it would file for Chapter 11 bankruptcy to restructure its debt.

They are followed in descending order by Diamond Offshore, whose market share has risen, Rowan Companies, Noble Drilling and Maersk Group, companies that each hold between 4 and 6% of the global market.

Each of these companies' turnover has sharply declined (-23% to -45%), except for Diamond Offshore (-1%), which is showing resilience, and the Chinese company COSL (China Oilfield Services) (-8%), majority-owned by the Chinese government. COSL operates internationally and through its European subsidiary. It has 45 offshore rigs, as well as 130 ships used for offshore services and 6 ships that gather seismic data.

Table 3: (a) Change in turnover since 2014 and (b) Estimated market share in 2017 for the leading players in the offshore drilling sector.



(a)

Offshore Drilling	2017 Market share estimated	Cumulated share	Change of turnover %
Transocean	10,6%	11%	-23%
Seadrill	8,5%	19%	-27%
ENSCO	6,8%	26%	-34%
Diamond Offshore	5,9%	32%	-1%
Rowan Companies	5,0%	37%	-27%
Noble Drilling	4,6%	41%	-45%
Maersk Group	3,7%	45%	-44%
COSL	3,3%	48%	-8%
Saipem	2,6%	51%	-29%

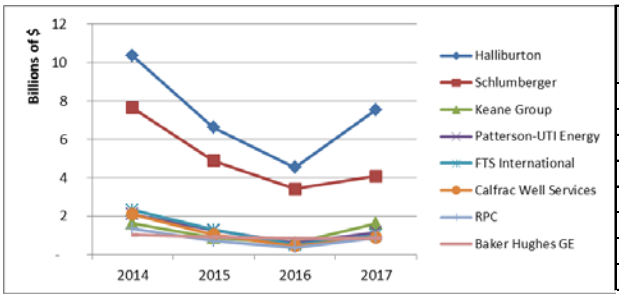
Sources: IFPEN, Spears & Associates (b)

3.2.3. Hydraulic fracturing - the leading players

The hydraulic fracturing segment is dominated by even fewer players than offshore and onshore drilling. In 2017, eight companies accounted for 75% of the hydraulic fracturing market. Halliburton and Schlumberger alone represented half of the global market, nearly $13 billion. The other players, Keane Group, Patterson-UTI Energy, FTS International, have turnover under $2 billion and make up between 4 and 7% of the global market.

Following a sharp decline in 2016, turnover rebounded with the resumption of drilling for shale oil and gas. It increased from between 20 to 200%, depending on the company. Mid-size companies that specialize in the sector could double their turnover this year. Baker Hughes, which at the end of 2016 merged its oil and gas activities with General Electric (GE), only grew slightly in terms of turnover (3%) in the fracking sector.

Table 4: (a) Change in turnover since 2014 and (b) Estimated market share in 2017 for the leading players in hydraulic fracturing.



(a)

Hydraulic Fracturation	2017 Market share estimated	Cumulated share	Change of turnover %
Halliburton	31,7%	31,7%	66%
Schlumberger	17,2%	48,9%	20%
Keane Group	6,9%	55,7%	183%
Patterson-UTI Energy	4,8%	60,6%	95%
FTS International	4,2%	64,7%	98%
Calfrac Well Services	3,7%	68,5%	95%
RPC	3,7%	72,2%	136%
Baker Hughes GE	3,5%	75,7%	3%

Sources: IFPEN, Spears & Associates (b)

4. Geophysical: global activity and markets

SUMMARY: According to our estimates, the global geophysical market (all segments) will fall to $6.9 billion in 2017, a further 11% decline. This further drop follows two years of sharp declines in the geophysical market (-30% in 2015 and -34% in 2016). The stabilization expected in 2017 has not yet arrived.

The global geophysical market remains impacted by the slowdown in exploration. However, the January 4 announcement by the President of the United States, stating his intent to conduct drilling in the Gulf of Mexico and off the coasts of the Arctic and the Atlantic and Pacific oceans, could herald a significant number of future seismic surveys.

During 2017, the multi-client (MC) survey and equipment segments each rose 4%. The highly competitive geoscience sector fell 15%. Contractual surveys declined 26% in favor of MCs, this market segment which creates libraries of seismic data makes use of some of the shipping fleet operated by CGG and the principal contractors.

However, at the end of 2017, only one-third of this fleet was in operation, i.e. around 40 ships including 13 Chinese vessels. The ship utilization rate rebounded slightly in mid-2017 to 39%, then returned in the third quarter to a very low 33%, far from the 60 to 70% needed to ensure the fleet's profitability.

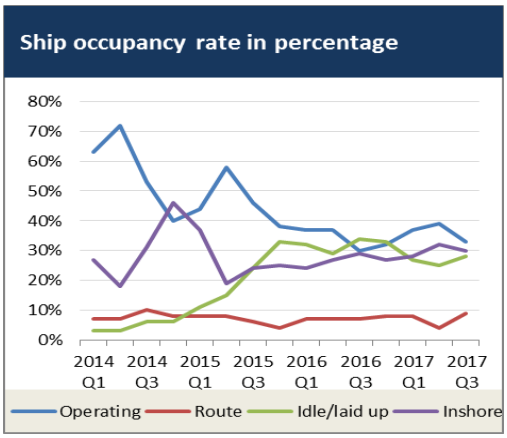
Contractors are expecting a significant recovery in oil prices, which could encourage oil operators to make new investments in exploration. For 2018, consultants estimate recovery of the worldwide geophysical market at around 5%.

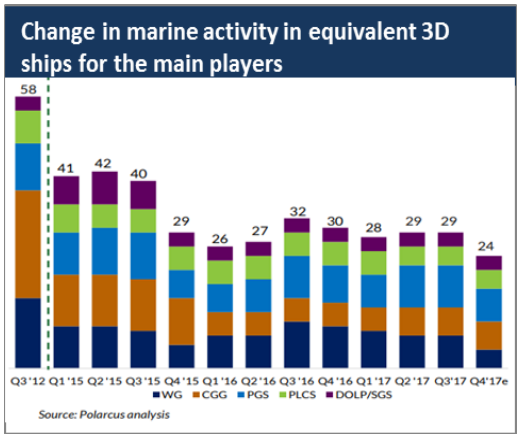
4.1. Geophysical activity

4.1.1. Global ship fleet and activity by region

In the third quarter of 2017, there were 130 geophysical ships that could record 2D and 3D seismic surveys through OBC cables, OBN nodes and electromagnetic surveys. Despite earlier reductions in the fleet, only one-third of the ships are still in operation. The rest of the ships are decommissioned (28%), inactive (30%) or in transit (9%). The ship utilization rate rebounded slightly in mid-2017 to 39%, returning in the third quarter to a very low 33%. Expressed in number of equivalent ships (with a 100% utilization rate), geophysical activity by the principal contractors fell 60% between the 3rd quarter of 2013 and the 4th quarter of 2017. Seismic activity by CGG and SLB-WG suffered the sharpest decline.

Figure 19: Ship occupancy rate in percentage (a) and change in marine activity in equivalent 3D ships (b).

