

## OVERVIEW

Following several years of stronger-than-expected North American supply growth, the shockwaves of rising United States (US) shale gas and light tight oil (LTO) and Canadian oil sands production are reaching virtually all recesses of the global oil market. This North American supply revolution is not happening in a vacuum. Sustained high oil prices helped unleash it. Its impact is also compounded by other market developments, most prominently social and political turmoil in the MENA region in the wake of the 'Arab Spring' and the shift in demand to East-of-Suez markets. Together, these powerful forces are redefining the way oil is being produced, processed, traded and consumed around the world. There is hardly any aspect of the global oil supply chain that will not undergo some measure of transformation over the next five years, with significant consequences for the global economy and oil security.

### Global Balance Summary

(million barrels per day)

	2012	2013	2014	2015	2016	2017	2018
<b>GDP Growth Assumption (% per year)</b>	<b>3.09</b>	<b>3.39</b>	<b>4.03</b>	<b>4.30</b>	<b>4.41</b>	<b>4.47</b>	<b>4.44</b>
<b>Global Demand</b>	<b>89.78</b>	<b>90.58</b>	<b>91.80</b>	<b>93.12</b>	<b>94.38</b>	<b>95.58</b>	<b>96.68</b>
Non-OPEC Supply	53.35	54.43	55.79	57.03	57.84	58.62	59.31
OPEC NGLs, etc.	6.31	6.56	6.75	6.90	7.00	6.97	7.00
<b>Global Supply excluding OPEC Crude</b>	<b>59.66</b>	<b>60.98</b>	<b>62.54</b>	<b>63.92</b>	<b>64.84</b>	<b>65.59</b>	<b>66.30</b>
<b>OPEC Crude Capacity</b>	<b>35.00</b>	<b>35.35</b>	<b>36.30</b>	<b>36.37</b>	<b>36.66</b>	<b>36.80</b>	<b>36.75</b>
<b>Call on OPEC Crude + Stock Ch.</b>	<b>30.12</b>	<b>29.59</b>	<b>29.26</b>	<b>29.19</b>	<b>29.54</b>	<b>29.99</b>	<b>30.37</b>
Implied OPEC Spare Capacity <sup>1</sup>	4.87	5.76	7.04	7.18	7.12	6.81	6.38
as percentage of global demand	5.4%	6.4%	7.7%	7.7%	7.5%	7.1%	6.6%
<b>Changes since October 2012 MTOGM</b>							
<b>Global Demand</b>	<b>-0.01</b>	<b>-0.02</b>	<b>-0.03</b>	<b>-0.05</b>	<b>-0.07</b>	<b>-0.09</b>	
Non-OPEC Supply	0.14	0.46	0.99	1.07	1.00	1.09	
OPEC NGLs, etc.	0.09	0.06	0.11	0.02	0.04	0.03	
<b>Global Supply excluding OPEC Crude</b>	<b>0.22</b>	<b>0.52</b>	<b>1.10</b>	<b>1.08</b>	<b>1.04</b>	<b>1.13</b>	
<b>OPEC Crude Capacity</b>	<b>0.00</b>	<b>-0.42</b>	<b>-0.60</b>	<b>-1.05</b>	<b>-0.89</b>	<b>-0.75</b>	
<b>Call on OPEC Crude + Stock Ch.</b>	<b>-0.23</b>	<b>-0.55</b>	<b>-1.12</b>	<b>-1.13</b>	<b>-1.12</b>	<b>-1.22</b>	
Implied OPEC Spare Capacity <sup>1</sup>	0.23	0.12	0.52	0.09	0.23	0.47	

<sup>1</sup> OPEC Capacity minus 'Call on Opec + Stock Ch.'

