Quarterly Report on European Gas Markets

Market Observatory for Energy

DG Energy

Volume 9
(issue 2 & 3; second and third quarter of 2016)
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Highlights of the report

- EU gas demand was flat in the first quarter of 2016 but increased by 9% in the second quarter and (according to preliminary data) by 3% in the third quarter, year-on-year. The increase is driven by growing gas use in power generation. EU gas consumption seems to be on track to showcase another annual increase after 2015.

- EU gas production decreased by 11% in the first half of 2016, driven by a 26% fall in Dutch output. The production cap for the Groningen field was reduced again in June. The UK overtook the Netherlands and became the largest gas producer in the EU.

- As a result of growing consumption and falling indigenous production, imports were significantly higher in the first half of 2016 than in the previous year. In the third quarter, however, imports were flat compared to the same period of 2015. Russia remained the top supplier of the EU and falling oil-indexed prices allowed the country gradually to increase its market share. Norwegian imports were restricted in the third quarter by a busy maintenance schedule.

- In both the second and the third quarters of 2016, EU LNG imports increased by 7% year-on-year. Poland’s Świnoujście terminal started commercial operations in June 2016 while France’s new terminal in Dunkirk is to start commercial operations by the end of the year. Two LNG cargoes arrived from the US to the EU, covering 0.7% of total EU LNG imports in the second and third quarters of 2016.

- During the second and third quarters of 2016, storage levels have been consistently higher than in 2015. In October, the average filling rate reached 92% compared to 84% a year earlier. The outage of the Rough facility in the UK is likely to have implications on the supply of the country during the coming winter.

- European hub prices continued to fall as low oil prices and steady imports put downward pressure on prices. After a temporary surge in the first part of the summer, in August most hub prices fell to their lowest level since 2009. Oil-indexed prices bottomed out in the summer. The gap between European and US prices narrowed in the third quarter.

- Trading activity on European hubs increased by 51% in the second quarter and by 14% in the third quarter. The Dutch and the UK hub continue to dominate the European wholesale market.

- The decrease of retail prices accelerated in 2016, for both household and industrial consumers.
Executive Summary

- **EU gas consumption was flat in the first quarter of 2016 but increased by 9% in the second quarter** compared to the same period in 2015. Preliminary Eurostat data shows that consumption in the third quarter increased by 3% year-on-year. The relatively mild temperatures reduced gas demand for space heating, but at the same time falling gas prices improved the profitability of gas-fired power generation, thereby increasing the gas intake in the sector.

- **EU gas production decreased by 24% in the first quarter of 2016 but increased by 8% in the second quarter** on a year-on-year basis. The 2% increase of UK production and the rapid ramp-up of the Corrib field in Ireland was more than offset by the 26% reduction of Dutch output in the first half of the year. In June, the production cap for the Groningen field was reduced again and the seasonal fluctuation of Dutch output has been reduced.

- **In the first half of the year, EU gas imports were significantly higher than a year earlier.** According to ENTSO-G data, imports increased by 21% and 13% in the first and second quarters, respectively. In the third quarter, imports were 1% lower than in the same period of 2015. Falling oil-indexed prices allowed Russia gradually to increase its exports and the country remained the top supplier of the EU, covering 45% of total extra-EU imports in the third quarter. Norwegian imports, in turn, were limited by an unusually busy maintenance schedule and the country’s share decreased to 29% in the third quarter. Pipeline imports from Algeria steadily increased but those from Libya remained well below year-ago levels.

- **In the first and the third quarters of 2016, EU LNG imports increased by 7% year-on-year.** Qatar remained the top LNG supplier to the EU but its share slightly decreased compared to 2015.

- **Poland’s Świnoujście terminal started commercial operations in June 2016.** Commercial operations at France’s new LNG terminal in Dunkirk are set to start by the end of the year.

- **In April, Europe received the first LNG supplies originating from the US.** The first cargo arriving to Portugal was followed by a second one landing in Spain in July. The two US cargoes covered 0.7% of total EU LNG imports in the second and third quarters of 2016. From the total US LNG exports, 8% was destined for the EU in the first nine months of the year.

- **In spite of increasing import volumes, falling prices reduced the EU’s gas import bill to around 13 billion euros in both the second and the third quarters of 2016, about 30% less than a year earlier.**

- **Ukraine has not purchased gas from Russia since 25 November 2015** which means that, for more than one year, the country had to rely on indigenous production and imports coming from the EU.

- Following the signature of an **interconnection agreement** between gas network operators in Bulgaria and Greece in June, similar agreements were signed between Bulgaria and Romania and between Romania and Ukraine in July. The agreements will allow bi-directional gas flows between Ukraine and Greece.

- Europe finished the 2015/2016 winter with relatively high stock levels and, throughout the second and third quarters of 2016, storage levels have been consistently higher than in 2015. As a result, **stock levels were comfortable at the start of the 2016/2017 winter:** in October, the average filling rate reached 92% compared to 84% a year earlier. The outage of the Rough facility in the UK had widespread impacts on prices and gas flows and is likely to have implications on the supply of the country during the coming winter.

- **International gas prices converged in the third quarter:** as a result of the increasing US prices (driven by rising demand in the power generation sector and increasing exports) and falling European prices, the ratio of European and US prices decreased to 1.4.

- **Spot prices at European gas hubs were volatile:** the long-term decline driven by low oil prices and steady imports was interrupted by a surge in June-July but in August prices decreased again and most hub prices reached 7-year lows.

- **Oil-indexed prices started increasing from summer** which means that the gap between hub prices and oil-indexed prices started to grow again.

- **Trading activity on European gas hubs increased:** traded volumes reached 12,300 TWh in the second quarter and 10,400 TWh in the third quarter, representing a year-on-year increase of 51% and 14%, respectively. The UK and Dutch hubs continued to dominate gas trade in Europe, with the Dutch hub now clearly ahead of the UK hub. The share of exchange-traded volumes slightly decreased in the second and third quarters.

- **The decrease of retail prices accelerated in 2016,** for both household and industrial consumers. On the other hand, no real price convergence could be observed in the last year, either for households or for industrial customers.
1. Gas Consumption – Production – Imports

1.1 Consumption

- EU gas demand was flat in the first quarter of 2016 but increased by 9% in the second quarter, year-on-year.

- In the first quarter, some of the Baltic and Scandinavian countries (Estonia, Latvia and Sweden) experienced a high growth, driven by below average temperatures in the region in January. In contrast, Luxembourg, the Netherlands and Slovakia registered double-digit decreases (-25%, -20% and -19%, respectively).

- In the second quarter, Greece (73%) and Ireland (28%) experienced a robust year-on-year increase. In case of Greece, this was driven by the increasing use of gas in power generation while in Ireland the commissioning of the Corrib field facilitated an increase of gas consumption. From the biggest markets, consumption in France, Germany and the UK also showed a double-digit growth. At the same time, Finland, Lithuania and Slovakia recorded decreases between 17% and 25%.

- In the first six months of the year, consumption increased by 3% compared to the same period of 2015, although in most Member States temperatures were higher than the long-term average in this period. This implies that the growth occurred outside the residential sector.

