

Europe Exploration and Production Trends 2016

Introduction

As a result of the lower oil price, global oil and gas producers have cut costs, postponed projects and reassessed priorities. High cost areas such as in Europe have been particularly impacted by the challenging commercial context. This is important because domestic production is particularly relevant to EU energy security, supply diversity and sustainability: for example, over 50% of the EU's natural gas continues to be sourced from various countries within Europe, with decades worth of production potentially available. In the context of EU Energy Union objectives, domestic production is often an important aspect in the development of trading hubs and competitive gas markets, as the experience of the UK's NBP and Dutch TTF liquid hubs has shown. Even with today's lower oil price, there are opportunities to better support European natural gas exploration and production, and encourage continued investment.



Woodmac chart showing global exploration expenditure

Source: Wood Mackenzie

EU policy and exploration trends

In June 2014, the European Commission published its European Energy Security Strategy Communication, which aimed at improving Europe's resilience to supply disruptions in the short, medium and long-term. This in turn helped to pave the way for the Energy Union framework and associated objectives.

Exploration and production of indigenous resources in full compliance with relevant energy and environmental regulations, such as the Offshore Safety Directive, was recognised as an important tool to help meet the Energy Union objectives, both in relation to established areas such as the North Sea as well as new regions including the eastern Mediterranean and Black Sea. The International Association of Oil and Gas Producers (IOGP), representing companies that supply around one third of the world's oil and gas, including a substantial share of the EU's gas, welcomed this recognition of the role of indigenous production - especially when complemented by the growing role of LNG as recognised in the EU LNG and storage strategy, as additional gas volumes into the hubs will help to enhance EU gas market flexibility and security of supply.

Maximising the safe exploration and economic recovery of Europe's oil and gas will remain an important focus for the industry in Europe, as well as for governments that have identified the benefits associated with the development of such indigenous resources. While Europe still retains considerable potential for new and material indigenous oil and gas production, the recent oil price decline has made the picture more challenging, as it has in other parts of the world.

The economics of oil and gas

Oil market fundamentals began to decline from mid-2014, the beginning of a steep market fall leading to a low of \$28/bl in January 2016, followed by a slight recovery to 45\$/bl in May 2016. For natural gas a similar downtrend has taken place (NBP was below 30p/therm in March 2016), as has a reduction in the world gas price spread. These fundamentals are expected to persist as a result of new innovation in the shale gas industry, Middle East geopolitics and weak global demand, particularly in Asia. The upside of these structural changes may be a positive impact on demand for oil products, while the Paris climate change agreement may spur a switch from coal to natural gas as part of a broader shift in the energy mix, including greater penetration of renewables and energy efficiency.



Oil and gas producers have responded to these new dynamics by reducing expenditure. Woodmac estimates that over the last two years, around \$380 billion of projects have been cancelled globally, of which \$170 billion were due to start producing in 2016-2020. In 2015 and 2016, the industry is expected to cut capital expenditure in consecutive years for the first time in thirty years.



Barclays Upstream Spending Survey

Source: Global 2016 E&P Spending Outlook: The Double-Dip Downturn, Barclays Equity Research

A <u>Wall Street Journal</u> analysis has noted that global exploration activity has declined to such an extent that 2015 saw the biggest drop in reserves reported by major companies in at least a decade. This could become a real concern as many companies are pulling back on new exploration in favour of optimising production operations consistent with best safety.

In that context some governments in Europe have taken a number of steps to support the industry during this challenging period. For example, in the UK, regulatory and fiscal reforms have been introduced designed to maximise economic recovery (MER) of oil and gas from UK waters. This policy reflects the need to enhance security of supply, jobs and skills innovation in a context in which oil and gas are still expected to play a major role in the energy mix for decades to come.

The EU energy picture

In its 2015 World Energy Outlook, the International Energy Agency published a number of scenarios taking into account key energy and climate trends by fuel, region and sector for the period 2013 to 2040. In Europe oil and gas accounted for more than 55% of energy demand in 2013 (total demand was 1,624 Mtoe).