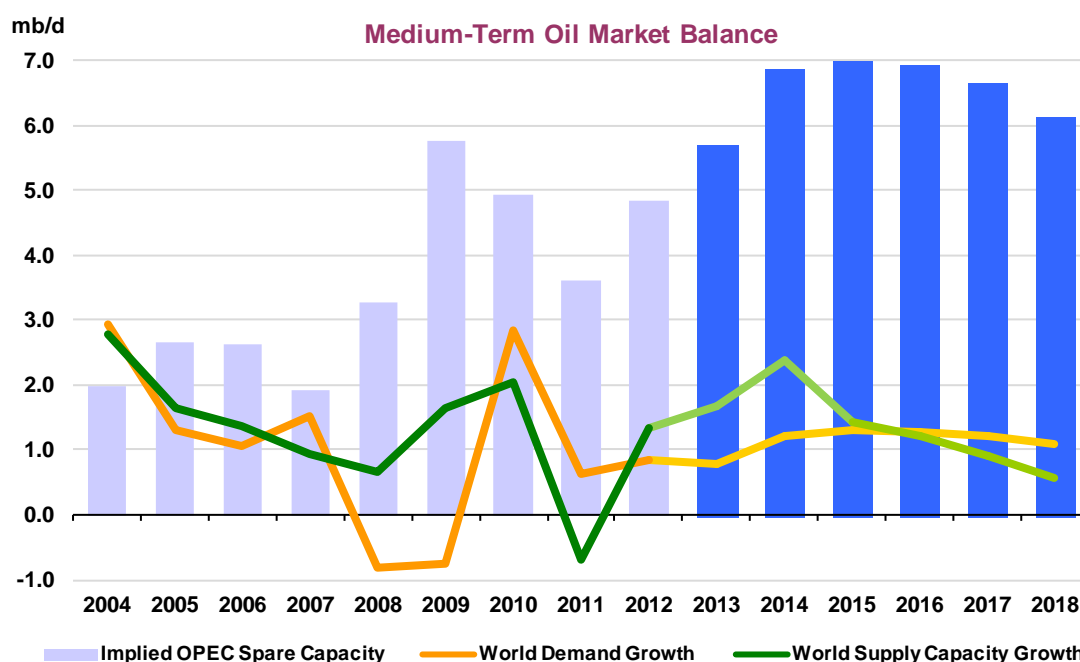
Note: unless otherwise indicated, all material in figures and tables derives from IEA data and analysis.

### Supply growth and the resurgent North American primacy

Regional contrasts that were identified in the previous edition of the *Medium-Term Oil Market Report (MTOMR)*, released in October 2012, have become even more pronounced in the last few months. On the upstream front, incremental North American LTO and oil sands production, which already towered over the 2012 *MTOMR*, has increased in prominence. The forecast of non-OPEC supply growth has been adjusted upwards, with North America now forecast to grow by 3.9 mb/d from 2012 to 2018, accounting for more than half of the increase. Downward revisions to the non-OPEC forecast are limited to a 60 kb/d cut to the forecast for Africa.

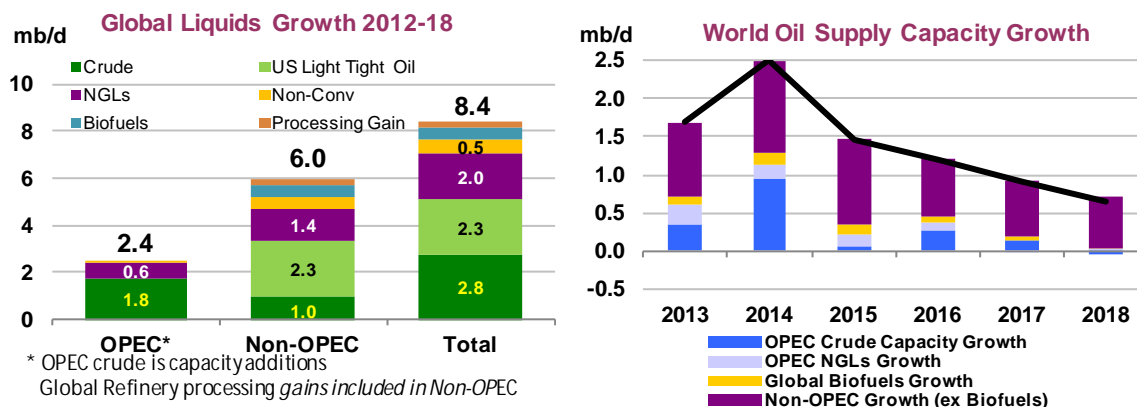
Although non-OPEC supply growth looks more robust than in the 2012 *MTOMR*, those upwards revisions are more than offset by downward adjustments in OPEC crude production capacity. Several members of the producer group face new hurdles, notably in North and sub-Saharan Africa. The regional fallout from the 'Arab Spring' is taking a toll on investment and capacity growth. Security

risks are on the rise, compounding the uncertainty about future changes to the oil laws and investment regime. Two years into the region's process of far-reaching social and political transition, the biggest challenges lie ahead. A resurgent Iraq remains the largest single source of incremental OPEC capacity, but a host of above-ground problems – administrative hurdles, delays to contract awards, disagreements over payments between Erbil and Baghdad, lingering security risks and problems in executing investment and production plans – are bogging down development. Downward adjustments across the group are partly offset by substantially stronger growth in Saudi capacity than previously expected, reflecting newly announced development projects. But the balance of global supply growth, more or less evenly split between OPEC and non-OPEC in the 2012 *MTOMR*, is tilting towards the latter. North America thus increases its share of supply growth both within the non-OPEC group and more globally.