- According to preliminary Eurostat data, consumption in the third quarter of 2016 was about 2% higher than in the same period of 2015, with Greece, Ireland and Slovakia showing a robust growth, partly offset by significant decreases in Finland, Latvia and Lithuania. From the biggest markets, France and the UK showed an above-average growth (7% and 8%, respectively), while Spanish consumption decreased by 17% year-on-year.

- If the preliminary third quarter data are confirmed, it would mean that EU gas demand grew by 3% in the first nine month of 2016. Accordingly, consumption seems to be on track to showcase another annual increase after the 4% growth seen in 2015.

**FIGURE 1 - EU GAS CONSUMPTION, IMPORTS AND PRODUCTION**

*Source: Eurostat, data as of 10 November 2016 from data series nrg_103m. Net imports refer to imports minus exports.*
In absolute terms, Germany and the UK showcased the biggest consumption growth in the first quarter of 2016 which was, however, offset by the decrease in France and the Netherlands. In the second quarter, the increase was again driven by Germany and the UK.

The seasonally adjusted Gross Domestic Product (GDP) of the EU rose by 1.8% in both the second and the third quarters of 2016, compared to the same quarter of the previous year. Although these growth rates are slightly lower than the ones seen in the second, third and fourth quarters of 2015, they are robust compared to the previous years. The gross value added in the manufacturing sector was 3.0% higher in the second quarter of 2016 than a year earlier. In addition to the falling prices, the economic recovery is likely to have contributed to the increase of gas consumption in 2016.
Figure 4 shows the deviation of actual heating degree days (HDDs) from the long term average in individual EU Member States in April, May and September of 2016. In most Member States, temperatures in this period were above the seasonal norms, thereby reducing gas demand for space heating. Only three Member States (Hungary, Portugal and Spain) had more heating degree days than the long term average in these three months.

Figure 5 shows the deviation of actual heating degree days (HDDs) from the long term average in individual EU Member States in April, May and September of 2016. In most Member States, temperatures in this period were above the seasonal norms, thereby reducing gas demand for space heating. Only three Member States (Hungary, Portugal and Spain) had more heating degree days than the long term average in these three months.

After years of decline, gas–fired power generation started to increase in the second half of 2015 and this trend continued in 2016. In the seven important markets depicted in Figure 5, gas deliveries to the power generation increased by 17% in the first eight months of 2016 compared to the same period in 2015. The growth rate was 113% in France, 73% in Greece, 41% in the UK and 14% in the Netherlands. On the other hand, gas deliveries decreased in Spain (-18%) and Belgium (-9%) and were unchanged in Italy.
• In these seven markets, gas deliveries to power generation increased by 15% in the first quarter, by 31% in the second quarter and by 5% in July-August, in each case compared to the same period of 2015.

• While the growth of EU electricity consumption remains low (1.1% in the second quarter of 2016) and gas has to face the continuing penetration of renewables in the power sector, it seems that the falling prices have improved the competitiveness of gas compared to other fuels, in particular coal.

• Hub prices, LNG prices and oil-indexed prices all decreased during 2015 and the first half of 2016. While gas prices stabilised in the third quarter and started to increase towards the end of the period, this coincided with a sharp rise of coal prices and, therefore, the competitiveness of gas vis-à-vis coal remained favourable (see details in section 3).

• UK clean spark spreads – measuring the profitability of gas-fired generation – remained high, averaging around 15€/MWh in March-August 2016 and increasing to nearly 35€/MWh in September. As a result of the improving economics and the closure of some coal-powered plants, gas consolidated its position as the number one fuel in the UK power sector, covering 45% of the electricity mix in the second quarter of 2016.¹

• In case of Germany (where wholesale electricity prices are lower), clean spark spreads averaged -1€/MWh in the second quarter and 3€/MWh in the third quarter of 2016 which is an improvement compared to previous years when they were consistently negative.² As a result of the improving competitiveness of gas in Germany, the share of gas-fired power generation reached 8% in the second quarter of 2016, compared to less than 5% in the same period of 2015.³

FIGURE 6 - GAS DELIVERIES TO POWER GENERATION

Source: Eurostat, data as of 21 November 2016 from data series nrg_103m. Germany is not included because of gaps in reporting.

2. Charts of clean spark spreads in Germany and the UK can be found in the Quarterly Report of European Electricity Markets
1.2 Production

- In 2015, EU gas output decreased by 9%, driven by a 24% decline in the Netherlands. The trend continued in the first quarter of 2016: year-on-year, EU production decreased by 24%; Dutch production almost halved (~48%) which was only partly offset by the increase in the UK (5%) and Ireland (1276%). The massive increase in the Irish output is explained by the Corrib gas field which started production at the end of 2015. In absolute terms, Dutch output was 12.4 bcm lower than in the same period of 2015.

- The picture was very different in the second quarter of 2016: total EU output increased by 8% compared to the same period of 2015. Dutch production grew by 49% which was partly offset by declines in Germany (-20%) and Italy (-29%). UK output was rather stable (~1%) while production in Ireland continued its rapid climb (1913%).

- In the Netherlands, the lowering of the production cap at the Groningen field continued: on 25 June 2016, the government has decided to restrict the extraction of natural gas to 24 bcm per gas year (for the 2015/2016 gas year, the cap was 27 bcm). The new cap applies to the next five gas years; additional gas of maximum 6 bcm may be produced «in the event of a cold winter or if otherwise absolutely necessary». In addition, the government reiterated the aim of minimising fluctuations in output.⁴ The latter objective is already reflected by the pattern of total Dutch production: while in previous years (2009-2015) Q2 output was 45-70% lower than in Q1, in 2016 this decrease was only 17%. In the first half of 2016, Dutch gas production was 26% lower than in the same period of the previous year.

- In contrast, UK gas output increased by 2% in the first half of 2016, as the start-up of new fields continued to offset decreasing output from mature fields. However, sustained low oil and gas prices put pressure on producers to cut costs which leads to cancellations and delays of new projects, thereby making the longer-term supply outlook less promising. As a result of the falling Dutch output, the UK overtook the Netherlands in the first half of 2016 to become the largest gas producer in the EU.

- The commissioning of the Corrib field off the northwest coast of Ireland in late 2015 allowed Irish gas output to show a robust growth, making the country the eighth largest gas producer of the EU in the first half of 2016. According to one of the project partners, production volumes reached full capacity at the end of the second quarter of 2016.⁵ In the first half of 2016, indigenous production covered 45% of Irish gas consumption, up from 3% in 2015.

- Going forward, EU gas output is forecast to decrease further in the second half of the decade but the rate of the decrease is expected to slow down compared the rapid fall seen in 2014 and 2015. This forecast is based on the assumption that Dutch output stabilises towards 2017-2018, showing a slow (3-5%) annual decrease afterwards. Apart from the increase of Irish production in 2016, no Member State is expected to show a meaningful output growth in 2016-2020.

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1.3 Imports

• According to Eurostat data, net imports increased year-on-year by 22% in the first quarter of 2016, followed by a 14% increase in the second quarter. In the first six months of 2016, net imports were 18% higher than in the same period of 2015. Growing consumption and falling indigenous production both contributed to the rise of imports. Net imports were particularly high in the second quarter, reaching the highest quarterly level in 5 years.