After COP 21, energy and climate policies should now be consistent with the IEA's 450 scenario, which establishes a framework in which a 50% chance exists of limiting the long term increase in average global temperature to well below 2 degrees celsius. In this scenario, the share of oil and gas in the EU primary energy mix would likely drop to around 38% by 2040, but this is in the context of reduced total EU energy demand, which

could be as low as 1,246 Mtoe. Oil and gas demand would therefore be reduced by almost 50% between 2013 and 2040 (from 900 Mtoe to 481 Mtoe). However, when applied to world energy demand, the 2 degrees scenario has a different impact, as oil and gas demand would remain almost unchanged. There would therefore be less oil and gas demand in Europe, but the global share remains constant (with oil demand expected to be lower, while gas demand is higher).



EU Oil & Gas energy demand

Achieving the 2 degrees scenario will require an ambitious deployment of energy efficiency, nuclear and bioenergy with a contribution from other renewables. In this context, Europe's reliance on oil and gas would be reduced and, on current trends, a large share of oil and gas consumption would need to be imported. Such LNG or pipeline gas is expected to grow in market share as a result of multiple new projects, including in the US and Australia, contributing to global supply. To achieve a balanced energy mix comprising domestic production as well as imports, a better understanding of the scale of Europe's indigenous resources is necessary along with greater insight into the conditions under which they can be economically produced. New exploration will be necessary in that context, and the regulatory framework in Europe should encourage investment in finding new resources.

Europe's oil and gas potential

Europe is a generally highly mature operating region, with high costs. New discoveries tend to be smaller and technically challenging, requiring significant investments to develop. This is also the case offshore Romania in the Black Sea.

Exploration in Europe (apart from Norway) is significantly lower that it was only a few years ago.

Exploration drilling in 2015		
Ireland	1 well	
Denmark	2 wells	+ 1 onshore
UK	13 exploration wells	+ 13 appraisal wells
Spain	1 well	
Norway	56 exploration wells	
Germany	1 exploration well	3 appraisal wells

This is cause for concern, not least because new discoveries are key to securing future production and addressing the EU's exposure to the perceived challenges around import dependency. Fortunately European licensing activity has attracted positive interest from operators in some areas:

Ireland	43 new licence applications	14 new options granted
Denmark	16 new licences	
UK onshore	150 new licences	

The material discoveries offshore Egypt demonstrate the potential for similar discoveries in and around Europe.

Potential technical European resources evaluations provided for IOGP by Woodmac for conventional in 2015 and by Poyry for unconventional remain important (see below). These numbers should be adjusted to prevailing economic conditions.

Global Challenge for Europe

Breakdown of the current energy specifics of Europe:

Remaining to be producedDiscovered, awaiting development	-	43 Gbloeq 14 Gbloeq
Yet to be discovered Scenario of limited Shale		13 Gbloeq (up to 56) 14 Gbloeq (up to 25)
• Total -		84 Gbloe
Demand in Europe for Oil & Gas	: -	7.5 Gbloeq/year

Reminder: Unconventional Potential in Europe

 Potential "not covered by the Wood Macket (reference) 	enzie study". ice: Poyry report, Camb	ridge Economics paper)
Potential of Shale Gas in Europe:		
 Risked resource in place Technically recoverable (RF 25%) 	:	54 TCM (1900 TCF) 13 TCM (475 TCF)
> Recoverable after European constraint	s:	
 In case of Shale boom In case of limited Shale 	-	4.4 TCM (150 TCF) 2.5 TCM (85 TCF)

Exploration needed to confirm potential: some 500-1000 Wells.

Maximising European economic recovery of oil and gas

European policymakers, including the European Commission, should reflect further on how to create a policy framework that encourages investment through policy stability and technology neutrality. The industry will need to focus once again on exploration as soon as the commercial environment allows, find new fields and be able to put into production already known marginal accumulations. This is a challenge more difficult than ever.

New technologies that can lift the recovery factors from fields also need to be developed. Significant investment in infrastructure to guarantee life extensions is becoming a major focus area for the North Sea, and reducing costs while maintaining strong safety management are key industry objectives today. IOGP's <u>JIP 33</u> is an important aspect of

that industry drive, and such efforts should be complemented by technology-neutral regulatory frameworks.

The policy framework, including for market segments such as Europe's heating sector, which shape the context for upstream oil and gas investments remains an important component in project final investment decisions. For example, any policy which explicitly seeks to switch from gas to electricity in Europe's consumer and residential sectors could potentially lead to some producers assessing commercial options for discoveries in a global gas market context, perhaps involving the export of LNG, rather than an EU one. At the same time, the EU is competing with rapidly growing gas markets in Turkey, the Middle East and North Africa. The heating sector in Europe accounts for around one half of gas demand and should be recognised as a key element of demand security for gas producers.