### Non-OECD economies take the lead in most other aspects of the market

In every other aspect of the supply chain, be it demand, refining, trade or storage and transportation, the fast rise of the non-OECD region is striking. Emerging market and developing economies are projected to overtake advanced economies in oil product consumption as of 2Q13 and to widen their lead through the forecast period, jumping from 49% of global demand in 2012 to more than 54% by 2018. Taken in aggregate, OECD refining, notwithstanding a renaissance in the US, is increasingly relinquishing market share to the non-OECD region, a form of de facto off-shoring not unlike the trend in other manufacturing sectors. Already most of the world's refining capacity is located in non-OECD economies. In the next five years, virtually all net crude distillation capacity growth is forecast to take place in the emerging market and developing economies. Non-OECD refineries are also rapidly catching up with the OECD in conversion depth and complexity. And while international crude trade appears poised to contract in the next five years as refineries move closer to the wellhead, more of that internationally traded crude is expected to end up in non-OECD economies, whose share of global crude imports looks set to push through 50% by the end of the forecast period.



Last but not least, these tectonic shifts in supply, demand and refining capacity growth have sparked an explosion of storage capacity. This is relatively well documented in North America, where news of logistics and storage additions can move markets and have been closely watched. But rising Asian import needs and changing crude and product trade patterns have sparked equally strong, though less broadly publicised, storage and transport infrastructure growth in the non-OECD region, whether for commercial or strategic purposes. As trade patterns shift, new trading hubs are emerging at both OECD and non-OECD strategic locations such as Northwest Europe and the Caribbean. Storage terminals are being expanded along the African coast amid rising African imports of LPG and transportation fuels. Non-OECD companies are expanding their international footprint in some of those strategically located terminals, while trading firms seek to expand and leverage their storage assets to arbitrage emerging supply/demand imbalances.

### Beyond supply growth: the LTO paradigm shift

The intrinsic complexity of the oil market is such that its transformation cannot be pinned down to any single cause. There is a long list of factors that will shape market developments in the next five years, ranging from the impact of sustained high oil prices to shifts in the global economy (including Europe's debt crisis and China's changing pace of growth) to the social and political transition in the MENA (including, but not limited to, the outcome of the Syrian conflict and how the international dispute over Iran's nuclear plans is resolved). Yet a common thread runs through many of the developments forecast in the oil market for the next five years. While continued uncertainties remain about the economics and ultimate impact of unconventional production technologies, recent developments in North American supply stand out as an overarching driver, colouring the way in which virtually all other factors impact the market, and causing ripple effects through all aspects of the oil industry, from supply to demand and all the links in between.

What makes the tight oil boom truly transformative is not just the sheer production volumes unlocked but the combination of volumetric production growth with other factors: the crude's distinctively light quality, the unconventional nature of both the plays from which it is extracted and the technologies which have unlocked it, the economic and market impact of the new production, and the chain reaction it is creating in the global transportation, storage and refining infrastructure.

Incremental North American supply clearly played a critical role in offsetting record supply disruptions in 2012, and is likewise forecast to help offset decline rates elsewhere through the

forecast period. Yet one needs not go far back in history to find times when Saudi production went through comparable swings, whether on the upside or the downside, without causing a paradigm shift. The case of US LTO is distinctive in that rising production is causing an unexpected quality shift in the global crude mix. While many supply growth forecasts had long been predicated on the notion of a shift in crude quality towards heavier and sourer grades, LTO is exceptionally light and sweet, including large volumes of field condensate. While a good fit for some US refineries which had seemed on the brink of closure, the supply boom is proving a challenge as well as an opportunity for others, which had bet on a widening heavy-light price spread and invested massively in upgrading capacity. The adjustments required in the US refining and petrochemical industry to absorb and leverage continued light-end supply growth will send ripple effects far beyond the US, through the global refining industry and product markets, and may result in part in large US exports of such light products as gasoline, naphtha and other petrochemical feedstock.

Another distinctive trait of the North American supply boom is that it is taking place at the heart of one of the world's most highly industrialised, mature economies. The emergence of large-scale new supply in such a context will necessarily play out very differently from the way in which a comparable increase might affect the market if it came from a Middle East or sub-Saharan producer. The initial impact of the LTO boom on global crude markets has thus been indirect: rather than seeking out export markets, the new supply has so far affected international crude markets mostly by backing out imports. Future growth could be constrained by logistical and marketing challenges, however. Those stem both from the inland and relatively remote locations of many of the new plays and from current US law restricting most crude exports, as well as from proposed European legislation that could effectively ban some or all European oil imports from North America. This *Report* assumes that US restrictions will largely remain in place through the forecast period, though other scenarios are clearly possible. On the logistics front, new infrastructure designed to transport LTO to coastal markets may cause significant changes in crude and benchmark pricing. New terminals and trading hubs may appear on the Gulf Coast or wherever else LTO or Canadian heavy oil and syncrude might be traded. Price reporting agencies and oil companies are reportedly mulling new LTO-related benchmarks in Texas or Louisiana.