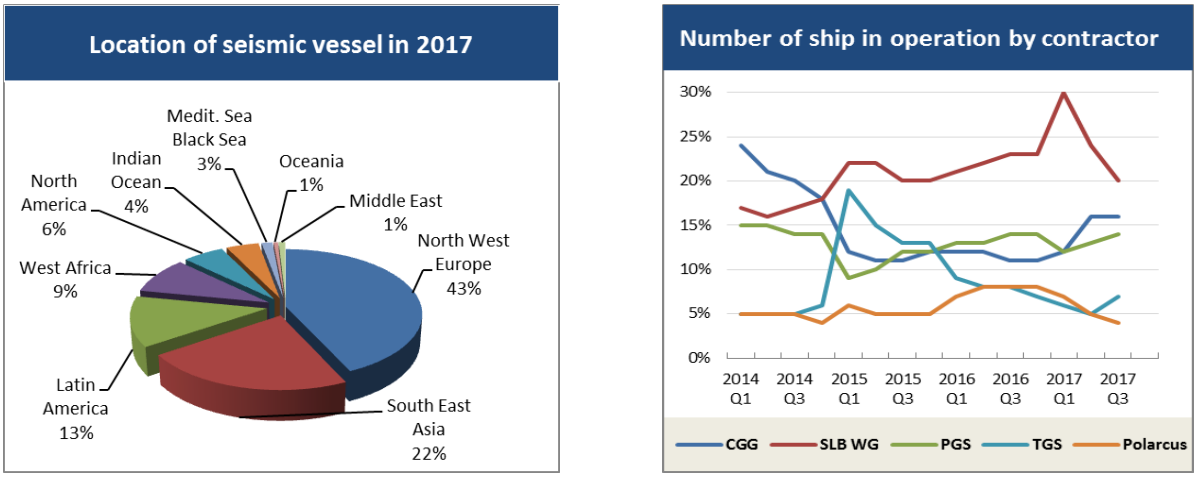




The majority of the geophysical ship fleet is located in five major regions: Northwest Europe (43%) with the North Sea, Southeast Asia (22%), Latin America (13%), West Africa (9%) and North America (6%) with the Gulf of Mexico.

Activity declined 8% over one year. It focused in particular in the Indian Ocean (-43%), North America (-36%) and Latin America (-22%). Only West Africa rebounded in mid-2017 (+55%), in part making up for the 2016 drop in activity. Northwest Europe bounced back by 8%.

Figure 20: Marine acquisition activity over a one-year period (a) and number of ships in operation (b).



(a) *Sources: IHS and IFPEN* *(b)*

SLB WG remains the leader in terms of its share of worldwide marine activity (20%). However, since reaching a record 30% in early 2017, the company lost 10% of its business share to its main competitors. The geophysical sector is highly competitive, with low prices and many calls for tender carried out with no profit by contractors. In this context, CGG and PGS recovered lost ground and, in the 3rd quarter of 2017, respectively gained a 16% and 14% share of the global market.

In the third quarter of 2017, CGG's marine seismic activity grew 17% over one year, while SLB WG only gained 13%. TGS's activity levels have changed little, as the company has a business model based on the sale of MC data and continues to limit its exposure to vagaries in seismic contracts. Activity by TGS and Polarcus fell 34% and 14% respectively. Following a sharp decline in 2016, Fairfield Nodal's business, which specializes in multi-component seismic surveys by nodes, gained 18%.

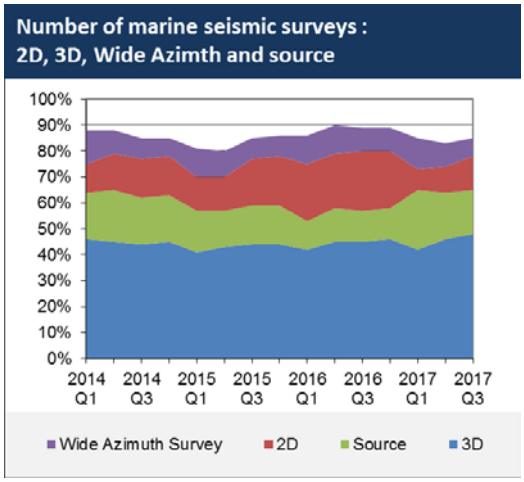
4.1.2. Nature of surveys

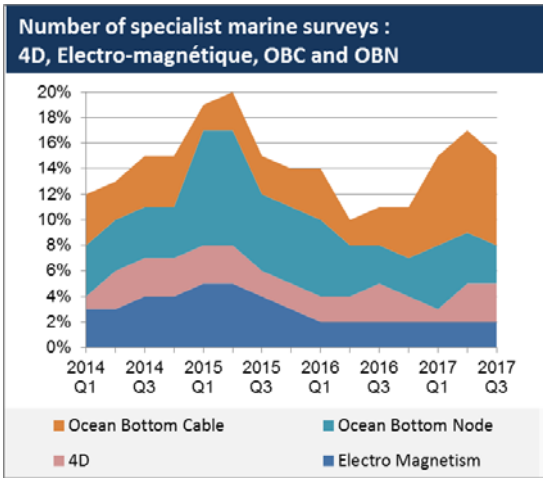
During the 3rd quarter of 2017, 3D marine surveys represent the main activity (48%) by ships, up 6% over one year. 2D seismic surveys only represent 13% of activity, down 45% over one year. The shift from 3D surveys toward the less onerous 2D surveys appears to be reversed.

Wide Azimuth surveys (WAZ) total 13% of surveys and the use of 17% source boats. The remaining activity (15%) concerns specialized marine surveys, that remain at low levels: OBC (7%), OBN (3%), 4D seismic (3%) and electromagnetic surveys (2%).

The number of 4D surveys has been relatively stable over the past two years, as this technology is costly and its market has not taken off as expected despite advancements in imagery.

Figure 21: Number of marine 2D and 3D surveys (a) and number of specialist surveys (b).





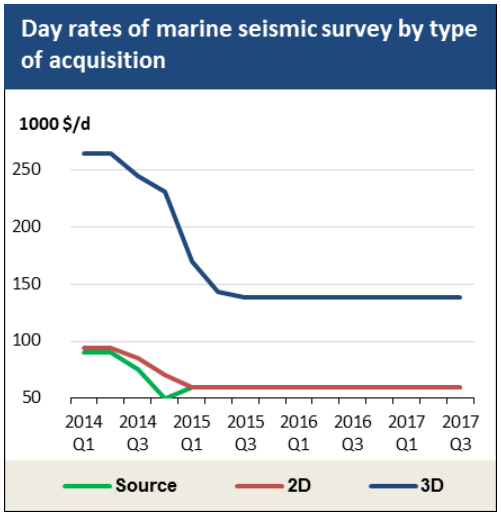
(a) *Source: IFPEN, based on IHS data* *(b)*

4.1.3. Price of surveys

Survey prices have remained desperately low since late 2015. There has been no price increase despite the reduction in the global fleet, as demand for surveys remains too low. Prices for 2D surveys are between $40,000 and $80,000 per day, depending on the configuration; for 3D, prices fall between $80,000 and $230,000 per day. By way of comparison, the daily price for a ship is around $40,000/day.

Prices have bottomed out, contractors' margins are almost at zero. Operators should start to reinvest in exploration to benefit from low prices for services, and minimize investment amounts.

Figure 22: Daily prices of marine seismic survey.