Natural gas remains a fundamental part of the transition to a low carbon economy. It is well placed to partner with intermittent renewables, given its flexibility in the power sector, as well as being an important replacement in its own right for higher-carbon sources of power, such as coal, and for nuclear where capacity is coming offline or not being built to time and budget. Most energy outlooks, including the IEA, foresee a role for gas for many decades to come, as a result of its cleaner-burning properties and flexibility.

The EU's Energy Security Package should take account of the role of indigenous production, particularly in the key North Sea, Black Sea and eastern Mediterranean basins, by providing an attractive policy framework for gas in the EU power, heating and heavy-duty transport sectors, as well as by avoiding upstream policies which create investment uncertainty, such as the Hydrocarbons BREF; insufficient carbon leakage protection for offshore installations in the EU ETS Phase IV, particularly the requirement to grant free allowances for on board generation of electricity for platforms which cannot be connected to the onshore grid; and any future revisions to the Offshore Safety Directive which seek to prescribe cost inefficient approaches to demonstrating financial capability. Given the right framework, the EU is well placed to take advantage of the climate, security of supply and infrastructure benefits that gas has to offer.

Conclusion

The positive policy and demand signals for gas in the context of the Energy Security Package, such as the LNG and Storage Strategy have been welcomed by our industry. However to attract new investment in European exploration and production, which along with new sources of gas flexibility such as LNG and pipeline gas, is what helps to underpin security of supply and market competition, the EU should recognise the importance of providing consistent and positive signals to potential investors.

In a new era of global gas market flexibility and supply abundance, with new potential sources of LNG and pipeline gas, Europe is well placed to benefit from competitively priced gas and to play a role in incentivising new investment in regional supply. Required investments are more likely to happen when the policy framework provides policy predictability and stability. Gas will continue to play a vital role in meeting Europe's future energy demand, including achieving the environmental objectives agreed in Paris at COP 21. Oil will continue to remain vital in transportation.

Annex: Member State overview

The UK

In 2015, oil and gas production in the UK North Sea increased by around 10% to 1.64 million barrels of oil equivalent per day, as a result of new fields coming on stream and enhanced production efficiency. However, despite the improvement in production, company revenues fell by 30% as a result of the lower oil price, impacting the ability to invest in 2016. Less than £1 billion of fresh capital is expected to be sanctioned in 2016, compared with an average of around £8 billion per annum over the preceding five years.



Despite industry progress in reducing costs, which are predicted to fall by a total of 42% between 2014-2016, nearly half of offshore UK fields are likely to operate at a loss in 2016. The interconnectivity of these fields, may of which use common processing facilities, means that a 'domino effect' from the closure of a number of installations could force many others to become uncommercial.



Exploration drilling is at an all-time low, with only seven to ten wells forecast to be drilled in 2016, compared with 13 exploration wells in 2015. The average discovery size has fallen five-fold over the last thirty years, with increasing signs that the UK North Sea is becoming 'super mature'. In the current low oil price environmental, and similar to much of the rest of Europe, industry in the UK is cutting almost all discretionary expenditure to survive. The investment projections are a major concern for the whole of the UK industry.

In a demonstration of the key role of domestic oil and gas to the UK's national interests, the Government has taken steps designed to support existing and new investment, and to maximise economic recovery of oil and gas in the North Sea. In the Infrastructure Act 2015 requires all relevant persons, including industry and regulators, to 'take the steps necessary to secure that the maximum value of economically recoverable petroleum is recovered from the strata beneath relevant UK waters'. Activities, behaviours and / or regulations which prevent this objective are now contrary to UK law.

Another adjustment made by the government to encourage new investment in exploration will involve making oil and gas licences more flexible, including on timing. The next tender round will enable companies to better adapt exploration schedules to their specific fields.

Norway

In 2015, 56 exploration wells were drilled, and seventeen discoveries made, many of which were, however, minor. By the end of the year, eighty-two fields were in operation, compared with fifty-one ten years ago. Despite the high-level of exploration and development activity in recent years, investments fell by 16% from 2014 – 2015 and this decline may continue until 2019 when a moderate uptick is expected. In comparison with the rest of Europe, activity in Norway is high, with four new fields coming on stream in 2015, and nine developments ongoing. The NPD expects to receive development plans for three new fields this year.

