

World Oil Outlook

OPEC Secretariat background paper

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EXECUTIVE SUMMARY

The global energy dialogue among consumers, producers and other market stakeholders continues to strengthen and deepen. The International Energy Forum (IEF) has proven to be a significant focal point of these efforts, providing an inclusive platform for producers and consumers to discuss issues of common interest, while promoting an environment of greater mutual trust and understanding. Besides joint work being carried out by the IEF, IEA and OPEC to enhance understanding of important energy market developments and evolving market dynamics, the Joint Organisations Data Initiative (JODI) continues to be an important part of the effort to enhance oil market transparency. OPEC has been a key driver in these efforts, participating in both JODI Oil and JODI Gas, along with other partner organizations. More recently, the energy initiatives carried out by the G-20 have become a part of the international energy dialogue.

Since the 13th IEF Ministerial Meeting in 2012, several notable energy trends have emerged

Oil prices have seen an extended period of reduced volatility; recognition of the adverse effects of speculative behaviour on oil price volatility has led to growing efforts to address regulatory deficiencies in paper commodity markets; recovery from the Great Recession was delayed longer than had been expected, but is proceeding; downside risks to the global economy have nevertheless become increasingly apparent for emerging economies; the non-OECD region, particularly Asia, is leading the energy demand growth; the emergence of tight oil as a major contributor to oil supply growth has affected the geography of oil, at least for the short- to medium-term; similarly, the shale gas ‘revolution’ is affecting energy industry and trading patterns; regional price differentials have emerged for oil and gas; the viability of ambitious renewable energy targets has been increasingly questioned.

Medium-term economic growth sees delayed full recovery from recession

The assumption for medium-term economic growth is that the global recovery from the recession will be more delayed than previously thought. Nevertheless, the Reference Case assumes that a turn-around is already underway, with average global economic growth rising from 3.5% p.a. in 2014 to 3.9% p.a. by 2018. The US economy is supported by the improving housing market and rising consumer confidence, as well as the availability of cheap energy due to shale gas. The sovereign debt crisis in the Euro-zone, on the other hand, continues to cast a shadow over the magnitude and speed of recovery in OECD Europe. Globally, downside risks clearly exist.

Global economic activity continues to shift towards Asia

Long-term world economic growth rates average 3.5% p.a. over the period 2013–2035 in the Reference Case, up from the 3.3% in the WOO 2012. Growth in all regions is slower for the period 2021–2035 compared to 2013–2020, reflecting downward demographic and productivity trends. Already by 2018, China will have the largest economy in the world, and by 2035, its economy will be 41% larger than OECD America and double the size of OECD Europe. India’s growth, which will average 6.3% p.a. to 2035, means that its share in global GDP doubles from 5.4% in 2010 to 10.6% by 2035. The share of developing Asian countries in the global

economic activity rises in the Reference Case from 26% in 2010 to 44% by 2035. Despite these realignments in terms of GDP size, by 2035 OECD regions will still by far have higher levels of GDP per capita.

Oil prices assumed to remain stable, at \$100/b in real terms in the long-run

The rising cost of supplying the marginal barrel has been, and remains, one of the major factors in making assumptions for oil prices over the medium- and long-term. Upstream capital costs more than doubled over the 2004–2008 period. The oil price assumption of the Reference Case reflects these cost developments. The nominal OPEC Reference Basket (ORB) price remains at an average of \$110/b over the period to 2020 and then rises, reaching a nominal value of \$160/b by 2035. In real terms, the ORB is \$100/b by that year.

Energy policies also shape the outlook and are a source of uncertainty

Energy policies also shape the Reference Case outlook. The Reference Case takes into account new policies that have been enacted recently or that are widely anticipated. It also involves assessing the impact of policies that were implemented in the past. The viability of some policy targets is increasingly being questioned in light of on-going discussions about the sustainability of crop-based biofuels. Such policy shifts, while reflected in the Reference Case, are a source of uncertainty in the outlook.

Fossil fuels retain their share above 80% of energy supply

Over the projection period 2010–2035, energy demand in the Reference Case increases by 52%. Fossil fuels accounted for 82% of energy supply in 2010, and constitute 80% of the global total by 2035. Throughout most of the projection period, oil will retain the largest share. However, in the Reference Case, each of the fossil fuel types converges towards a share of around 26–27% each by 2035. In volume terms, natural gas use rises faster than any other form of energy supply. In percentage terms, gas rises faster than any fuel, except non-hydro renewables.

Shale gas an increasingly important source of energy, but there are constraints ahead

The increased attention paid to natural gas worldwide could be linked to the emergence of shale gas as a growing source of supply in the US and Canada. Continued low gas prices in the US increasingly support the switch to natural gas for power generation. Despite the rapid rise of supply from shale gas and its large resource base, there are many potential barriers to such sharp rise in supply in both the medium- and long-term. These include concerns about potential adverse environmental impacts in the extraction process, the disposal of waste water and excessive water use. However, these concerns seem to be fading away. Another hurdle relates to the behaviour of gas prices in the future.