• Among the biggest gas markets, in the first half of 2016 the net imports of Germany and the UK increased by 26% and 19%, respectively. The Netherlands remained a net exporter but net exports were 26% lower than a year ago. In case of Ireland, the rapid ramp-up of production at the Corrib field allow the country to reduce imports by almost 40%.

• ENTSO-G data also show a robust 17% year-on-year increase in the first half of 2016 (21% in the first quarter and 13% in the second quarter) but in the third quarter imports were 1% lower than in the same period of 2015. Imports in the first nine months of 2016 were 11% higher than a year earlier.

• Imports from Russia have been rather stable since the third quarter of 2015, showing no sign of seasonality. In the first quarter of 2016, imports were 42% above the unusually low volumes in the first quarter of 2015. In the second and third quarters, the year-on-year increase slowed down to 6% and 5%, respectively. Russia remained the top supplier of the EU and falling oil-indexed prices allowed to country gradually to increase its market share: Russian imports covered 39%, 41% and 45% of total extra-EU imports in the first, second and third quarters of 2016, respectively. Oil indexation remains dominant in Gazprom’s European exports, with hub pricing gradually gaining ground: the latter accounted for 17.8% of the company’s supply contracts in 2015, compared to 16.5% in 2014.6

• Following the auctions taking place in September 2015 and March 2016, Gazprom conducted a third one between 31 August and 2 September 2016. Gas was offered at the Greifswald, Gaspool, Olbernhau, Baumgarten and Arnoldstein delivery points. As a result of the auction, about 2 bcm was sold to 11 clients, to be delivered during the 2016/2017 winter season.7

• In contrast to Russian supplies, imports from Norway show seasonal variations, with quantities peaking in winter and then falling in the summer months. Compared to 2015, Norwegian imports increased in the first part of 2016 (by 7% in the first quarter and 15% in the second quarter) but decreased by 17% in the third quarter. The share of the country from total extra-EU imports was 38% in the first quarter of 2016 but dropped to 34% in the second quarter and to 29% in the third quarter. The latter is the lowest quarterly market share seen in the last three years.

• Maintenance and unplanned outages reduced Norwegian export flows in certain periods, especially in June, August and September. Exports to the UK were down in the third quarter because of the outage of the Rough storage site which decreased demand for injection.

• Pipeline imports from North Africa continuously increased in the first three quarters of 2016, driven by the growing volumes coming from Algeria: in this period, Algerian supplies increased by 44% year-on-year. Supplies to Spain remained practically unchanged but Italian deliveries more than doubled. While Libyan oil exports started to recover lately, the trend for gas deliveries is less positive: volumes decreased by 37% in the first nine months of the year. The combined share of the two countries from total extra-EU imports was 9% in the first quarter of 2016 but reached 12% in the second and third quarters.

• Imports of LNG increased throughout 2016 and covered 14% of total extra-EU gas imports in the first quarter, 13% in the second quarter and 14% in the third quarter (see further details below).

• The EU’s estimated gas import bill was around 13 billion euros in both the second and the third quarters of 2016, about 30% less than a year earlier. The decrease was clearly driven by the falling prices.

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In 2016, the share of the main supply routes of Russian gas imports has been relatively stable. Ukraine continued to be the main supply route, covering 41% of total EU imports from Russia in the second quarter and 43% in the third quarter. Volumes arriving through Ukraine (which includes the Brotherhood Pipeline and the Balkan route), traditionally the main supply route of Russian gas to the EU, were 24% higher in the first nine months of 2016 than in the same period of 2015. Volumes surged in August when Nord Stream and the Yamal pipeline were temporarily shut down for maintenance.

Gas flows on the Nord Stream pipelines represented 31% of total EU imports from Russia in the second quarter of 2016 but this share decreased to 27% in the third quarter as a result of scheduled annual maintenance between 9 and 17 August. In the first 9 months of 2016, Nord Stream carried 13% more gas than in the same period of the previous year.

Gas supplies transiting Belarus covered 26% of total EU imports from Russia in both the second and the third quarters of 2016. Volumes dropped on the Yamal pipeline between 21 and 27 August because of maintenance. Compared to 2015, volumes were 2% higher in the first nine months of 2016.

On 28 October 2016, the Commission has adopted revised exemption conditions for the operation of the OPAL gas pipeline which connects Nord Stream in Northern Germany with the gas infrastructure in the Czech Republic. The decision is expected to improve the utilisation of both the OPAL and the Nord Stream pipeline; the latter stood at 70% in the first nine months of 2016.

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European LNG imports started to rise in the last quarter of 2014, facilitated by subdued demand in Asia, increasing global supplies and the convergence of Asian and European prices. The increase stalled in the first quarter of 2016 when LNG imports were 5% lower than in the same period of 2015 but resumed in the second and the third quarters.

In both the second and the third quarters of 2016, EU LNG imports increased by 7% year-on-year. In this period, deliveries decreased year-on-year to the two largest importers, the UK (-4%) and Spain (-11%), but this was more than offset by increasing imports in France (47%), Greece (171%), Italy (29%) and Lithuania (162%).

Poland’s Świnoujście terminal started commercial operations in June 2016: the first cargo of LNG under the Qatargas contract arrived on the 17th while another delivery of LNG, purchased under a spot contract with Statoil, arrived from Norway 8 days later. In the third quarter, 3 cargoes were received from Qatar. The capacity of the terminal is 5 bcm/year, representing approximately one-third of the country’s gas demand.

France’s new LNG terminal in Dunkirk received the first cargo on 8 July 2016 from Nigeria, thereby launching the industrial start-up of the facility. A second cargo arrived from Peru in September. Commercial operations are set to start by the end of the year. The terminal has a capacity of 13 bcm/year, representing around 20% of France’s and Belgium’s annual gas consumption.

Source: Based on data from the ENTSO-G Transparency Platform
Deliveries to Estonia, Finland and Latvia are not included; transit volumes to the Former Yugoslav Republic of Macedonia, Serbia and Turkey are excluded.
In the second and third quarters of 2016, Qatar remained the main LNG supplier of the EU (49%), followed by Algeria (21%), Nigeria (14%), Norway (9%), Trinidad & Tobago (3%) and Peru (3%). Compared to the market shares in the same period of 2015, this shows a 5 percentage point decrease for Qatar and a 3 percentage point increase for both Nigeria and Norway.

In the second and third quarters of 2016, Qatar had a dominant role in the Belgian (100%), Italian (85%) and UK (91%) markets. Algeria was the principal supplier of France (69%) and Greece (100%) while Portugal’s main supplier was Nigeria (56%). Norway was the sole supplier of Lithuania. The Netherlands and Spain were the only countries with no single supplier covering more than 50% of total LNG imports. With a cargo coming from the US (see below), the number of Spain’s suppliers grew to seven.