Like in the UK, oil and gas production in Norway increased in 2015, supported by greater operational efficiency and cost reductions. There was also a new gas sales record for gas volumes into Europe as a result of higher demand. However, the lower oil price led to revenues being substantially lower. More than half of the resources on Norway's Continental Shelf have yet to be produced, and the challenge for the whole industry, including the regulators, is ensuring that these discoveries are developed economically. According to the Head of the NPD, Bente Nyland: "Activity will remain high in the years to come, in spite of the decline since 2014. Therefore, it is important that the companies make wise decisions and keep a long-term perspective."

In May 2016, Norway awarded licences to 13 companies as part of the country's 23rd round, including blocks in a new area of the Barents sea, in order to help promote new exploration. Norway's Energy Minister viewed the industry's interest in this licencing round as a sign that "the Norwegian continental shelf remains attractive. The potential is huge". Any new potential production in the Barents Sea may help to offset declines in the more mature North Sea, with exploration operations expected to begin in 2017. According to the Norwegian Petroleum Directorate, the Barents Sea is thought to contain almost half of Norway's yet-to-find 18 billion boe.



Graph showing Norwegian production. Source: NPD

The Netherlands

The Netherlands is currently the EU's largest producer of gas. At the end of 2015, the Dutch government set production from the Groningen field – which is Europe's largest gas field – at 27 bcm for the gas year to 1 October 2016, and said it would continue to reduce production limits as a result of small earthquakes associated with production. This follows a 25% fall in the volume of gas produced in the Netherlands in 2015, to 51 bcm in total. Groningen gas is an important source of energy in the Netherlands, as well as in neighbouring Member States, and until the recent production cuts was a source of flexible and swing supply for the European market. The fact that cuts at Groningen did not result in price spikes is testament to the liquidity and flexibility of the Dutch TTF hub, which offset lower domestic production with alternative sources of supply, including from Norway and LNG.

An important objective in the Netherlands is now to improve gas recovery from small fields as a way of compensating for the decline at Groningen. EBN, the state-owned gas company, believes that around 159 bcm of reserves remains to be produced, enough to slow down the decline in production for decades to come.



EBN, Dutch Government's natural gas company, and the industry in the Netherlands strongly believe upside scenarios are possible, both onshore and offshore. In the context of offshore, offshore the window of opportunity is decreasing as critical infrastructure reaches the end of its lifetime. There is therefore a sense that more should be done to develop innovative techniques to extend field life, even in the current unfavourable economical environment. As a result, the Government has been assessing new incentives to enhance investment in smaller fields, including offshore.



Denmark

According to Oil and Gas Denmark, the Danish North Sea has, since the first oil was produced in 1972, contributed significantly to the development of the Danish welfare state. Four billion barrels of oil have been produced over 40 years from the Danish part of the North Sea and have delivered about 400 billion kroner to the state. The industry employs around 15,000 people.

In recent years a decline in production, ageing facilities, increasing operational costs and a drop in oil prices have been the reality for the oil and gas sector, causing serious market adjustments. However the remaining potential is large and Wintershall for example has announced a successful drilling of the own-operated Hibonite exploration well located in the 5/06 licence. Preliminary resource estimates indicate potential oil in place for Hibonite of approximately 100 million barrels which is significant in a mature country like Denmark. This confirms there is remaining potential.

In April 2016, Denmark issued sixteen exploration licences in the North Sea, after a round that attracted a range of Danish and international producers.

This successful round will generate new investment in exploration and may result in commercially viable discoveries that could help finance Denmark's energy transition. This is now particularly important as existing offshore gas production is facing a challenging time after the operator of Denmark's most important field announced plans to potentially shut the Tyra gas field in October 2018 in the absence of a fiscal arrangements that are proportionate to the existing economic context. The Tyra complex produces approximately two thirds of Denmark's gas and forms a hub through which 90% of Denmark's gas is processed.