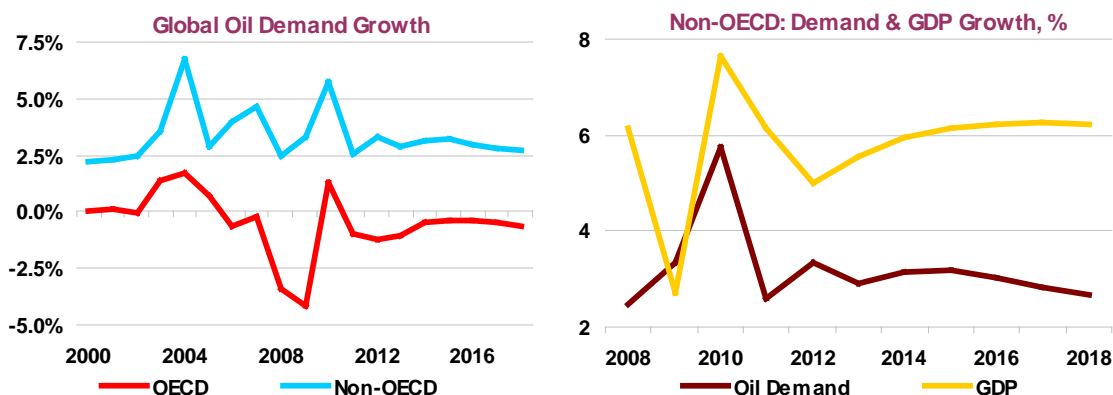
The revolutionary power of the North American supply boom also reflects the still untested potential for replicating and applying transformative new technologies developed in US LTO plays to other oil provinces with comparable success. This includes not only tapping shale oil and gas resources in places ranging from Latin America to China and Russia, but also extending the life and yield of low-permeability conventional crude plays. Companies in countries ranging from China to Russia to Saudi Arabia are already reporting good results in applying fracturing technology to enhance recovery in mature conventional plays. Although uncertainties remain, it is impossible to ignore the possibility that current non-conventional technologies, as they spread and get both perfected and mainstreamed, could lead to a wholesale reassessment of global reserves. Although challenges abound and the full impact of this transformation may not occur until after our forecast period, expectations of future resource availability and production potential are already undergoing a sea change.

Last but not least, the surge in US shale gas production and associated shifts in natural gas pricing are challenging the conventional wisdom about fuel switching and gas-in-transport. Cheap and abundant natural gas has already facilitated the transition of the US economy towards broader use of the fuel.

But US fuel switching so far has mostly come at the expense of coal, whose share of US power generation has collapsed. The conversion of US space heating from oil to gas was well underway before the shale gas revolution, and the scope for further substitution is comparatively limited. Oil-to-gas substitution in transport would have a larger impact as the sector accounts for the lion's share of oil demand. Long seen as a remote possibility, transport gas now looks much closer to becoming a reality. This is true not only of the US market but also of China and other gas producers such as Australia. Given the considerable infrastructure build-up required to convert the vehicle fleet and fuel distribution network to gas, transport gas will not likely happen in a big way until after the forecast period, and the next five years are more likely to witness the rollout of the needed infrastructure than a large-scale shift in the fuel mix. Nevertheless, as with supply factors associated with LTO developments, expectations are shifting, and this forecast expects natural gas to start making meaningful inroads into the transport sector towards the end of the forecast period.

### Demand: beyond the BRICS

The primary driver of oil consumption growth is the economy, but global demand in the next five years will also be affected by the broader economic impacts of the North American supply revolution. The economic assumptions used in this *Report* are those of the International Monetary Fund's *World Economic Outlook* of April 2013, which notes a "growing bifurcation [within advanced economies] between the United States on one hand and the euro area on the other." The two-speed pattern of economic recovery that had prevailed until now has thus evolved into a three-speed recovery characterised by a growing divergence in economic growth between three main blocks: non-OECD economies, low-growth European advanced economies and the US.