Developing Asia accounts for 88% of the growth in oil demand to 2035

While the key driver and source of uncertainty for medium-term oil demand is economic growth, long-term oil demand in the Reference Case is also affected by policies, technological development and diffusion, oil prices and consumer choice, particularly in the transportation sector. Global oil demand increases by close to 20 mb/d over the period 2012–2035, reaching 108.5 mb/d by 2035. Of this increase,

developing Asia accounts for 88% of the growth, and demand in China, India and other developing Asia reaches 94% of that of the OECD by 2035.

The transportation sector in developing countries is key to the rise in demand

Oil use in all forms of transportation in developing countries will witness a significant rise, by an average of 0.7 mboe/d p.a. A key factor in the growth in oil demand is the rise in passenger car ownership in non-OECD countries. In the Reference Case, the number of passenger cars more than doubles by 2035, reaching almost 1.9 billion cars. Fully 64% of the increase in car ownership will be in developing Asia. By 2028, there will be more cars in developing countries than in the OECD. China sees the largest rise in the number of passenger cars, increasing by more than 380 million over 2010–2035. Developing Asia is also the key source of growth in the number of commercial vehicles.

Tight oil growth is projected to be a short- to medium-term supply phenomenon in the Reference Case

The primary source of recent non-OPEC supply growth has been from the tight oil and oil sands projects in the US & Canada. The strong rise in tight oil supply in the US – and to some extent Canada – is expected to continue to contribute to the medium-term non-OPEC supply increase. The current expectation is that the increase in OECD America tight oil of 2.5 mb/d between 2010 and 2013 will be followed by a further rise of 1.6 mb/d by 2018. However, tight oil supply in the US is expected to plateau by 2017–2018. This is due to a number of constraints and challenges, such as steep initial decline rates, a transition away from ‘sweet spots’, environmental concerns, availability of equipment and skilled labour, and the likelihood of rising costs. The Reference Case considers that tight oil production will remain limited to North America throughout the projection period.

Non-OPEC supply growth limits the demand for OPEC crude in the medium-term, but investments continue

Total non-OPEC supply is projected to increase steadily over the medium-term, rising by 5.7 mb/d over the six years 2012–2018. While the key sources of supply growth are tight oil and oil sands, there are other regions expected to register increases, primarily Latin America, Africa, the Caspian region, and Russia. There will also be some increases in biofuels supply, mainly from Brazil and Europe. OPEC NGLs supply is also expected to continue to increase over the medium-term. The amount of OPEC crude required in the Reference Case will fall from 30.3 mb/d in 2013 to around 29 mb/d in the period 2015–2017. It will only start to rise again in 2018. Although concerns exist that huge investments might be made in capacity that might not be needed, OPEC Member Countries remain committed to supporting oil market stability, and are investing and will continue to invest in additional capacities.

Long-term liquids supply growth comes from both OPEC and non-OPEC, and both crude and non-crude

Although non-OPEC crude supply actually declines over the period 2020–2035, the increases in non-crude liquids supply more than compensate for this, so that total non-OPEC supply rises from 53 mb/d in 2012 to approach 62 mb/d by 2035. After the medium-term steady call on OPEC crude of around 29 mb/d, OPEC crude supply rises over the long-term in the Reference Case. By 2035, the call on OPEC

crude oil is 37 mb/d, more than 6 mb/d higher than in 2012. The overall increase in non-crude liquids supply will satisfy 75% of the demand rise to 2035. Total crude supply in the Reference Case ranges between 72 and 75 mb/d.

The downstream sector is marked by surplus capacity in OECD and capacity expansion in developing countries

Developments in the downstream sector are marked by existing surplus distillation capacity, mainly in the OECD regions, and capacity expansion in developing countries. More than 9 mb/d of new distillation capacity will be added globally in the medium-term largely concentrated in two regions: Asia-Pacific and the Middle East. The potential incremental crude runs resulting from this additional capacity compared with the required additional crude runs resulting from demand increases means that potential production from new projects exceeds the incremental ‘call on refining’ every year, making for a cumulative overhang of 4 mb/d by 2018. This points to a period of severe international competition for product markets and the need to continue refinery closures on a significant scale in the next few years in the OECD.