Onshore, it should be noted also that one shale gas well was drilled by Total in 2015; however insufficient reservoir thickness for development stopped the exploration process. The Danish Energy Agency has estimated that Denmark could remain self-sufficient with oil up to 2021 and with gas up to 2023. However it is recognised that this would need joint work between industry and government to formulate a clear long-term strategy to clarity how existing barriers to achieving this potential can be overcome.

Offshore Ireland

Ireland imports all its oil requirements and, for the past number of years, 95% of gas consumption. In December 2015, the Corrib gas field, off the northwest coast of Ireland, began production nineteen years after it was first discovered. This is Ireland's fourth gas field and its largest, with Corrib expected to meet up to 60% of Ireland's gas demand at peak production. This field is the first to come onstream off the northwest coast, as all Ireland's existing fields lie off the south coast. Currently, the level of drilling nationally is low, with only one exploration well drilled in 2015.



In February 2016, the Irish government awarded 14 new oil and gas licences to a number of IOCs, and saw this as a welcome development despite the low oil price environment. Recent discoveries in the Flemish Pass Basin in eastern Canada, which is indicative of prospectivity across the Atlantic in Ireland, have helped to enhance confidence in the Irish offshore. A second phase of licence awards is planned in 2016. In December 2015, the Government published a White Paper on Energy, which stated the important contribution of oil and gas to Ireland's future energy mix and overall energy security.

Black Sea

The Neptun Deep licence in Romania, which borders the maritime boundaries of Bulgaria, Turkey and Ukraine, is a potentially material new discovery of up to 71 bcm. Since 2012 when the discovery was made, seven exploration and appraisal wells have been drilled, most of which have confirmed gas. The Black Sea generally remains an unexplored basin with few wells drilled to date. Romania's offshore gas resource including from Neptun Deep could enable gas self-sufficiency by the end of this decade, as well as potential exports to support the development of a south-east Europe gas hub involving Bulgaria and Greece.

As well as Romania, further exploration work is planned in Turkish waters in the western Black Sea, and in Bulgarian waters.

Map of offshore concessions in Romania. Source: RBSTA



East Mediterranean - Cyprus

The eastern Mediterranean is the focus of much industry attention, with a number of prospective discoveries having been made in the region in recent years, including in Egypt, Israel and Cyprus. Europe is well placed as a potentially attractive market for this resource; however, the EU faces competition from other markets for this gas, including from North Africa, the Middle East and Turkey.

Regional volumes could be delivered into the EU via a new pipeline connecting the Levant Basin to Greece and South East Europe, or through existing regional LNG liquefaction capacity, for example in Egypt. This could have a real impact on EU security of supply, even if the development plans still need to be defined and the political / diplomatic challenges overcome.

Several export routes are also under investigation.



The region's gas potential was recognised in 2009, when Israel announced its first offshore find, the Tamar field. That was followed by Israel's Leviathan in 2010, Cyprus' Aphrodite in 2011 (see below), and the largest of them all, Egypt's Zohr, in 2015. Combined, the four fields hold around 2 trillion cubic meters of gas. Europe's largest field, Groningen in the Netherlands, had 2.8 trillion cubic meters when it was discovered in 1959.

Development dates of these fields remain uncertain. Aphrodite and Leviathan are not expected to be developed before 2019-2020, Tamar, which is already producing, could supply gas to Egypt earlier, and the development of Zohr by 2020 could positively impact the supply and demand dynamics of the region.

In March 2016, Cyprus opened a new licensing round in relation to three new exploration licences (blocks 6, 8 and 10). Hopes for Cyprus's southern offshore acreage have been raised by the discovery of the nearby Zohr field in Egypt.



Cyprus's offshore blocks and third licensing round.

According to IHS, the eastern Mediterranean has potential gas volumes in place which are similar to Norway's.

Table showing the gas resource potential in the eastern Mediterranean, with comparisons to other key suppliers. Source: IHS

Total Hub resources (bcm)	
(gas in place)	2.787
Further Potential (yet to find)	Bcm
Levantine Basin (Israel, Cyprus, Lebanon)	3,455

Total Hub	9,771
Egypt (Nile Delta)	6,315

Spain

Local oil and gas Gm3 of gas oil production was in 2015). One well was drilled Canary Islands while cancelled. very low despite for shale in Castilla y However, public a key challenge. A new tax regime is in

Current supplier reserves	Bcm
Russia	48,145
Norway	2,832
Netherlands	1,076
United Kingdom	227

sector is limited (2.5 production in 2015; around 10 000 bopd

by Repsol in the the second well was Exploration activity is some good prospects Leon region. acceptability remains

(Source: IHS)

place, which

established a ration between production and tax rate. Royalties need to be paid in cash, and a new regulation giving 1% of production proceeds to landowners was introduced in May 2015.