On 26 April 2016, Europe received the first LNG cargo originating from the US: the ship arrived to the Sines terminal in Portugal, carrying LNG from Cheniere’s Sabine Pass plant. This was followed by a second cargo landing in Spain in July (Also in the third quarter, an additional cargo arrived to Turkey.) In spite of Europe’s relative proximity to the US, no further US-sourced cargoes were reported in the EU in the second and third quarters, with most US exports destined for South America. The two US cargoes covered 0.7% of total EU LNG imports in the second and third quarters of 2016.
1.4 Ukraine

- Since 25 November 2015, Ukraine has not purchased gas from Russia, citing the uncompetitive terms offered by Gazprom. This means that, for more than one year, the country had to rely on indigenous production and imports coming from the EU. The transit of Russian gas to Europe continued uninterrupted but during the summer of 2016 Ukraine repeatedly pointed to pressure drops on the Russian-Ukrainian border. As a result, the Commission offered to organise a monitoring mission to Russia and Ukraine to check facts on the ground. Until the finalisation of this report, despite trilateral talks which took place on 9 December 2016, no agreement was reached between Russia and Ukraine on the terms for the purchase of Russian gas in the coming winter.

- In the second quarter of 2016, imports from Europe amounted to less than 0.4 bcm, with gas flows dwindling to a trickle in June – presumably in expectation that prices would fall further in the third quarter. Imports from Slovakia decreased to an unusually low level but still covered 47% of total imports. Polish imports came to a halt from the beginning of May to mid-July.

- In the third quarter, European imports surged and reached 3.3 bcm, 38% more than in the same period of 2015. Slovakia remained the main supplier of Ukraine: deliveries from Slovakia covered 82% of the total, followed by Hungary (9%) and Poland (8%).

- According to Gas Storage Europe, gas stocks in Ukraine bottomed out in early April at 8.4 bcm and by 30 September 2016 increased to 14.3 bcm, equivalent to 46% of storage capacity and about 1.4 bcm less than a year earlier. The relatively low stocks levels raise some concerns about gas transit to Europe in case of a cold winter.

- On 20 July 2016, gas pipeline operator Ukrtransgaz signed an interconnection agreement with Transgaz, the Romanian grid operator. The agreement, together with similar agreements signed between Greece and Bulgaria and between Bulgaria and Romania, will allow bi-directional gas flows between Ukraine and Greece.\(^{15}\)

- On 1 July 2016, the Ukrainian government approved a plan to separate Naftogaz from the transmission grid operator Ukrtransgaz and set up a separate storage company.\(^{16}\) However, on 19 September the unbundling plan was put on hold.\(^{17}\)

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**FIGURE 12 - GAS IMPORTS TO UKRAINE FROM RUSSIA AND THE EU, JULY 2014 – SEPTEMBER 2016**

Source: Data from ENTSO-G Transparency Platform and Naftogaz

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17. ICIS Heren European Gas Markets, 30 September 2016
2. Gas Storage

- As a result of the above-average temperatures and the low spot prices, withdrawals were moderate in the first quarter of 2016. Therefore, Europe finished the 2015/2016 winter season with higher stock levels than a year earlier: on 1 April 2016, the average filling rate was 35%, compared to 29% on the same day of 2015.

- This «surplus» compared to 2015 persisted throughout the second and third quarters of 2016 and the average filling rate remained consistently within the 5-year range during this period. Low prompt prices incentivised injections for most of the period although in August and September maintenance of Norwegian and Russian infrastructure reduced supply, thereby limiting the volume of gas available for injection.

- At the beginning of the 2016/2017 winter season, storage levels were near to maximum capacity: the quantity of stored gas peaked on 9 October 2016 at 950 TWh, equivalent to 92% of storage capacity. In comparison, the maximum filling rate in October 2015 was 84%.

- Almost every Member States had a higher filling rate at the start of the gas winter (1 October 2016) than a year earlier. The only exceptions were Portugal and Spain but these countries largely rely on LNG stored at the import terminals (not reported in the GIE database). On 1 October 2016, 12 out of 19 Member States reported a filling rate of more than 90%, including Germany (94%), Italy (97%), the Netherlands (99%) and the UK (95%).

- In the UK, an unplanned outage affected the storage capacity of the Rough facility, the country’s main gas storage site. Because of technical issues, all injection and withdrawal activity was halted on 22 June 2016 and the site was expected to remain offline by 3 August. The operator of the facility later said that injection capacity would remain offline by March or April 2017 while withdrawal operations would be possible from December 2016. However, the facility has only 1.26 bcm in store compared to the 3.73 bcm peak reached in November 2015. As a result, the UK may face some supply tightness during the upcoming winter and will have to rely more on LNG cargoes, imports from Norway and supplies from storage sites in mainland Europe, especially if the winter proves to be colder than usual. (On the other hand, lower gas exports to Ireland following the commissioning of the Corrib field may give some relief.)

**FIGURE 13 – GAS STORAGE LEVELS AS % OF MAXIMUM GAS STORAGE CAPACITY IN THE EU**

Source: Gas Storage Europe AGSI+ Aggregated Gas Storage Inventory, extracted on 29 November 2016. See explanations on recent changes in data coverage at https://agsi.gie.eu/#/faq.

The 5-year range reflects stock levels in gas years 2012-2016. The graph shows stock levels on the 15th day of the given month.

18. The UK figure does not include the Rough site which is not reported in the GIE database.
20. ICIS Heren European Gas Markets, 31 August 2016
• Figure 14 shows that seasonal spreads have been relatively high in 2014 and the first half of 2015 but started to fall in July 2015, dropping to as low as 1.6 Euro/MWh on the NBP and 1.0 Euro/MWh on the TTF. Among other factors, low seasonal price spreads probably contributed to the muted storage injections in 2015.

• From the second part of January 2016, spreads slightly recovered but remained below the 2014 levels. On the NBP, seasonal spreads averaged 2.2 Euro/MWh in both the second and the third quarters. On the TTF, the average seasonal spread was 1.4 Euro/MWh in the second quarter and 1.5 Euro/MWh in the third quarter.

• High spreads between winter and summer contracts provide an incentive to inject gas into storage. Narrowing spreads may not cover storage costs and thereby put the profitability of storage facilities under pressure. As a result, some sites could be threatened with closure. RWE’s storage facility at Hoogstede-Kalle (Germany) was decommissioned in 2016, with no stocks reported from 1 June 2016.21

**FIGURE 14 - WINTER-SUMMER SPREADS IN THE DUTCH AND BRITISH GAS HUBS**

![Graph showing winter-summer spreads in the Dutch and British gas hubs.](source)

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3. Wholesale Gas markets

3.1 The broader energy commodity picture: comparisons between oil, gas and coal prices in the EU

- After bottoming out below 30 USD/bbl in January 2016, Brent began to increase and, from June, have stabilized in the 40-50 USD/bbl range. Low prices and spending cuts finally started to take their toll on non-OPEC oil supply but OPEC production remained high, reaching new highs throughout the year. As a result, the global market remained oversupplied. In September, OPEC decided to cut output in order to accelerate market rebalancing; the details were agreed in November. The agreement provided some support to prices. If the agreement is duly implemented, prices are likely to increase further but the high level of stocks accumulated over the last two years, as well as a potential increase of US shale oil output triggered by a price increase, will limit the potential for a significant price rise.