Economic growth scenarios point to considerable oil demand uncertainty

In additional scenarios, a range of economic growth reflects uncertainties, with downside risks assumed to be greater than the upside potential. Average global economic growth ranges from 3.0% to 3.9% p.a. in the low and high economic growth rates, respectively. By 2035, oil demand remains below 100 mb/d in the low economic growth scenario. This is 10.1 mb/d lower than in the Reference Case. By 2025, the reduction is already 5.1 mb/d. If OPEC absorbs all of this loss in demand, the call on OPEC crude oil falls to 27 mb/d by 2020 and then stays approximately constant at that level throughout the period to 2035. The higher economic growth scenario sees additional demand of 7.5 mb/d by 2035 compared to the Reference Case.

An Upside Supply scenario also emphasizes uncertainties for call on OPEC crude

A further scenario looks at the possible impacts of higher non-OPEC supply than in the Reference Case. The Upside Supply (UPS) scenario includes considerations over the future path of tight oil supply in North America but also the possibilities of developments in other non-OPEC countries outside of North America, namely Russia, Argentina and China. The scenario sees tight oil supply in North America 1.3 mb/d higher than in the Reference Case already by 2020, with a further widening thereafter, reaching 2.5 mb/d higher than the Reference Case by 2035. In addition to the potential for a more rapid expansion of supply from tight oil, upside production assumptions are made for crude oil and NGLs in Brazil and Russia, and for biofuels. In total, the UPS scenario adds 5.7 mb/d additional non-OPEC liquids supply by 2035 compared to the Reference Case. Assuming that this additional supply is fully absorbed by OPEC, OPEC supply of crude would remain below 28 m/b until 2021, falling steadily throughout the rest of the decade. However, as with the economic growth scenarios, the lower OPEC crude path may not be deemed feasible or sustainable.

Climate change-related policies and measures add to uncertainty

Estimates of the impact of a 550 ppm greenhouse gas (GHG) atmospheric concentration stabilization scenario on oil demand decline relative to the Reference Case produces a large range. At the low end, with full global carbon trading, the emphasis of GHG reduction is on the electricity generation sector, involving both a switch away from coal as well as widespread implementation of CCS technologies in the long term. Additionally, forestry becomes a major factor in reducing net emissions. In this case, oil demand by 2050 is just 5% lower than in the Reference Case. At the other extreme, command-and-control policies that target oil use in the transportation sector result in far higher reductions in oil demand, which falls 23% by 2050 relative to the Reference Case. There are ‘win-win’ policies and measures that can deliver effective mitigation in a cost effective manner with minimum cost to the global economy. However, it is far from clear whether these least-cost mitigation policies and measures will be pursued.

The importance of alleviating energy poverty

The Rio+20 Conference in 2012 set a landmark by recognizing the importance and positive contribution of ‘energy’ in combatting poverty. While poverty alleviation is essential for achieving sustainable development, poverty cannot be alleviated without addressing energy poverty. Access to electricity and the use of modern fuels for home cooking and heating are two aspects of energy poverty that are considered high impact areas and for which a better quantitative picture is available. The Rio+20 outcome document provides a comprehensive approach to sustainable development. It is, therefore, important to address energy poverty in a broader context: one that addresses poverty under all the three pillars of sustainable development – that is, social, environmental and economic.

Availability of skilled manpower is a major challenge to the oil and gas industry

The oil and gas industry is known for being capital intensive and technology driven; but it also employs a diverse workforce with a range of abilities and highly specialized skills. But recent global trends have put pressure on the industry to find and recruit necessary manpower. This has put the issue of human resource bottlenecks on the agenda of many companies and organizations. In addressing the challenge of manpower bottlenecks and skills shortages, stakeholders in the oil and gas industry need to address structural problems in education and training, and improve the industry’s image. Governments, in turn, need to better understand the employment gap, facilitate and support international mobility and provide support to educational initiatives. In addition, broader shared solutions would be useful, particularly since the oil and gas sector will remain essential for the global economy in the 21st century and for the foreseeable future.

Dialogue and co-operation is beneficial for market stability

OPEC continues to engage in focused activities in international dialogue and co-operation. An example is its participation in the IEF, which plays an important role in the strengthening of co-operation and dialogue between producers and consumers. This has been pursued through various modalities, such as the JODI programme, workshops and symposia, and other regional summits. OPEC has also been closely involved in several of the G-20’s energy related workstreams focused on, for

example, the role of Price Reporting Agencies (PRAs) and enhancing JODI-related activities. Other on-going dialogues are being pursued with various countries, regional groupings, and international institutions. OPEC continues to value the importance of a co-operative and constructive approach to dialogue in an interdependent world that is beneficial for market stability both in the short- and the long-term.

1. INTRODUCTION

The International Energy Forum (IEF) is a highly focal point for strengthening energy dialogue. The Cancún Ministerial Declaration of March 2010 from the 12th IEF Ministerial Meeting specified areas for IEA-IEF-OPEC co-operation, and since then there have been several productive Symposia and Workshops: January 2014 saw the Fourth IEA-IEF-OPEC Symposium on Energy Outlooks take place at the IEF Headquarters in Riyadh, Saudi Arabia; in March 2014, the Fourth Joint IEA-IEF-OPEC Workshop on the interactions between physical and financial energy markets was held in Vienna; and the first joint IEA-IEF-OPEC symposium on Gas and Coal Market Outlooks was organized in October 2012 at the IEA in Paris. A second symposium is being planned to take place later this year.