Sources: IFPEN, based on IHS data

4.2. The global geophysical market

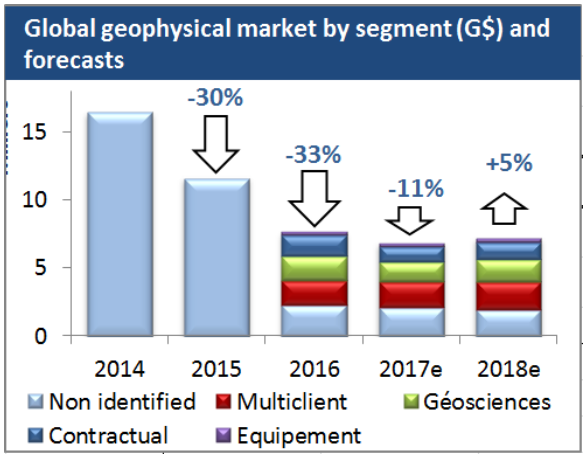
4.2.1. Business volume and leading players

According to our estimates, the global geophysical market (all segments) will fall to $6.9 billion in 2017 ($7.7 billion in 2016), down 11%. This further drop follows two years of sharp declines in the geophysical market (-30% in 2015 and -34% in 2016). Market stabilization is still not forthcoming in

2017. Turnover for the eight main players in our study, representing 74% of the global market ($5 billion), fell by 11% in 2017.

These 2017 declines varied from -2% (PGS) to -32% (Polarcus). Schlumberger, the market leader with 25% of the worldwide market, saw its turnover fall by 19%. CGG and BGP remained stable, while TGS and COSL are expected to post increases of 2% and 19% respectively.

Figure 23: The global geophysical market in $billions (a) and Turnover by company (b).



(a)

M$	2016 turnover	Estimated 2017 turnover	Change %	Estimated 2017 market share %
SLB WG+SIS	2095	1700	-19%	25%
CGG	1196	1200	0%	18%
PGS	764	746	-2%	11%
TGS	456	463	**2%**	7%
Landmark	395	355	-10%	5%
IGSS	270	205	-24%	3%
COSL	160	190	**19%**	3%
Polarcus	243	165	-32%	2%

(b)

In 2017, turnover in the MC and Equipment sectors each rose slightly by +4%, $1,900 million and $280 million respectively. Schlumberger achieved the best results for MC sales, up 15% within the segment. According to analysts, CGG also recorded 13% growth of it MC sales. In order to share investment risk, contractors work together on MC recording (for example, PGS, WesternGeco-SLB and TGS).

Equipment manufacturers are surviving on income from maintenance operations and leasing.

Contractual turnover remains in freefall (-26%), as operators prefer to purchase MC surveys. During 2017, this market only reached $1,150 million, 17% of the worldwide market for geophysical activities.

The geoscientific surveys market has become highly competitive, and also declined during 2017. At $1,500 million (-15%), it represented 21% of the global geophysical market. MC and geoscientific surveys now represent nearly 50% of the global geophysical market.

Given the weakness in the market and the length of the crisis (now a 3 years), geophysical contractors continue to cut costs, form collaborations between service companies and oil companies, conduct MC surveys in partnerships and share technological development expenses.

To avoid bankruptcy and Chapter 11 in the United States, the most indebted players, such as CGG, renegotiated their debt into capital with the banks. Many contractors are striving to tough it out while awaiting better days.

5. Offshore construction: market and activities

SUMMARY: The global offshore construction market is expected to decline for the third straight year, down -11% compared with 2016. This market fell by 24% in 2016 and 20% in 2015.

In 2017, as in 2016, many deepwater and ultra-deepwater offshore projects were postponed due to declining investment. The most costly developments are being reviewed in light of the falling cost of services, and some operators are making counter-cyclical investments to take advantage of this opportunity.

The subsea development market represents one-third of the global market. Subsea wellheads remain costly for field development, but allow a reduction in the number of surface installations.

During 2017, construction of fixed platforms was stable, while the development of shallow (less than 200 m of water) offshore fields remained profitable with WTI prices at $50/barrel.

Other construction types (Floating Production Systems, drilling rigs and pipelines) are expected to decline by 20% to 25%. FPS construction has the advantage of relying on development of Floating Storage Regasification Units (FSRU), since the global LNG market is growing.

Two-thirds of offshore investment is dedicated to existing fields, extensions and brownfields. Development of new oil and gas regions is very costly and generally being postponed. This situation may change in 2018. Oil prices that consistently remain above $60/barrel could be a positive sign to redirect oil and gas investments toward deepwater offshore fields.

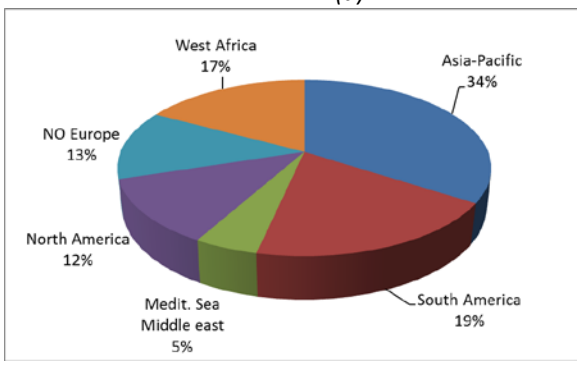
5.1. Offshore construction and services

5.1.1. Floating Production Systems (FPS)

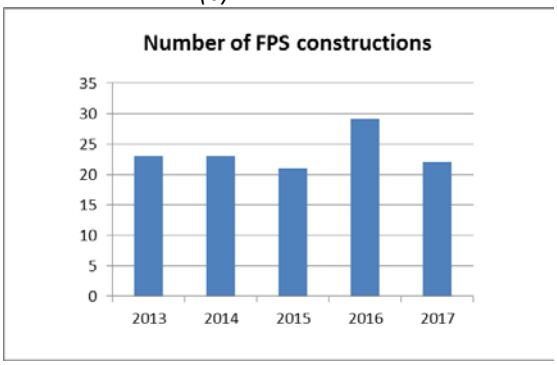
Construction of this type of platform, which is used in deepwater projects, fell by 24% over one year. These projects are impacted by the postponement of high-cost deepwater offshore projects, but benefit from FSRU orders for the growing LNG market. TLP (Tension Leg Platform) and Spar platforms remain in the minority, as most FPS are tankers (FSO) and FPSO (Floating Production Storage and Offloading).

Figure 24: Geographic distribution of FPS platforms worldwide (a) and evaluation of the number of installations since 2013 (b).

(a)



(b)



Sources: IFPEN, IHS

South America and the Asia Pacific markets account for 58% of the world's constructions, and have declined by 11% and 25% respectively. In Northwest Europe and West Africa, the number of FPS built fell by 50%.

Over the longer term, demand for FPS construction in 2022 is growing, reaching approximately 100 units. This appears to be the result of a three-year accumulation of postponed projects.

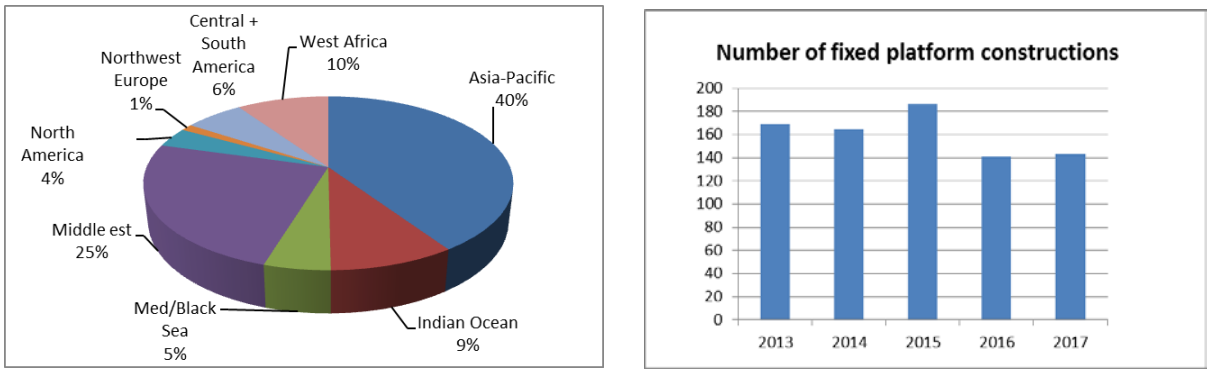
5.1.2. Construction of fixed platforms

This type of platform is used in shallow offshore applications (up to 300 m). It is especially widely used in the Asia-Pacific and the Middle East, with the latter region having numerous field extensions in offshore shallow water fields.