- The NBP spot price showed a clear decreasing trend in 2015 and the first three quarters of 2016: its value has halved from an average 23.3 Euro/MWh in February 2015 to 11.3 Euro/MWh in September 2016. A combination of mild weather, falling oil prices and a well-supplied market with robust pipeline imports and steady LNG supply put downward pressure on European hub prices. Some UK-specific factors put additional pressure on the NBP price in the summer of 2016 (see more details in Section 5.3.2). In the second quarter of 2016, NBP averaged 13.6 Euro/MWh, 36% less than a year earlier. In the third quarter, the average NBP price was 12.5 Euro/MWh, 37% below the same period of 2015. In September 2016, the NBP price reached the lowest level since 2009.

- Falling oil prices directly affect oil-indexed gas prices, albeit with a 6-9 month time lag. Accordingly, in spite of the recovery of oil prices from early 2016, oil-indexed prices continued to fall and reached the lowest level around August. Platt’s North West Europe Gas Contract Indicator (GCI), a theoretical index showing what a gas price linked 100% to oil would be, averaged 14.9 Euro/MWh in the second quarter of 2016 and 13.6 Euro/MWh in the third quarter. Oil-indexed prices became increasingly competitive with hub prices: GCI’s average premium over NBP decreased to 1.3 Euro/MWh in the second quarter and 1.1 Euro/MWh in the third quarter but for shorter periods it turned into negative, i.e. oil-indexed prices were from time to time lower than hub prices. Oil-indexed prices have an important but diminishing role in the European market: oil-indexation accounted for 30% of gas consumption in 2015, down from 32% in the previous year. There are considerable regional differences: the share was 8% in Northwest Europe, 29% in Central Europe, 63% in the Mediterranean, 37% in Southeast Europe and 48% in Scandinavia and the Baltics.22

- Coal prices have been on a declining trend since 2011, driven by global oversupply. However, from mid-2016 coal prices started to rise and in the third quarter of 2016 the CIF ARA spot price averaged 53.8 Euro/ton, 7% more than in the same period of 2015 and 31% more than in the first quarter of 2016. The price rise accelerated in October with the price reached the highest level since 2012. The price increase was largely caused by supply-side factors outside Europe: closing mines and reducing the number of days for which mines are allowed to operate in China, disruptions in Indonesia and Australia. Increasing oil prices were also a supporting factor. As a result of increasing coal prices, the relative competitiveness of gas has noticeably improved in the second half of 2016.

3.2 International gas markets

- Figure 16 displays an international comparison of wholesale gas prices. In the last few years, prices have been on a declining trajectory in all regions but this trend seems to have come to an end in the third quarter of 2016.

- Since the beginning of 2015, Asian LNG prices traded on average 1 USD/mmbtu higher than NBP, the UK gas hub but in certain periods the premium has disappeared. In the second quarter of 2016, Japanese landed prices averaged 4.5 USD/mmbtu and were practically on par with NBP. In the third quarter, the average Japanese LNG price increased to 5.4 USD/mmbtu while NBP continued to fall; as a result, Japanese landed prices had an average 1.4 USD/mmbtu premium over NBP in this period.

- European gas prices gradually decreased in the last three years and averaged 4.5 USD/mmbtu (13.6 Euro/MWh) in the second quarter of 2016 and 4.1 USD/mmbtu (12.5 Euro/MWh) in the third quarter. The average German border price was higher: 4.6 USD/mmbtu (14.0 Euro/MWh) in the second quarter and 4.7 USD/mmbtu (14.3 Euro/MWh) in the third quarter of 2016. In September 2016, the German border price was almost 1 USD/mmbtu (3 Euro/MWh) higher than the NBP – this is the biggest premium seen since 2014.

- After two years of steady decrease driven by record production, high stocks and warmer than average winters, the Henry Hub price started to increase from April 2016. In the second quarter, the average price was 2.1 USD/mmbtu which increased further to 2.9 USD/mmbtu in the third quarter. The recent price increase was helped by rising demand in the power generation sector (driven by high temperatures, the retirement of coal plants and nuclear outages), as well as increasing exports (to Mexico and by LNG).

- The convergence of international gas prices continued in 2016. The ratio of the Japanese LNG price and US Henry Hub decreased to 1.8 in September 2016 which is the lowest since the Fukushima accident. In 2013, this ratio was in the 4-5 range.

- The average NBP/Henry Hub ratio was 2.1 in the second quarter of 2016 and decreased to 1.4 in the third quarter. This is the lowest level since 2010. The differential also declined in absolute terms: while in 2012-2013 it averaged 6.8 USD/mmbtu, in the third quarter of 2016 it was only 1.2 USD/mmbtu. The euro significantly weakened compared to the US dollar over 2014 and the first quarter of 2015 (thereby lowering European prices expressed in dollars) but the exchange rate has been relatively stable since then.
3.2.1 LNG markets

- Spot LNG prices decreased significantly in 2014 and early 2015 in both Asia and Europe, driven by weak demand in Asia and increasing global supplies, and compounded by the fall of oil prices. The decrease was steeper in Asia and, as a result, the premium of Asian LNG prices over European ones, which regularly exceeded 5 USD/mmbtu in previous years, practically disappeared.

- For most of 2015 and early 2016, spot prices in Asia were higher than those in Europe but by the second quarter of 2016 the premium again disappeared: in this period, spot prices averaged 4.3 USD/mmbtu in the UK, 4.5 USD/mmbtu in Spain, 4.5 USD/mmbtu in Japan and 4.4 USD/mmbtu in China. JCC, the Japanese benchmark of oil-indexed LNG prices, was higher, moving in the 6-8 USD/mmbtu range in the second quarter.

- In the third quarter of 2016, Spanish and Asian prices started to grow, largely driven by increasing demand in Asia, a disruption in Australia’s Gorgon facility and a force majeure on LNG loadings from Nigeria, but in the UK the falling NBP price put pressure on LNG prices which remained relatively stable. In this period, the average price was 4.5 USD/mmbtu in the UK, 5.1 USD/mmbtu in Spain, 5.4 USD/mmbtu in Japan and 5.3 USD/mmbtu in China. JCC, the Japanese benchmark of oil-indexed LNG prices was around 6 USD/mmbtu in this period.

- After a slight annual decrease in 2015, Asian LNG demand picked up in 2016. In the first nine months of the year, imports increased by 25% in China and by 35% in India year-on-year, which was offset by smaller decreases in Japan (–2%) and Korea (5%). Latin American imports, in turn, decreased by 26% in the same period.23

- In August 2016, the Ikata 3 nuclear reactor was restarted in Japan. This is the country’s third nuclear reactor to resume commercial operations after the 2011 Fukushima accident resulted in the idling of all Japanese reactors. A fourth reactor, the Takahama 3 unit was restarted in February 2016 but was ordered by a court to shut in March. The gradual restart of nuclear reactors is expected to reduce the country’s oil and LNG demand.24 In Korea, four nuclear reactors were closed as a precaution following an earthquake on 12 September 2016, potentially leading to higher LNG demand in the power sector of the country in the last quarter.25

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23. Source: Thomson Reuters Eikon for Commodities
LNG exports from the mainland US started in February 2016. In the first nine months of 2016, the country exported 3.1 bcm of LNG. The main destination was Latin America (57%), followed by the Middle East and Asia (16% each). Looking at individual countries, the three largest buyers were Chile, Argentina and India. Only 6% of US LNG exports was destined to the EU, with one cargo arriving to Portugal and another one to Spain. As increasing Henry Hub prices since mid-2016 deteriorated the economics of US LNG exports to Europe, volumes are not likely to pick up in the short term.