In demand terms, the non-OECD region is projected to increase its lead over the rest of the world from 2Q13, when oil demand in emerging and developing economies is estimated to have exceeded that in advanced economies for the first time, through the end of the forecast period. But this broad trend, which extends earlier patterns of demand growth, should not obscure new shifts in the allocation of demand growth within the non-OECD region itself. Chinese demand growth, by far the most powerful engine of growth in the last 10 to 15 years, is expected to shift to a lower gear as the country's government, under new leadership, changes the focus of economic policy from an aggressive emphasis on growth to a stance that balances expansionary objectives with an attention to the quality of growth and the need to address global economic and monetary imbalances. China is also expected to embark on a drive to address severe urban pollution problems through greater

efficiency and emission control in coal-fired power generation, but also by encouraging the use of natural gas in transport.

Whereas non-OECD demand growth had been led in the last few years by the so-called BRICS countries (Brazil, Russia, India, China and South Africa) and Saudi Arabia, a shift toward slower Chinese growth may help decrease their share of incremental demand somewhat. At the same time, demand growth is expected to pick up momentum in other non-OECD economies which are enjoying robust economic expansion and where income growth looks poised to lift internal consumption and oil demand. African economies are a case in point. While oil statistics in most African countries remain scarce and of low quality, there is growing evidence that African demand has been underestimated and is set to grow relatively steeply, albeit from a low base, in the next few years, turning the continent, despite its persistent governance and other problems, into a new demand frontier.

The US energy supply revolution has helped accelerate an industrial renaissance which accounts in part for the country's relatively stronger pace of economic recovery both in recent months and the foreseeable future. This includes a steep rise in US exports of refined products and a remarkable rebound in petrochemical manufacturing. This stronger growth performance is not expected to lead to a comparable rebound in oil demand, however, due to shifts in the fuel mix, marked efficiency improvements, demographic trends and changing consumer behaviour. New North American supply may accelerate the change in the US fuel mix through greater use of ethane in the petrochemical sector at the expense of naphtha and a shift towards natural gas in transport towards the end of the forecast period. In Europe, on the other hand, the North American supply revolution may indirectly cause adverse impacts on economic growth by undermining the competitiveness of the European industrial sector, particularly its troubled refining and petrochemical industries.

### **Supply: spreading the benefits of technological breakthroughs**

The North American hydrocarbon revolution continues to dominate the supply outlook. As noted, North America is forecast to account for an even larger share of non-OPEC supply than estimated in the 2012 *MTOMR*. While US crude, condensate and natural gas plant liquids (NGL) supplies are booming, this growth should not obscure two concomitant developments: on the one hand, the many challenges facing continued North American supply growth, and, on the other hand, the global impacts of the North American boom on oil companies' asset portfolio management and allocation of capital expenditure around the world. At the same time, the spread of technologies being used to tap tight oil in the US, whether in prospective shale formations or in low-permeability conventional crude plays elsewhere, may improve yields and production worldwide and lead to a broad reassessment of reserves. While little is known at this point about the size and quality of the global tight oil resource, and while it seems unlikely that shale plays or other tight oil formations will be developed outside of the US before the end of the forecast period, unconventional technologies used in shale extraction may nevertheless significantly boost production in conventional plays where they can be applied to enhance recovery.

The challenges facing continued North American production revolve in part around the massive infrastructure and logistical requirements associated with this new production, the uncertainties concerning the legislative and regulatory framework for potential oil exports from the US and Canada, and prospective environmental challenges to gas flaring and wastewater treatment. These

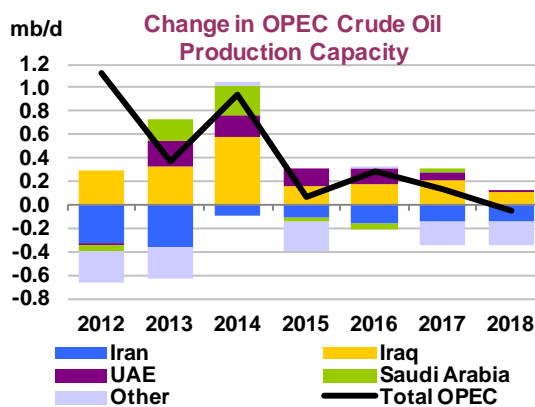
challenges may not be as daunting as they appear. The industry has shown flexibility and ingenuity in coming up with new transport links to bring production to market and in tweaking refineries and petrochemical plants to handle the new feedstock. Regulatory and legislative frameworks, in both North America and Europe, also remains uncertain and may offer room for flexibility. But neither should those challenges be dismissed. The impact of logistical bottlenecks on prices may already have played a role in Total and Suncor's decision to cancel their Voyageur oil sands upgrader in Canada, and have no doubt triggered reviews of many other capital expenditure projects. Deep discounts for bottlenecked Canadian grades are an obvious downside for Alberta project economics at current oil prices.