Following a sharp drop in 2016, the number of fixed platform installations stabilized in 2017. The cost price for offshore shallow water projects is compatible with oil prices at $50/barrel, and remains competitive with other types of oil and gas developments.

Figure 25: Geographic distribution of fixed platform installations in 2017 (a) and evaluation of the number of installations since 2013 (b).

(a) *(b)*



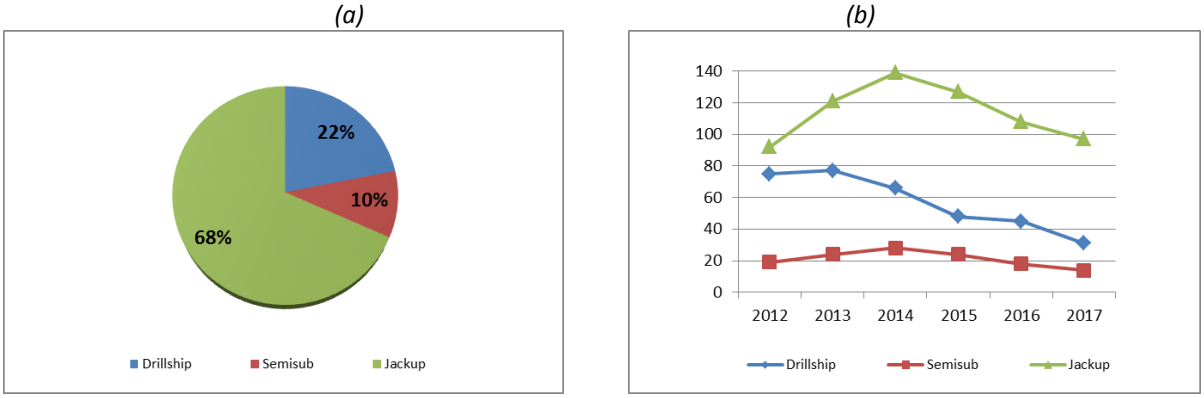
5.1.3. Construction of drill stands: platforms and ships

Since 2014, construction of drillships, semi-submersible and jackup drilling rigs has been hit by the global reduction in offshore drilling, both in exploration and the development of offshore fields.

In September 2017, over a one-year period, orders for construction of all types of offshore drilling rigs fell 17%. This was the third straight year of declines, and the sharpest drop since 2014.

Figure 26: Number of drilling vessels under construction by type in September 2017 (a) and trends since 2012 (b).

(a) *(b)*



Sources: IFPEN, IHS

Construction of drillships for deepwater offshore use was hit especially hard. Semi-submersible platforms operating in shallower water were slightly more resilient, falling -22%, though only jackups intended for use in shallow water truly withstood the decline (-10%).

More than 2/3 of platforms under construction in 2017 are jackups, with the remaining 1/3 drillships (22%) and semi-submersibles (10%).

5.1.4. Subsea construction

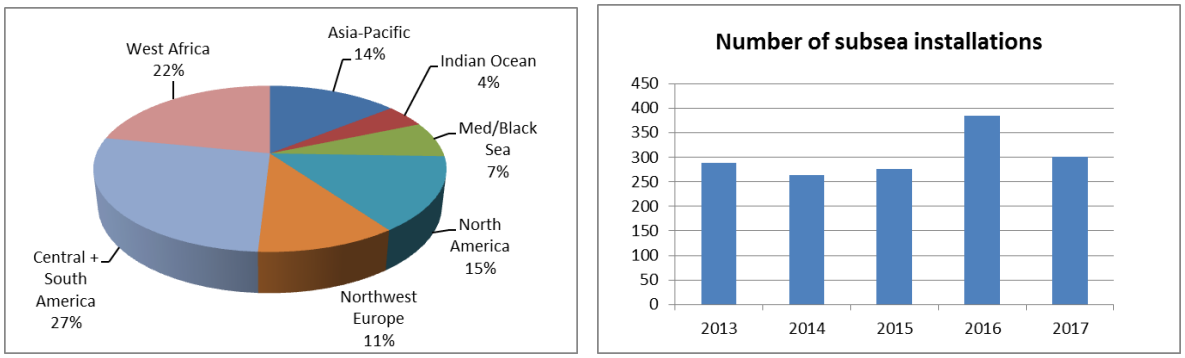
It is estimated that the number of subsea wellheads installed in 2017 fell by 22% over one year. Subsea wellheads remain costly for field development, but have benefitted from the decline in daily rates for pipelaying ships.

This type of installation is used to connect wells in satellite fields and to carry out regional development while minimizing the number of platforms.

Following their rapid expansion in Northwest Europe and the Gulf of Mexico, operations now take place primarily in South America (27%) and West Africa (22%).

Figure 27: Estimate of 2017 geographic distribution of subsea wellhead installations (a) and evaluation of number of subsea wellhead installations since 2013 (b).

(a) *(b)*

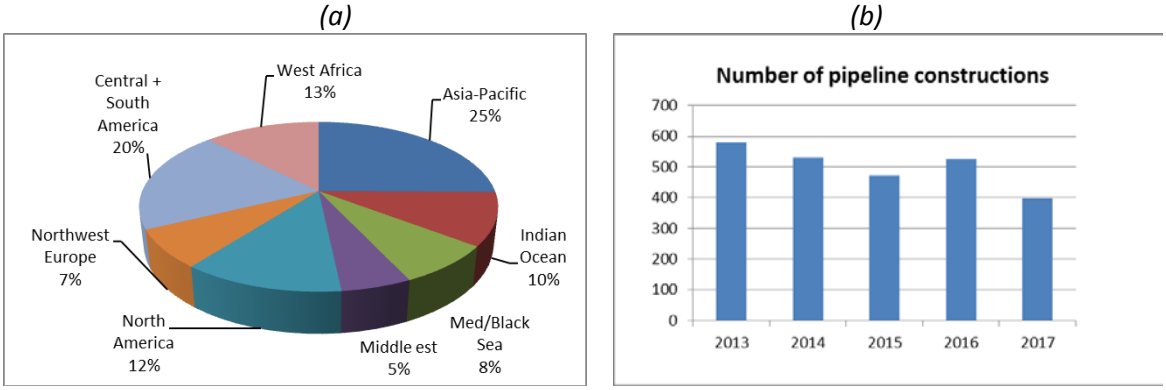


5.1.5. Offshore pipelines

The number of pipe installations, all kinds of pipe included (field pipelines, umbilicals, export pipelines) are expected to fall by 24% this year.

Figure 28: Estimate of 2017 geographic distribution of pipeline installations (a) and evaluation of number of pipeline installations since 2013 (b).

(a) *(b)*



Most investments are dedicated to existing fields and extensions (satellite fields). Development of new oil and gas regions is highly costly and generally being postponed.