Cheniere’s Sabine Pass facility completed its second production train in September 2016, thereby doubling the plant’s capacity. The opening of the expanded Panama Canal in June 2016 can facilitate a shorter shipping route from the US to Asia. The first LNG tanker to transit the newly expanded canal carried LNG from the Sabine Pass plant in July 2015.

Figure 17 displays the evolution of spot LNG prices paid in the UK and Spain and estimated border prices for pipeline imports from Norway and Algeria, which account for the major part of pipeline imports in the UK and Spain, respectively. The evolution of the day-ahead prices on the UK NBP hub is also presented. The fall in LNG prices has helped to narrow the gap between the prices of pipeline and LNG imports in the EU, the significant differences seen in previous years having disappeared in mid-2015.

In the UK, spot LNG prices closely follow the NBP price but, unusually, in September 2016 the average LNG price was 2.3 Euro/MWh above the average NBP price. For a long time, the estimated price of Norwegian imports was below the NBP price but the difference largely vanished from May 2015, indicating that Norwegian export prices are now clearly linked to European hub prices.

In previous years, there have been seasonal differences in the price development of Algerian pipeline imports and spot LNG in Spain: LNG had a high premium during the winter months but was cheaper than Algerian pipeline gas in the summer. In the 2014-2015 winter, however, LNG prices plummeted and since then, typically remained below the price of Algerian pipeline imports. In the third quarter of 2016, however, LNG was more expensive than the pipeline gas coming from Algeria and, as a result, Spanish LNG imports decreased at the benefit of higher pipeline imports from Algeria.

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26. http://www.eia.gov/dnav/ng/ng_move_expc_s1_m.htm
3.3 European gas markets

3.3.1 Wholesale markets in the EU

- In the second quarter of 2016, liquidity on the main European gas hubs increased significantly: total traded volumes amounted to around 12,300 TWh, 51% more than in the same period of 2015. This is almost ten times more than the gas consumption of the seven Member States covered by the analysis in this period. Among other factors, the decision about the production cap in the Dutch Groningen field (see section 1.2), the outage of the Rough storage site in the UK (see section 2) and the Brexit vote contributed to increased market volatility and liquidity in this period.29

- TTF, the Dutch virtual trading point alone covered 46% of hub traded volumes, followed by the NBP, the UK hub (42%). Volumes at the TTF increased by 76% year-on-year while NBP volumes grew by 34%. From the smaller markets, French hubs showed the biggest year-on-year increase (75%) while volumes decreased by 16% at Zeebrugge.

- The market continued to move from bilateral trade towards clearing. OTC markets, still the preferred channel of trade, had a 69% share of total traded volumes in the second quarter of 2016, down from 74% in the same period of 2015. 9% of OTC volumes was cleared at a clearinghouse, unchanged from the previous year.

- On the UK NBP hub, 45% of total traded volumes were executed directly on an exchange in the second quarter of 2016. This share was 23% on the Dutch TTF hub. This share was 24% at the French hubs, 13% at the German NCG hub and less than 10% in the other hubs covered by the analysis.

Note: Landed prices for LNG.
Source: Platts, Thomson Reuters, European Commission estimates based on Eurostat COMEXT data

29. ICIS Heren European Gas Markets, 15 July 2016
In the third quarter of 2016, the increase of traded volumes continued, albeit at a slower pace: total volumes traded on the main European gas hubs were nearly 10,400 TWh, 14% more than in the same period of 2015. This is about eighteen times more than the gas consumption of the seven Member States covered by the analysis in this period. Traded volumes at the TTF increased by 33% year-on-year while in the UK hub volumes were 5% lower than in the same period of 2015. One of the factors limiting liquidity at NBP was the uncertainty triggered by the Brexit vote.\textsuperscript{30} The Austrian hub showed the biggest year-on-year increase (46%) in this period.

The share of exchange-executed trade was 28% in the third quarter of 2016, down from 31% in the same period of 2015. At the French hubs this share increased from 6% to 22%.

\textsuperscript{30} ICIS Heren European Gas Markets, 30 November 2016
Over the last two years, exchanges gradually gained ground: while in the first quarter of 2014 their share from total traded volumes was 23%, by the first quarter of 2016 it increased to 32%. However, this trend seems to have turned in the second and third quarters of 2016 when this share decreased to 31% and 28%, respectively. The share of cleared OTC volumes also decreased recently, from 7% of total traded volumes in the first quarter of 2016 to 6% in the second and third quarter.
3.3.2 Wholesale price developments in the EU

- Between February 2015 and April 2016, day-ahead hub prices showed a continuous decreasing trend as low oil prices and steady LNG supply put downward pressure on European hub prices. During the 2015/2016 winter, higher-than-average temperatures also weighed on demand and thus on prices, compounded by robust pipeline imports from Russia, Norway and Algeria, and relatively high storage levels at the end of the withdrawal season.

- From the second half of April 2016, hub prices started to increase, helped by a combination of factors: a late cold spell in Northwest Europe, increased storage injections, growing oil prices, the decision on the Groningen output cap and a number of outages affecting Norwegian infrastructure. In France, a strike affecting the country’s LNG terminals in late May and early June also contributed to tighter supplies and higher prices.

- In August, day-ahead prices returned to the downward trend, helped by falling seasonal demand, high stocks, lower oil prices and increasing Norwegian imports.

- Although prices were volatile, the average price was very similar in the second and the third quarters of 2016: in both quarters, hub prices moved in the 12-16 Euro/MWh range and average day-ahead prices were about 35% lower than in the same period of 2015. In most hubs, prices reached their lowest level in August-September 2016 since 2009 (when prices were depressed in the wake of the financial crisis).

- Prices at the Italian PSV hub remained relatively high in the second and third quarters of 2016, with an average premium of 1.9 Euro/MWh above TTF, the Dutch hub. In France, the average premium of TRS over PEG Nord was 0.3 Euro/MWh in the second quarter of 2016 but increased to an average 2.6 Euro/MWh in the third quarter because of increasing restrictions on north-south gas flows and falling LNG imports in Southern France. In August, the average premium increased to 3.8 Euro/MWh, the highest level since 2014, following a force majeure on the north-south link issued due to a compressor failure.31

- The difference between the highest and the lowest priced hub in North-West Europe was relatively low in the April-July period: if Italy is not taken into account, it was in the 0.7-1.6 Euro/MWh range. However, this difference increased to unusually high levels in August (3.3 Euro/MWh) and especially September (5.1 Euro/MWh), driven by high prices in Southern France and low prices in the UK.

**FIGURE 22 – WHOLESALE DAY-AHEAD GAS PRICES ON GAS HUBS IN THE EU**

Source: Platts
• Gas at the UK hub typically trades at a small premium to the Dutch hub (in 2015, the price at the NBP was on average 0.2 Euro/MWh higher than the price at TTF) but this was not the case in certain periods of the second and third quarters of 2016.