Meanwhile, gains in North American production and technical developments can indirectly affect supply gains elsewhere. On the downside, increases in North American supply, compounded by the impact of host-country policies, may be delaying production and development plans in other regions, particularly Africa, as oil companies and investors prioritise the deployment of new technologies in well developed producing regions, where support services are available and the regulatory environment predictable, over costly mega-projects in frontier areas. On the upside, applying more broadly the technologies that unlocked US tight oil appears to be increasing production prospects in other regions, such as conventional plays in mature areas of Russia and China. The full scope of incremental production that may be unlocked in such a fashion will partly depend both on future technology improvements and on oil prices.

### OPEC: challenges ahead

Despite the growth in LTO, OPEC oil will remain an essential part of the global oil supply mix for the foreseeable future. Over the medium term, however, the projection of OPEC capacity growth has been adjusted downwards and reallocated by country. Several OPEC producers are facing challenging social and political transitions. While Libya surprised the markets by the speed with which it was able to restart production after the 2011 civil war, production growth has since stalled. Companies operating in the region face severe security challenges as the central government struggles to assert its authority over the armed militias tasked with providing security to oil facilities. The legal framework of production is also unclear as Libya moves from an established autocratic regime to a less predictable democracy. Security concerns have spread to Algeria following a deadly terrorist attack in January on the In Amenas gas facility, and to Nigeria following kidnappings and attacks by Islamist groups in the North and others in the Niger Delta southern producing region. In Venezuela, the death of long-serving President Hugo Chavez in March 2013 opened another kind of transition period equally fraught with uncertainty.

Iraq continues to account for most of the incremental OPEC production capacity over the forecast period, growing by 1.57 md/d to 4.76 mb/d, or near 20% of global crude production capacity growth. But continued above-ground challenges – lingering disagreements between Baghdad and the Kurdistan Regional Government not least among them – are slowing down development, and the

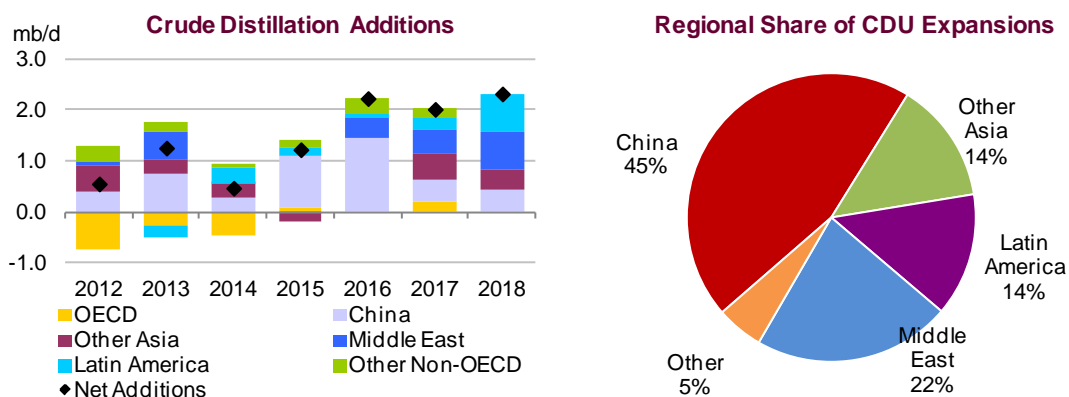


growth forecast has been trimmed marginally by around 100 kb/d from the 2012 *MTOMR* forecast. Perhaps symptomatically, Baghdad itself is reviewing its previous, highly ambitious production goal of 12 mb/d by 2017, with 9 mb/d being mooted as a more achievable target.

### Global refining: rise of the export titans

The North American supply revolution and the surge in non-OPEC demand continue to redraw the global refining map. In the process, the role of the refining industry in the global supply chain is changing as refineries move closer to the wellhead and growing non-OECD markets and international trade in refined products continues to grow.

In North America, the supply revolution and a downtrend in domestic consumption have helped turn the US, long the world's top importer of refined products, into one of its largest net exporters. Cheap natural gas and 'advantaged' (*i.e.*, discounted from benchmark prices) crude have dramatically increased the competitiveness of US refineries, which also benefit from economies of scale, good logistical links to export terminals (the capacity of which is rising) and state-of-the-art technology. US refiners also have benefitted from fast rising demand and a lack of refining capacity in Latin America, which have provided them with ready export markets for excess gasoline and distillate production. As US output of light products keeps rising, thanks in part to a planned expansion of condensate splitting capacity, US refiners might face increasing international pressure in marketing their surplus, however.