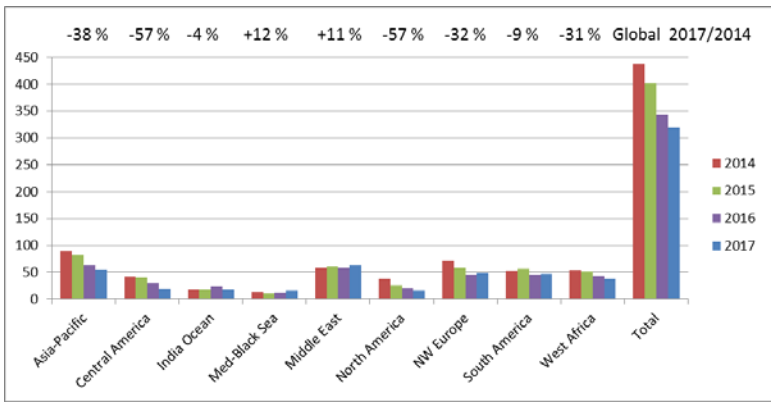
5.1.6. Offshore services for platforms

Offshore services include accommodation ships, pipelayers and derrick ships, diving support vessels, ROVs, and well services. However, these activities fell by 7% in 2017.

The number of ships in operation peaked in 2014 with 440 operating units, with the fleet utilization rate exceeding 60%. Since then, over a three-year period the number of ships in operation fell by 30%, with the fleet utilization rate remaining at just under 40%. However, we note that this rate has risen by 5 points since early 2017.

The strongest regions in terms of offshore services were the Middle East, the Mediterranean, the Black Sea and the Indian Ocean. North America, the Asia-Pacific region and Northwest Europe have suffered the most. South America has remained steady, primarily due to Brazilian offshore activity.

Figure 29: Number of ships active in offshore services and the trend for 2014-17.



Sources: IFPEN, IHS

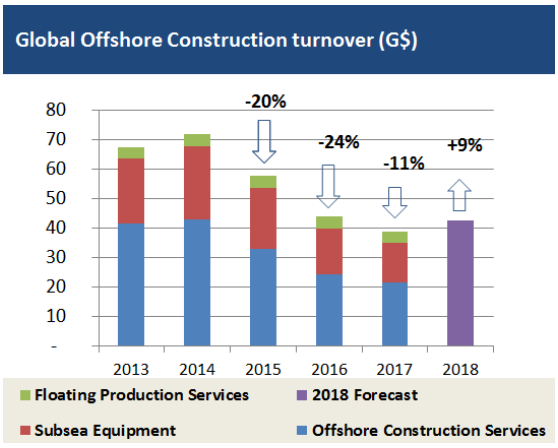
5.2. The global offshore construction market

In 2017, the value of the offshore construction and services market was estimated at $42 billion, a reduction of 11% relative to 2016. This market has lost nearly half of its value (-46%) since 2015.

For several years now, oil and gas companies have been postponing their major development projects, especially in deep offshore waters, in a bid to rein in investment and reduce costs. Statoil confirms that for certain fields, it has cut its expenses by 40% (Capex).

One-third of the global offshore construction market comes from subsea wellhead installations, this market segment is expected to fall 11% in 2017. Platform services account for 10% of the global market, had has demonstrated relative resilience (-5%). The remaining 55% of the market corresponds to offshore construction strictly speaking, including all types of support, and is expected to decline 12% in 2017.

Figure 30: The global offshore construction market in billions of $ (a) and estimated market share for 2017 (b).



Offshore Construction	2017 Market share estimated	Cumulated share	Change of turnover 2017/2016
TechnipFMC	22%	22%	0%
Saipem SPA	12%	34%	-29%
Subsea 7	10%	44%	11%
McDermott	7%	51%	10%
Schlumberger	5%	56%	-12%
SBM Offshore	4%	60%	-25%
Aker Solutions	3%	64%	-26%
Baker Hughes GE	3%	67%	-21%
Oceaneering Intern.	3%	70%	-11%

Source: IFPEN, based on data from Spears & Associates

Two thirds of global turnover is accounted for by 9 companies. TechnipFMC consolidated its position as the world leader in offshore construction with 22% of the global market, following its merger with FMC, a company specializing in subsea equipment. Saipem will be heavily affected by the declining market, but the company should remain in 2nd position with 12% of the global market.

Subsea 7 and McDermott, in 3rd and 4th position respectively, will see their turnover increase 11% and 10% in 2017. Baker Hughes, which is now a General Electric company, announced in October that it was entering discussions to acquire the Norwegian company Subsea 7.

After its buyout of Cameron in mid-2016, Schlumberger holds a 5% market share, ahead of SBM Offshore and Aker Solutions (4% and 3% respectively).

6. 2017: An upturn in refining projects?

Will **refining** projects start to increase, and halt the declines seen over the past four years? This is a question worth asking.

Factors that favor investment in new projects include (1) the growing need for oil products, whose center of gravity has shifted in recent years from industrialized countries to emerging markets, (2) margins that remain solid, (3) low industrial costs, and lastly (4) a reviving global economy. Tightening fuel standards, various rehabilitation programs, modernization and growth within the sector also create opportunities for investment, especially in regions with high demand.

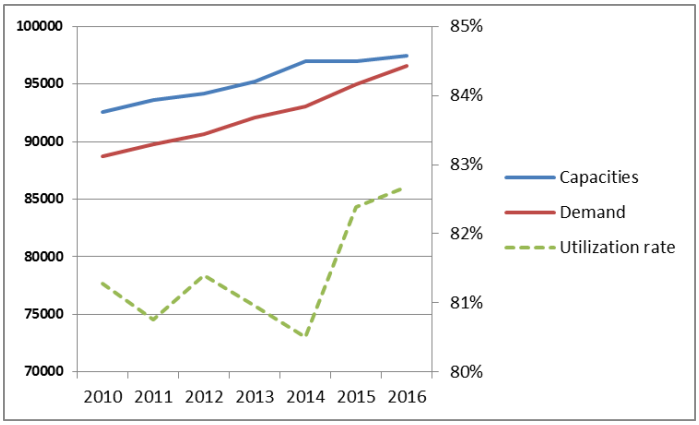
Accordingly, deep-rooted changes have been taking place in the refining economy over the past several years, both technologically and geographically. The emergence and development of shale hydrocarbons has contributed to this shift (through the introduction of light crudes).

Despite the uncertainties - changing demand for oil products, margin volatility, rising industrial costs - the investment outlook remains intriguing.

6.1. Global reduction in surplus refining capacity

Following a highly favorable 2014-2015, margins remained healthy during 2017, mainly due to steady demand for oil products (especially in China) and gasoline and fuel oil crack spreads[10].

Figure 31: Changes in surplus refining capacity, 2010-2016 (kb/d)



Source: *IFPEN, based on the BP Statistical Review of World Energy 2017*

Regarding global demand for oil products, note that it rose 9% between 2010 and 2016. This increase was mainly due to the Asia-Pacific region, where growth exceeded 20% for the period, and especially China, which recorded 32% growth in the period and where consumption (12.4 Mb/day) is catching up to Europe (12.9 Mb/day); conversely, Europe fell by 7% over the same period. To a lesser extent, the Middle East, with 16% growth, also contributed to rising global demand.

The current strength of global demand has encouraged investors to support adaptation and modernization projects for existing units, as well as the creation of new refining capacity. Due to

[10] Margins of North American refiners were sustained by significant volumes of exports to Latin America and by favorable crude oil prices.
European refiners' margins benefitted from gasoline exports to the Middle East and Latin America.
Strong growth in demand led to high margins in Asia (Dubai), particularly during the second half of 2017. Other factors had a favorable impact on margins, especially strong crack spreads and limits on export quotas in China. It should also be noted that Hurricane Harvey caused a brief uptick in Asian margins, since approximately one-quarter of U.S. refining capacity was temporarily halted, around 4.5 million barrels/day.