• On 22 June 2016, all injection and withdrawal activity was halted at the Rough site, the UK’s largest storage facility. As a result, demand for storage injections stalled, leading to temporary oversupply, thereby putting pressure on day-ahead prices which dropped below the equivalent price at TTF, the Dutch hub. The oversupply was aggravated by the annual maintenance of the Belgium-UK Interconnector in the second half of June as the surplus gas could not leave the UK on this route. (Once the pipeline was opened, gas flows from the UK to Belgium reached record levels.) In contrast to prompt prices, prices for the winter season increased on the expectation that the relatively low stocks will cause supply tightness during the 2016/2017 winter.

• The Brexit vote on 23 June caused a depreciation of the pound against the Euro, thereby increasing prices on the NBP (measured in pound) but, in case of prompt prices, this was offset by the impact of the Rough shutdown.

• On 15 July, the operator of the Rough facility announced that no injection would take place until March or April 2017. In the days after the announcement, day-ahead prices increased because of high export demand as shippers diverted the gas destined for injection to storage sites in continental Europe. As a result, the usual premium of NBP above TTF returned.

• In late August and the first half of September, a temporary oversupply caused day-ahead NBP prices to sink well below those in mainland Europe. Because of maintenance, part of the Norwegian flows destined for continental Europe were redirected to the UK while, at the same time, LNG send-out increased to high levels. As the Rough facility remained shut down, the Belgium-UK Interconnector was the only way of getting rid of the excess gas.

**FIGURE 23 – WHOLESALE DAY-AHEAD GAS PRICES ON THE DUTCH AND THE UK HUB IN JUNE-SEPTEMBER 2016**

![Graph showing wholesale day-ahead gas prices on the Dutch and UK hubs in June-September 2016](source: Platts)

• Figure 24 looks at the development of forward prices one, two and three years ahead in comparison to the development of the day-ahead price on the Dutch TTF. For most of 2014, there has been a situation of contango, whereby closer to the present date prices are lower than prices for future deliveries. With seasonally high stock levels and ample physical supply, spot prices significantly decreased in the first half of the year, while higher forward prices reflected the general uncertainty about future developments, in particular the Russia-Ukraine conflict.

• Day-ahead and forward prices have been more or less at parity in 2015 but in 2016 the forward curve moved higher. In the second quarter of 2016, the year-ahead price was on average 0.94 Euro/MWh more expensive than the day-ahead price. In the third quarter, this difference increased to 1.45 Euro/MWh. In this period, the oil price rise which started in late January 2016 provided support to forward prices.

32. ICIS Heren European Gas Markets, 29 July 2016
33. See the glossary for a definition of contango
3.3.3 Comparing the prices of different contracts for gas in the EU

- Figure 25 compares a selection of estimated border prices of gas deliveries from the main exporters to the EU – Russia, Norway, and Algeria.

- Estimated border prices showed a clear declining trend over 2015 and the first half of 2016. Driven by the oil price drop observed in the second half of 2014, oil-indexed prices fell faster than hub-based prices, leading to a significant price convergence in the third quarter of 2015. From the last quarter of 2015, however, the difference between the prices of various contracts increased again, although not to levels seen in previous years. In the third quarter, prices using an element of oil-indexations seem to have stabilised while hub prices and hub-based prices continued to decrease.

- For most of the second and third quarters of 2016, the estimated price level of Russian gas to Latvia remained the highest although in April was cheaper than the estimated price of Algerian gas to Italy and of Russian gas to the Czech Republic. The estimated border price of Norwegian gas to Belgium clearly follows the development of the day-ahead price at NBP, the UK hub. The German border price and the price of Russian gas to the Czech Republic are at least partly based on hub prices.

- The oil price rise starting in the end of January 2016 is reflected in oil-indexed prices from the summer of 2016. As a result, the price convergence seems to have reversed in the third quarter of the year, with oil-indexed prices becoming noticeably more expensive than hub prices.
FIGURE 25 – COMPARISON OF EU WHOLESALE GAS PRICE ESTIMATIONS

Source: Eurostat COMEXT and European Commission estimations, BAFA, Platts
Note: Border prices are estimations of prices of piped gas imports paid at the border of the importing country, based on information collected by customs agencies, and are deemed to be representative of long-term contracts.
**MAP 1 – COMPARISON OF EU WHOLESALE GAS PRICES IN THE SECOND QUARTER OF 2016**

The colour code for each Member State is defined according to a simple average of all available types of prices (hub, LTC, LNG) in the respective Member State.

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**Sources:**
- EBP estimates and LNG: Eurostat COMEXT, Thomson-Reuters, HUB: Platts, Finnish Gas Exchange, Gaspoint Nordic for Denmark, POUPIX for Poland, BAFA for border prices for Germany, Bulgarian regulator for border prices to Bulgaria.
- For the administrative boundaries: © Eurogeographic
- © DG ENER - November 2016

**Note:** Border prices are estimations of prices of piped gas imports paid at the border of the importing country, based on information collected by customs agencies, and are deemed to be representative of long-term gas contracts. [to change ThR from 2015 to 2016!!!]
The colour code for each Member State is defined according to a simple average of all available types of prices (hub, LTC, LNG) in the respective Member State.

Note: Border prices are estimations of prices of piped gas imports paid at the border of the importing country, based on information collected by customs agencies, and are deemed to be representative of long-term gas contracts.
4. Retail gas prices in the EU

- Figures 26 and 27 show the convergence of retail gas prices for household and industrial consumers, using as a metric the relative standard deviation of the prices in individual Member States. Monthly retail prices are estimated by using half-yearly prices from Eurostat (with the latest available figures relating to the first half of 2016) and Harmonised Consumer Price Indices (HICP) for the household prices and Producer Price Indices (PPI) for industrial consumers.

- For household consumers, the estimated average retail price (including all taxes) showed an increasing trend since 2010 but peaked in 2014, with a slight decrease in 2015 which accelerated in 2016. In the most typical consumption band, D2, the estimated average price in September 2016 was 5.9 Eurocents/kWh, 16% lower than a year earlier. In this period, the estimated price decreased in all Member States except Estonia. With a price decrease of 23%, Bulgaria became the cheapest country (overtaking Romania). In the most expensive country, Sweden, the estimated price decreased by only 4% between September 2015 and September 2016.

- In contrast to converging wholesale prices, retail prices for household show a slightly diverging trend, as shown by the increase of the relative standard deviation over the last four years. Moreover, observed price differences are higher for the consumers with lower annual consumption.

- There are still significant differences in retail gas prices across the EU: in September 2016, the estimated household price in consumption band D2 varied between 3.1 Eurocent/kWh in Bulgaria and 11.3 Eurocent/kWh in Sweden, resulting in a price differential ratio of 3.6 between the cheapest and the most expensive Member State. While this ratio is rather high, it shows a declining trend since March 2012 when it was 4.8.