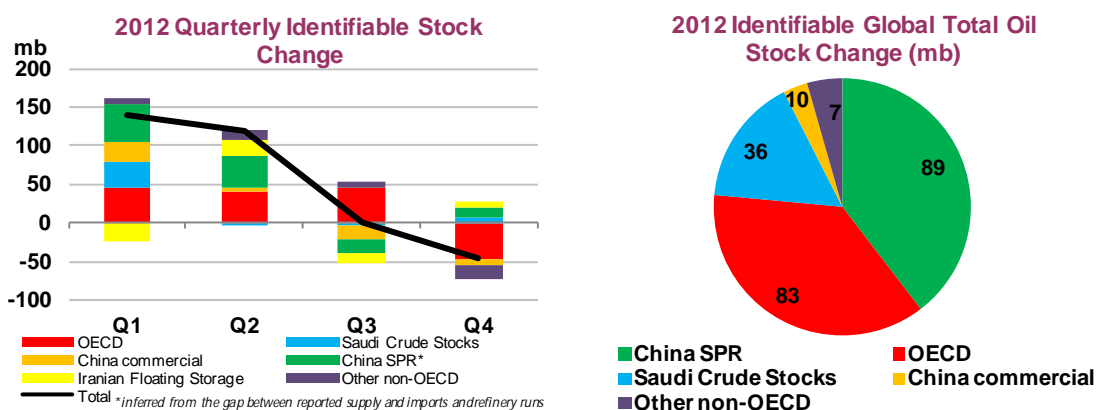
Non-OECD economies already account for a clear majority of global crude distillation capacity, but their share of the refining market is set to rise steeply in the next five years following large increments in the Middle East, Asia, Russia and Latin America. China, in particular, may become saddled with significant excess product output, following ambitious expansion plans at both state-owned refineries and so-called 'tea-pot' plants, a sector increasingly restructured and made more efficient in recent years. Saudi Arabia is also aggressively expanding downstream through large-scale joint ventures with international companies. As global refining capacity expansions outpace upstream supply growth, let alone demand growth, margins and utilisation rates will come under pressure and higher-cost refineries will face increasingly strong competitive headwinds. European refineries are at particularly high risk of closure over the forecast period. The rise in North American LTO production, coupled with cheap US shale gas, will greatly contribute to these pressures, as it will both make US export refineries more competitive and steeply increase excess light-product supply (gasoline and naphtha), causing US and European refineries to compete directly for export market outlets.



European refinery closures would likely carry significant implications for both energy security and prices. They would likely make Europe more dependent on product imports, lengthen European supply routes, increase their vulnerability to disruptions and raise European reliance on import terminals and product storage facilities, notably for jet fuel and gasoil. In so doing, they may also result in higher price spreads between European markets and exporters, so as to pay for long-haul transport costs, while price differentials or time spreads between low- and high-demand periods may widen to cover storage costs. Increased European reliance on trading houses and third-party suppliers may also leave a growing share of European supply in the hands of market participants with a different set of incentives than those of refiners. Whereas refiners have a clear interest in maximising production and plant utilisation, traders have a different mix of fixed assets and their strategy and market behaviour thus tend to respond to other signals, such as arbitrage opportunities or market volatility.

### Trends in stocks and storage capacity

Not surprisingly, the storage industry has undergone massive change and is expected to remain very dynamic in the next five years as global storage capacity continues to expand in response to shifts in supply and demand. In the US, shifting supply and demand patterns have been associated with a broad restructuring in the storage industry. Integrated oil companies and independent refiners have in recent years spun off their storage and transportation arms as stand-alone profit-seeking companies rather than integrated cost centres. Those newly minted US midstream companies, typically set up as Master Limited Partnerships with substantial tax incentives, have presided over a rapid expansion in transport and storage capacity in the US, both in the Midwest and Gulf Coast to support the gathering and distribution of new oil and gas supplies, and also on the East Coast and in the Caribbean, where the distribution of refined products has undergone significant transformation.



But the most dramatic expansion of storage capacity has occurred in non-OECD economies, where continued growth is expected over the medium term. This includes both strategic reserves, principally in China but also in other Asian economies, as well as commercial storage, associated with refinery capacity expansion and changing import and export requirements, in a broad range of economies, including Asia, Russia and Africa. Storage infrastructure is also on the verge of potentially significant change in Northwest Europe, reflecting refining capacity attrition, shifts in North Sea and Russian crude supply and the evolution of long-haul crude and product trade. There are plans by Russian market participants to set up the Amsterdam-Rotterdam-Antwerp centre as a trading hub not just for regional distribution but also for long-haul, global