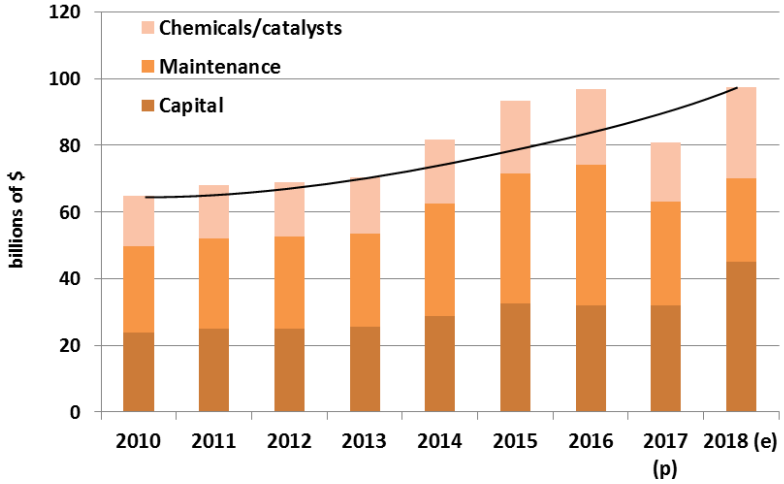
increased demand, the slowdown since 2014 in construction of new refining capacity as increased their overall utilization rate, with past surplus capacity currently on the decline (see Figure 31.), another factor that contributes to steady margins.

6.2. Dip in expenditures during 2017 and correction in 2018

Overall expenditures rose by an average of 50% between 2010 and the 2018 forecasts.

In 2017, expenditures declined by 17% compared with 2016, reaching $80 billion. To understand the reasons for this temporary trend reversal, one must analyze the various expenditure categories: capital expenditures, maintenance expenses and expenses for chemical products and catalysts.

Figure 32: Historical worldwide spending by the refining industry



Source: *IFPEN based on HPI Market Data: (f) forecast, (e) estimates*
Maintenance: 40% for facilities and equipment and 60% on labor and services

The significant drop in 2017 maintenance expenses, following three years of strong increases, is the main factor that explains this trend. Steady margins combined with steady demand for oil products has caused refiners to limit the number and duration of maintenance stoppages. This especially concerns refiners in industrialized countries with a mature industrial zone, with little variation in refining capacity.

Capital expenditures have stabilized over the past three years, at around $32 billion, spurring the creation of new assets to meet growing demand, especially in emerging countries.

In 2018, overall expenditures should clearly rise to reach $97 billion, a level comparable to 2016.

Three major factors support this trend: (1) the need for emerging countries to meet ever-growing demand, which stimulates investment through the commissioning and continuation of major projects in these regions (Table 2), (2) massive modernization programs at Russian installations[11] and the development of shale hydrocarbons on the other side of the Atlantic, along with (3) continued investment in the Middle East, particularly in Iran[12].

[11] For several years, the Russian refining sector has been undergoing a modernization program with the aim increasing hydrocracking (800 kb/d), coking (360 kb/d) andFCC (170 kb/d) capacity by 2020. The units already in operation under this program aim to improve the quality of gasoline, including isomerization, hydrotreatment and reforming units.

[12] Iran's ambitious program has a dual objective: to reduce the country's dependence on imported oil products on the one hand, and to reduce the production of heavy oils on the other. The emphasis is now on the production and exportation of lighter products such as aviation fuel, low-sulfur gasoline and diesel. The overall objective is to produce fuels that meet Euro 5 standards. In pursuit of these objectives, Iran is revamping, modernizing and expanding some of its existing refineries, and building new plants. The state oil company, NIORDC, plans to add 3.0 million bpd of new capacity by 2020.

Favorable medium-term trends in the petrochemical sector

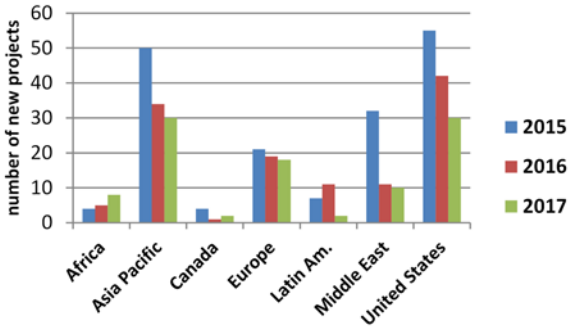
Forecasts for the petrochemical sector (capacity of 145 Mt in 2014) are optimistic in the coming years. Strong demand from emerging countries is driving the production increases and announcements of new projects. Most investment is concentrated in Asia, the Middle East and the United States. In the Asia-Pacific region, investment is striving to meet rising demand and reduce refined product imports. For its part, the United States is using inexpensive and freely available shale gas to bolster its supply of petrochemical products. It is heavily investing in additional petrochemical capacity for export. Investments in ethane cracking construction projects has exceeded $20 billion.

Currently existing surplus capacity could, to a certain extent, find a market in Latin America to meet their demand. Europe may also serve as an outlet for these products; in this case the risk would be intensified competition with less competitive European producers. Recall that demand fell in Western Europe (-0.6% between 2014-2019) but rose in Central and Eastern Europe (+4.9% between 2014-2019).

As a whole, announcements of new projects tended to decrease between 2015 and 2016 (-19%), stabilizing in 2017.

- *Only Africa posted an increase, though it only represented a small number of worldwide announcements. This mainly concerned Egypt and Nigeria (70% of the continent's market share)*
- *In Asia and the Pacific, high-demand countries such as China and India are by far the main investors, particularly operations to relieve bottlenecks, expand existing units and build new installations. In an effort to improve operational efficiency, integration of refining and petrochemical activities is an important part of triggering investment.*
- *With regard to Russia and CIS countries in Europe, we note that these two areas plus Eastern Europe are the main regions in terms of petrochemical investments in Europe. These regions rely on significant oil and gas reserves.*
- *In Latin America, most countries do not seem to be in a position to keep pace with demand for petrochemical products. The continent is becoming an import market, particularly from the United States which is currently investing substantial sums to establish production capacity for ethylene and its derivatives.*
- *The Middle East enjoys a "cost/raw materials" advantage over the rest of the world. However, this advantage is partially offset by the U.S. shale gas boom. Significant new capacity will be launched in the Middle East by 2020. Saudi Arabia and Iran currently have the largest petrochemical industrial parks in the region, but other countries are also making investments (Oman, Qatar, Kuwait, Iraq, UAE). These investments are part of the region's plan to diversify and integrate their refining and petrochemical activities.*

New petrochemical projects by region:



Source: HPI Boxscore

With declining crude oil prices, naphtha crackers have benefitted from lower raw materials costs over the past two years. This trend is giving new life to naphtha cracking units in places like northwest Europe and northeast Asia. Ethane cracking operations in the United States and the Middle East have maintained a price advantage over naphtha cracking, but the difference has been substantially reduced. In addition, naphtha cracking units offer producers the ability to produce a greater variety of co-products compared to ethane-based units.

Consolidation of world growth[13], rising demand for oil and the lack of supply tension promote a positive investment climate. The order portfolio (see Chapter 6.3) for new capacity in the coming years offers grounds for optimism regarding future investment, despite declining or stabilizing capacity in industrialized countries.