Poland

Conventional production remained unchanged in 2015.

Only 20% of gas demand is produced locally; the remaining 80% is imported. 10 new concessions were awarded in 2015 (9 for conventional, 1 for unconventional) Shale gas exploration has slowed down; major operators have left, and at this point there are three national companies exploring for shale gas. Two shale gas wells were drilled in 2015, and plan for 2016 drilling programme is not yet clear.

Germany

At the end of 2015 Germany's producers declared reserves of 34 million tonnes oil and 68 BCM of natural gas. While in recent years the development of crude oil reserves has been stable, natural gas production has fallen fell 30 percent over the last three years. The reason is a moratorium for hydraulic fracturing in Germany. Production of gas has fallen to 8.6 BCM per annum, or 10 percent of demand. If this situation is not addressed, the production level will continue to decline and many installations may need to be decommissioned in the next ten years. The German government has drafted a new regulation on hydraulic fracturing, but the draft law is on hold in the German Parliament.

A new report on German shale gas indicates a potential resource of 380 - 2340 BCM, and this could, if confirmed, cover indigenous production for more than 100 years. However, the water law creates challenges for potential shale gas developments in Germany. All exploration and appraisal wells in Germany in 2015 were searching for crude oil.

Production of natural gas has been decreasing for ten years and no exploration wells for gas were drilled in 2015. The moratorium for hydraulic fracturing compounds the situation for producers and the service industry. The block on new approvals has resulted in no

projects and no activity for the technical service companies, with the consequence that jobs are being lost.

Croatia

Indigenous production of gas in Croatia could, together with a proposed LNG terminal on the island of Krk, support new sources of gas entering the regional market. Early in 2015, 10 offshore exploration and production licences had been awarded to various companies as part of the country's first ever licencing round in the Adriatic Sea, although the signing of these has since been delayed.

Croatia currently meets around 65% of its annual 3 bcm gas demand from its offshore fields, and hopes to meet the entirety of such demand in due course from domestic production.

SHALE GAS in EUROPE

Extract from the

"European Science and Technology Network on Unconventional Hydrocarbon Extraction – Annual report 2015" https://ec.europa.eu/jrc/en/uh-network.

"With regard to the exploration and exploitation of unconventional hydrocarbons, the EU is still in early exploration phase. The shale gas drilling activity in the EU remains very low. It accounts for less than 3% of the shale wells drilled outside North America. Exploration activities are generally low and currently take place mostly in Poland, although activities are expected to develop also in the UK in the near future. There are also a number of site scale research activities now underway or beginning. These can also provide useful information particularly for baseline environmental conditions. There is already limited commercial production of tight gas and coal bed methane in the EU.

Hydraulic fracturing of horizontal wells has been limited, in part due to difficult geology resulting in low test outputs and low gas and oil prices as well as public acceptance issues.

Based on information collected, it appears that at least 132 shale gas wells have been drilled or are planned to be drilled so far in the EU (out of which at least 13 horizontal wells and one vertical well were fractured), 327 tight gas wells and 106 CBM wells. This list may not be fully comprehensive, notably with regard to tight gas and CBM wells as data collection efforts focused primarily on shale gas wells."



Fig. 3.1: Shale Gas wells² distribution in Europe by country. Note that only 13 horizontal wells (12 in Poland, 1 in UK) and 1 vertical well (in Germany) were hydraulically fractured

About IOGP

The International Association of Oil & Gas Producers (now IOGP and formerly known as OGP) is the voice of the global upstream industry. Oil and gas continue to provide a significant proportion of the world's energy to meet growing demands for heat, light and transport.

Our Members produce more than half the world's oil and about one third of its gas. They operate in all producing regions: the Americas, Africa, Europe, the Middle East, the Caspian, Asia & Australia.

We serve industry regulators as a global partner for improving safety, environment and social performance. And also act as a unique global forum in which our Members identify and share knowledge and good practices to achieve improvements in every aspect of health, safety, the environment, security and social responsibility.

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