FIGURE 26 - RELATIVE STANDARD DEVIATION OF GAS PRICES PAID BY HOUSEHOLD CONSUMERS IN EU MEMBER STATES

Note: all taxes included.
Source: European Commission estimates based on Eurostat data on consumer prices adjusted by the HICP

34. The relative standard deviation is calculated by dividing the standard deviation with the average. It shows the extent of variability in relation to the mean of the sample.
• Estimated industrial prices started to decrease already in 2014, and the trend continued in 2015 and 2016. The average estimated price (VAT and other recoverable taxes excluded) in September 2016 in consumption band I4 was 16% lower than a year earlier. Prices decreased in this period in all Member States but Estonia and Lithuania. Bulgaria (-32%), Denmark (-26%) and Greece (-25%) experienced the biggest decreases. Compared to December 2013, the average estimated price decreased by 27%.

• For industrial customers, the relative standard deviation has been significantly lower than in the case of households, indicating smaller price differences across Member States. However, in most consumption bands the standard deviation grew since mid-2015, implying that price differences increased in this period.

• In case of consumption band I5, the relative standard deviation increased significantly from the beginning of 2016. While several Member States with under-average prices had seen a relatively big drop of prices (including France, Poland and the UK), in a couple of countries with high prices (e.g. Austria, Greece, Slovakia) there was no or only minimal decrease in prices. As a result, price differences increased.

• In September 2016, Lithuania had the lowest estimated industrial price in consumption band I4 (1.61 Eurocent/kWh), while the highest price was observed in Sweden (3.41 Eurocent/kWh), resulting in a price differential ratio of 2.1 between the cheapest and the most expensive Member State of the EU. This represents an increase from the beginning of 2016 when this ratio was only 1.7.

FIGURE 27 - RELATIVE STANDARD DEVIATION OF GAS PRICES PAID BY INDUSTRIAL CONSUMERS IN EU MEMBER STATES

Note: Excluding VAT and other recoverable taxes.
Source of data: European Commission estimates based on Eurostat data on industrial prices adjusted by the PPI

• Figure 28 shows the level and the breakdown of residential end-user gas prices paid by typical households in 25 European capitals in September 2016. On average, 48% of the price covers the gas itself, while the rest covers distribution/storage costs (28%), energy taxes (8%) and VAT (16%).

• There are significant differences across Member States, with the share of energy cost ranging from 18 to 71%, the share of distribution/storage costs ranging from 10 to 40% and the share of taxes ranging from 8 to 35%. In Amsterdam and Copenhagen, taxes make up more than half of the price while in London and Luxembourg their share is less than 10%. For 7 of the 25 capitals covered, the price does not include an energy tax component.

• Apart from Amsterdam, Budapest and Stockholm, prices in all capitals were lower in September 2016 than a year earlier, with the biggest decreases in Sofia (-27%), London (-24%) and Zagreb (-24%).

35. Note that these are arithmetic averages.
Maps 3 and 4 show the estimated retail gas prices paid by households and industrial consumers in the third quarter of 2016.
MAP 3 - RETAIL GAS PRICE ESTIMATES FOR HOUSEHOLDS IN THE EU – 3RD QUARTER OF 2016

Prices in Eurocents/kWh

- no data
- < 4.00
- 4.01 - 6.00
- 6.01 - 8.00
- > 8.00

Including all taxes and levies

Band D2: 5.56 MWh < Consumption < 55.6 MWh

EU Average: 5.92 c€/kWh
(28 countries)

Sources: © European Commission estimates based on Eurostat data on consumer prices adjusted by the HICP;
© Eurogeographic for the administrative boundaries;
© DG ENER - November 2016.
GAS PRICES FOR INDUSTRIAL CONSUMERS

Estimates for the third quarter of 2016

Excluding VAT (value added tax) and other recoverable taxes

Prices in Eurocents/kWh

- no data
- <= 2.25
- 2.26 - 2.50
- 2.51 - 2.75
- > 2.75

Band I: 27 780 MWh < Consumption < 277 800 MWh

EU Average: 2.39 c€/kWh (28 countries)

Sources: © European Commission estimates based on Eurostat data on industrial prices adjusted by the PPI; © Eurogeographic for the administrative boundaries; © DG ENER - November 2016.
5. Glossary

**Backwardation** occurs when the closer-to-maturity contract is priced higher than the contract which matures at a later stage.

**Clean dark spreads** are defined as the average difference between the price of coal and carbon emission, and the equivalent price of electricity. Dark spreads are reported as indicative prices giving the average difference between the cost of coal delivered ex-ship and the power price. As such, they do not include operation, maintenance or transport costs. Spreads are defined for a coal-fired plant with 35% efficiency. Dark spreads are given for UK and Germany, with the coal and power reference price as reported by Platts.

**Clean spark spreads** are defined as the average difference between the cost of gas and emissions, and the equivalent price of electricity. Spark spreads are indicative prices showing the average difference between the cost of gas delivered on the gas transmission system and the power price. As such, they do not include operation, maintenance or transport costs. The spark spreads are calculated for gas-fired plants with standard efficiencies of 50% and 60%. This report uses the 50% efficiency. Spreads are quoted for the UK, German and Benelux markets.

**Contango**: A situation of contango arises in the when the closer to maturity contract has a lower price than the contract which is longer to maturity on the forward curve.

**Flow against price differentials** (FAPDs): By combining daily price and flow data, Flow Against Price Differentials (FAPDs) are designed to give a measure of the consistency of economic decisions of market participants in the context of close to real time operation of natural gas systems. With the closure of the day-ahead markets (D-1), the price for delivering gas in a given hub on day D is known by market participants. Based on price information for adjacent areas, market participants can establish price differentials. Later in D-1, market participants also nominate commercial schedules for day D. An event labelled as an FAPD occurs when commercial nominations for cross border capacities are such that gas is set to flow from a higher price area to a lower price area. The FAPD event is defined by the minimum threshold of price difference under which no FAPD is recorded. The minimum threshold for gas is set at 0.5 €/MWh. After the day ahead market closes, market participants still have the opportunity to level off their positions on the balancing market. That is why a high level of FAPD does not necessarily equate to irrational behaviour. In addition, it should be noted that close-to real time transactions represent only a fractional amount of the total trade on gas contracts. The FAPD chart provides detailed information on adverse flows. It has two panels. The first panel estimates the ratio of the number of days with adverse flows to the total number of trading days in a given period. It also estimates the monetary value of energy exchanged under adverse flow conditions (mark-up) compared to the total value of energy exchanged across the border. The mark-up is also referred to as «welfare loss». A colour code informs about the relative size of FAPD events in the observed sample, going from green if less than 10% of traded days in a given period are FAPDs to red if more than 50% of the days are FAPDs. The second panel gives the split of FAPDs by sub-category of pre-established intervals of price differentials. It represents the average exchanged energy and relative importance of each sub-category on two vertical axes.

**Heating degree days** (HDDs) express the severity of a meteorological condition for a given area and in a specific time period. HDDs are defined relative to the outdoor temperature and to what is considered as comfortable room temperature. The colder the weather, the higher is the number of HDDs. These quantitative indices are designed to reflect the demand for energy needed to heat a building.

**LNG sendout** expresses the amount of gas flowing out of LNG terminals into pipelines.