6.3. Upturn in atmospheric distillation projects

6.3.1. Fundamental change in investment over the past decade

Since the start of the decade, there have been fundamental changes to investments in atmospheric distillation units, concerning their geographic location and their technological and

[13] Chapter 1

regulatory aspects. Capacity has risen significantly, rising from 92 Mb/day in 2010 to 97 Mb/day in 2016. There are several factors to consider.

- At first, demand was the primary driver of investment. In recent years, investment has markedly risen in high-growth regions, as is the case for the Middle East and the Asia-Pacific region: refining capacity has risen in Saudi Arabia, China and India, by 38%, 22% and 25% respectively since 2010.
- While countries with growing demand direct their investments in an effort to increase their refining capacity, mature countries are targeting projects to streamline and/or adapt their industrial installations to new conditions (quality of crude oils, regulations)[14].
- The United States is an exception, due to the development of shale hydrocarbons and the need to adapt equipment to light oils[15]. The U.S. is undergoing a process of restructuring the refining sector - a process that consists of optimizing in each district (PADD) its crude fraction between local light crudes and imported heavy crudes. Oil supply was here – in addition to demand - the true driver for investment.
- Changing regulations has triggered the addition of new capacity, and has also directed decisions regarding modifications and improvements to refining processes, aiming to produce higher quality fuels with lower sulfur content (Euro 4, Euro 5, Euro 6). Key measures that govern allowable sulfur levels in fuels include: regulation of Tier 3 fuels in the United States (extension of California specifications to the federal level) and Canada, implementation of National 5 in China[16], and Bharat Stage (BS-6) in India[17], projects to produce fuels specific to the Middle East. Of course, this is in addition to regulations that sharply reduce sulfur content in the maritime sector[18].
- Conversely, in Europe, due to stabilization in demand, specially strict regulations and the decline in North Sea production, - elements that have considerably weakened the refining industry -, refining capacity has fallen by more than 9% over the period. These reductions have also impacted other industrialized nations such as Japan (-16%).

6.3.2. Recovery of projects in 2017

Though, in 2016, the **accumulation of capacity extension,** planned for the next 5 years and characterized by a high likelihood of completion[19], had sharply declined compared with 2015 (-35%), in 2017, its increase shows a certain improvement in terms of planned projects despite refiners' fears.

[14] Declines in OPEC production have perhaps not had the impact on prices that the group had hoped to see, but they have reinforced a crucial factor for refiners: substitution of light oil for heavy crude. Most of the OPEC reductions concerned less-profitable heavy or semi-heavy crudes, leaving space for lighter crude oils such as those produced in the United States. Refineries installed in the United States along the Gulf of Mexico were primarily designed to process heavy crudes, the region's basic raw material. A discrepancy has merged between current raw materials and refining technology. This is not limited to the United States. Substantial investment is needed to adapt these complex refineries to the new light crude oils.

[15] Refining capacity in the United States rose by 1.64% between 2016 and 2017, reaching 18.6 million barrels/day; the increase since 2013 was 4.5%. AFPM United States Refining and Storage Capacity Report , 2017

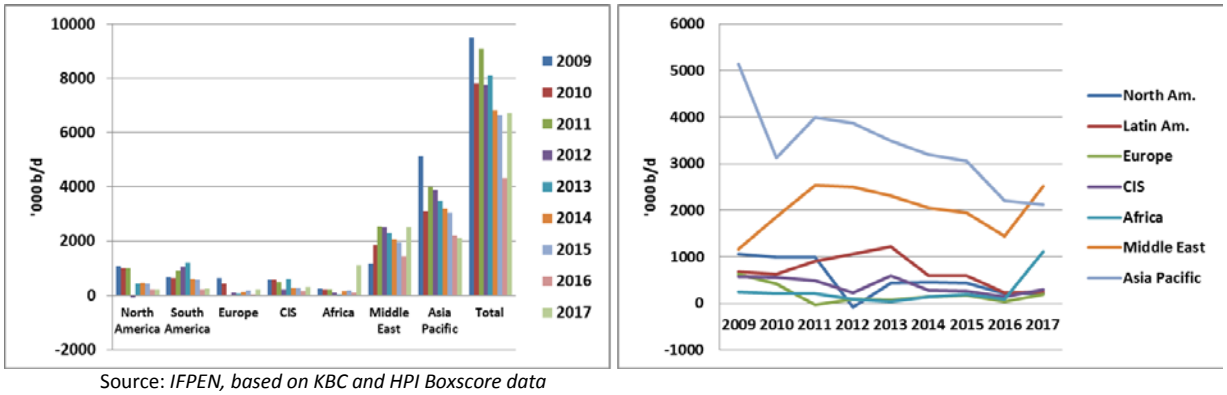
[16] Since January 1, 2017, the national sulfur limit fell from 50 ppm to a maximum of 10 ppm (China V).

[17] 10 ppm of sulfur gasoline and diesel throughout the territory, starting in 2020.

[18] The new regulation (IMO, International Maritime Organization) requires a reduction of sulfur levels in maritime fuels from 3.5% to 0.5% by 2020.

[19] To construct the project sampling for 2017, we have used projects in the Front-End Engineering Design (FEED) and engineering phases, along with those already under construction, to represent projects likely to achieve industrial implementation.

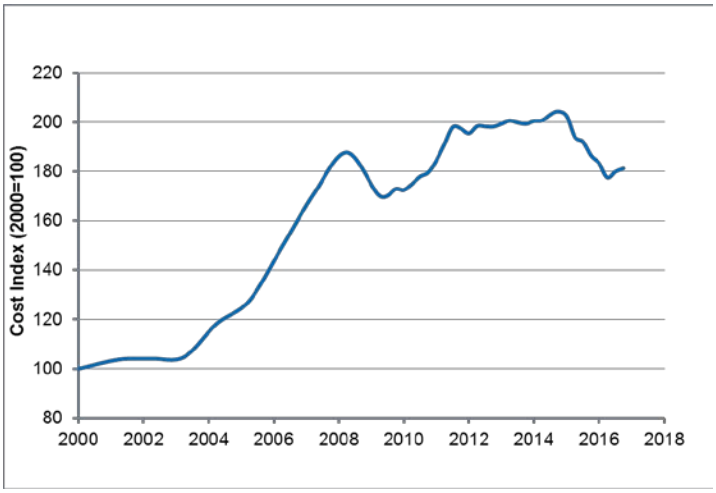
Figure 33: Atmospheric distillation projects - defined each year since 2009



Source: *IFPEN, based on KBC and HPI Boxscore data*

New atmospheric distillation capacity worldwide rose by 2.1 Mb/day according to the situation established in 2017 (for the 2017-2023 period), an increase of 48% compared with projects identified in 2016, reaching a total of 6.4 Mb/day, representing 6.6% of current atmospheric distillation capacity worldwide (97.4 Mb/day in 2016). A marked increase - following a sharp decline - due to solid demand, stable margins and industrial costs that remain relatively low for the second consecutive year, but remains at relatively low levels in light of the 2009-2017 period (Figure 33).

Figure 34: Refinery construction cost index.