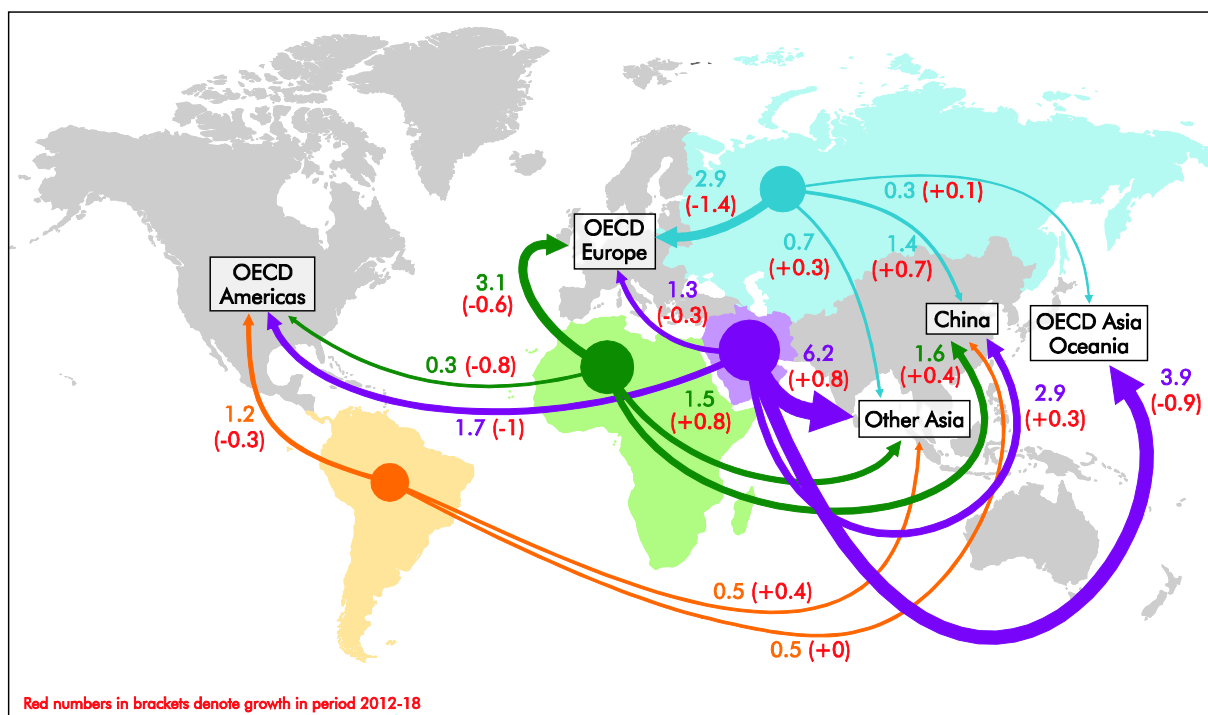
trading operations. Non-OECD storage capacity is, generally speaking, a proverbial black box for international oil statisticians. This Report attempts to shed some light on recent and medium-term forecast developments based on open-source information. Much more work is required in this direction.

### The shifting oil trade map: non-OECD countries overtake OECD crude imports

As North American refining activities are increasingly supplied with US and Canadian crude while more and more Middle Eastern crude is refined domestically, crude trade is expected to decline over the next five years. Nevertheless, the non-OECD share of international crude imports looks set to increase and push through 50% by the end of the forecast period. Rising Asian imports may fuel support for the establishment of new, internationally traded crude benchmarks in Asia and the Middle East. Meanwhile, long-haul trade in refined products is forecast to increase, partly offsetting the decline in crude volumes.

### Crude Exports in 2018 and Growth over 2012-18 for Key Trade Routes

(million barrels per day)



This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

### A note on prices

The International Energy Agency does not forecast prices as a matter of principle. The price assumptions used in this forecast for modelling purposes are derived from the forward curve in Brent futures prices, in keeping with the practice of other institutional and commercial forecasters. Recent and expected changes in price formation are not specifically addressed in this Report, although shifting oil supply, demand and trade patterns carry potentially significant implications for prices and

price spreads between products and geographical markets. New sources of supply and fast-growing consumption and import centres may also lead to the emergence of new benchmarks. China in particular is mulling the launch of a new international futures market, which may provide market participants with hedging and trading instruments based on a new locally devised benchmark index price. Finally, regulatory changes affecting commodities and financial markets have had and will continue to have substantial consequences for the oil market, including, but not limited to, shifts in trading and hedging strategies by market participants and changes in the cast of financial institutions active in physical and paper trading. These changes will be discussed in future editions of the *MTOMR* and of the monthly Oil Market Report (OMR), and may also be addressed in ad hoc notes and other publications.