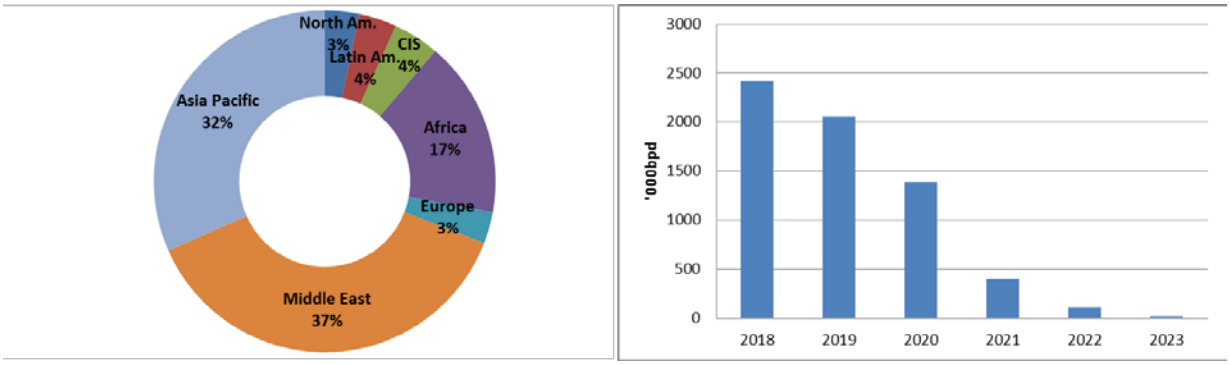
Source: *IHS CERA*

The Asia-Pacific region and the Middle East still hold the highest volume of projects, with 38% of projects worldwide (in volume). This year, more unexpectedly, includes Africa with projects in Algeria, Egypt and Nigeria, covering 18% of anticipated projects worldwide by 2023[20].

Table 2 below lists the main projects, with distillation capacity of 200 kb/day or higher. These projects represent 64% of planned additional capacity and are mainly located in emerging countries, which remain the regions of choice for investors: 2.5 Mb/day in the Middle East, 1.3 Mb/day in Asia and the Pacific. Europe has a presence with the refinery project in Turkey (STAR), the only project under construction in the region. Among the projects used this year, 80% are installations currently under construction.

[20] The projects in question are refineries in Hassi, Tiaret and Biskra in Algeria, each having expected capacity of 100 kb/j; the mega-refinery in Dangote, Nigeria with capacity of 650 kb/day; and the Mostorod and Niger Delta projects avec 100 kb/day and 10 kb/day respectively.

Figure 35: Atmospheric distillation projects, 2017 status, geographic distribution and timing



Source: *IFPEN, based on KBC and HPI Boxscore data*

Table 5: Main atmospheric distillation projects

Refinery name	Country	Company	kb/d
Dangote Refinery	Nigeria	Dangote Oil Refining Company	650
Al Zour Refinery	Kuwait	Kuwait National Petroleum Company (KNPC)	615
Siraf refinery	Iran	Siraf Refineries Infrastructure Co.	480
Zhoushan	China	Zhejiang Petrochemical Co Ltd (ZPC)	400
Dayushan Island Refinery & Petrochemical Complex	China	Zhejiang Petroleum and Chemical Co. (ZPC)	400
Jazan Refinery	Saudi Arabia	Saudi Aramco	400
Pengerang Integrated Complex	Malaysia	Petronas, Saudi Aramco	300
Moscow Oil Refinery	Russian Federation	Gazprom Neft	240
Duqm Refinery and Petrochemical Integrated Complex	Oman	Duqm Refinery and Petrochemical Industries Corp. (DRPIC)	230
Socar Turkey Aegean Refinery (STAR)	Turkey	Socar-Turcas Enerji JV	200
Nghi Son Refinery	Vietnam	Nghi Son Refinery & Petrochemical LLC	200

Source: *IFPEN, based on HPI Boxscore data*

Table 6: Summary of trends

	2015-2016	2016-2017
Worldwide	***Decrease***	***Increase***
Europe	***Decrease***	***Decrease***
Middle East	***Decrease***	***Sharp increase***
Africa	***Decrease***	***Sharp increase***
Asia Pacific	***Decrease***	***Stabilization***
Others	***Decrease***	***Slight increase***

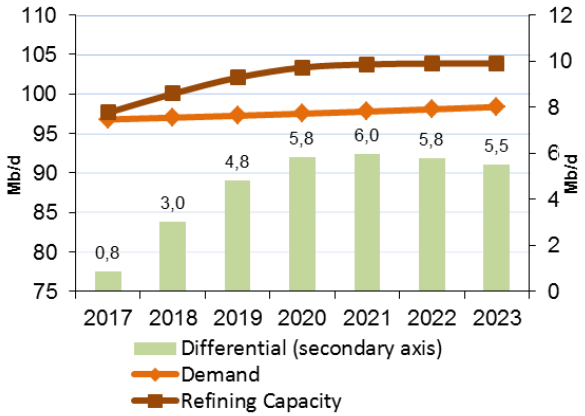
6.3.3. Increasing in capacity and demand stabilization in the medium-term

Figure 36 shows the increase in refining capacity throughout the world based on projects that are currently at an advanced stage of development and which are likely to be completed. It also shows predictions for increased demand according to the IEA [21] *in its central* scenario. This international organization forecasts a moderate increase in world oil demand over the medium and long terms[22]. This will result in a heightened surplus capacity in the medium term.

In 2017, refining capacity reached 97.6 Mb/day and oil demand[23] 96.8 Mb/day, creating a surplus of 0.8 Mb/day[24]. It is therefore unlikely that all of these new projects will be completed, since this would increase the surplus to 5.8 Mb/day by 2020.

[21] OMR – Oil Market Report and WEO 2017.
[22] Annual average growth: 0.6% in demand for oil in the 2016-40 period under the New Policies Scenario. WEO 2017.
[23] BP Statistical Review 2017. Including marine fuels, aviation fuels and biofuels.

Figure 36: Global medium-term trends in refining capacity and demand



Source: *IFPEN, based on KBC and IEA data*

6.3.4. Future investment opportunities

The outlook for post-2017 is brightening for investors, however, given the increasing need for improvements to product quality and the drive to adjust supply to market requirements. Investment should recover in the coming years for the following reasons:

- Worldwide, the IMO resolves to reduce maximum sulfur content of bunker oils by 2020.
- The introduction of Tier 3 in the United States and Canada will continue. Standards will gradually be introduced between 2017 and 2025.
- In many countries, the need to improve product quality and therefore to strengthen specifications entails significant investments in conversion infrastructure. Examples include:
  - The continuation of the Russian refinery modernization program;
  - The Iranian program for modernization of existing refineries and the development of additional capacity. However, development of this program is tied to the participation of international investors, who are aware of the risk of new sanctions being imposed against Tehran by the U.S. government, which could “short-circuit the recovery”, as emphasized by the IMF;
- Strong demand for oil products is expected from emerging regions such as China, India and the Middle East, and perhaps other countries/zones.
- Changing environmental regulations on refineries, which are especially severe in Europe (but also and more recently in the United States), require a reduction in current levels of emissions of local (SO2, NOx, PM, CO etc.) and general (CO2 for the most part) pollutants by refineries.

In general, efforts must be made to modernize and consolidate the refining sector, particularly in the Asia Pacific region, Latin and Central America and also the Middle East, in order to optimize production, to meet domestic demand and improve refinery utilization rates, which are very low in these regions. European refiners must address these same trends in a context of increasing competition that once again threatens to test the competitiveness of European refining.

Finally, we must highlight the lifting of the ban on the export of crude oil by US producers. Europe will be the main destination for this "new" oil. European refiners stand to benefit, as they are better equipped to process this grade of oil than the US refineries themselves. In the medium term, the lifting of the embargo may be a factor in future investment decisions.

[24] For previous years, surpluses totaled 1.9 Mb/day in 2015, 3.9 Mj/day in 2014, 3.1 Mb/day in 2013.