This background paper analyzes the outlook for energy and oil demand and supply, together with the uncertainties, challenges and opportunities that need to be addressed. It aims to support the discussion and deliberations at the 14th International Energy Forum Ministerial Meeting. The paper is organized as follows. Initially, the most significant changes since the last IEF Ministerial Meeting and the corresponding issues that have come to the fore that are expected to shape the energy landscape over the medium- and long-term are briefly discussed. The following section then develops OPEC's Reference Case outlook for energy and oil supply and demand to the year 2035.¹ This is followed by a section which addresses some of the challenges ahead, including some of the key uncertainties in the outlook. A final section reflects upon the significance of strengthening the dialogue and co-operation process among all stakeholders.

2. RECENT MARKET DEVELOPMENTS

Since the 13th IEF Ministerial Meeting, held in Kuwait City, Kuwait, 12th–14th March, 2012, several energy trends have emerged: oil prices have seen an extended period of reduced volatility; recognition of the adverse effects of speculative behaviour on oil price volatility has led to growing efforts to address regulatory deficiencies in paper commodity markets; recovery from the Great Recession was delayed longer than had been expected, but is proceeding; downside risks to the global economy have nevertheless become increasingly apparent for emerging economies; the emergence of tight oil as a major contributor to oil supply has affected the geography of oil, at least for the short- to medium-term; similarly, the shale gas 'revolution' is affecting energy industry and trading patterns; regional price differentials have grown for oil and gas; the viability of ambitious renewable energy targets has been increasingly questioned.

Despite major fiscal and monetary stimulus programmes – particularly the latter have been instrumental in reviving the world economy after 2009 recession – the recovery process has been slower than foreseen by most observers. Quantitative easing in the US in combination with on-going low interest rates turned out to be important factors for the recovery in the US housing market and further

¹ Based upon the OPEC World Oil Outlook 2013, published in November 2013 and available at <http://www.opec.org>.

improvements in consumer spending. While the low interest rate environment was an important pillar also in the other advanced economies, the large monetary stimulus of developed economies' central banks has also been a significant boost for emerging markets through large inflows of foreign investments to these markets with higher return expectations.

Moderate growth in the global world economy last year is expected to rebound from 2.9% to 3.5% in 2014 with improving conditions in the OECD economies to 2.0%. The underlying growth dynamic gained traction in the US economy (2.7% this year), the Euro-zone moved into positive growth trajectory following contraction by 0.4% in 2013. In Japan, the growth momentum is expected to continue with positive impact of stimulus efforts on GDP. Growth in emerging economies is forecast to continue decelerating. China's economy is now forecast to expand at 7.6% in 2014, close to the recently announced growth target of 7.5%, while India is on the path of recovery from relatively low growth in 2013 and is broadly forecast to grow by 5.6% in the current year. This deceleration of strong growth in emerging economies has also been mirrored in the foreign exchange markets over the past months.

However, many challenges remain, ranging from less expansionary monetary policies and the consequent tightening of financial conditions, the uneven recovery in the Euro-zone, the on-going drag from elevated public and private debt levels in major economies, the need for continued reforms in the emerging economies to improve structural issues and a combination of geopolitical issues causing rising uncertainty.

While these challenges will need close monitoring, the currently expected improvement in the global economy is also resulting in higher oil demand as growth in global oil consumption is forecast at 1.1 mb/d in the current year compared to 1.0 mb/d in 2013. Prospects of higher oil demand growth will be affected by Asian demand as well as contraction easing in the OECD area.

Most incremental demand has been seen in non-OECD countries – led by China, India and the Middle East – leading to their oil demand expected to surpass that of the OECD in the second half of 2014. OECD demand should continue its decline after peaking in 2005.

Uncertainties over oil market fundamentals are currently geared towards the pace of global and regional economic growth, and oil demand profile. Gradual impacts of energy policies, efficiency improvements, policy reforms in oil product retail prices, substitution are likely to dampen the oil demand growth potential as apparent in the declining trend in oil intensity in both OECD and non-OECD.

On the supply side, above-trend performance in non-OPEC supply is expected to continue in 2014. This is primarily attributed to the rapid growth in North America, coming largely from US tight oil production. US oil supply, with steady growth in recent years, has risen by more than 2.5 mb/d since 2011, and is expected to surpass 12 mb/d in 2014. Other major contributions to supply growth are seen mainly coming from Canada, Brazil, Caspian Region, Russian Federation,

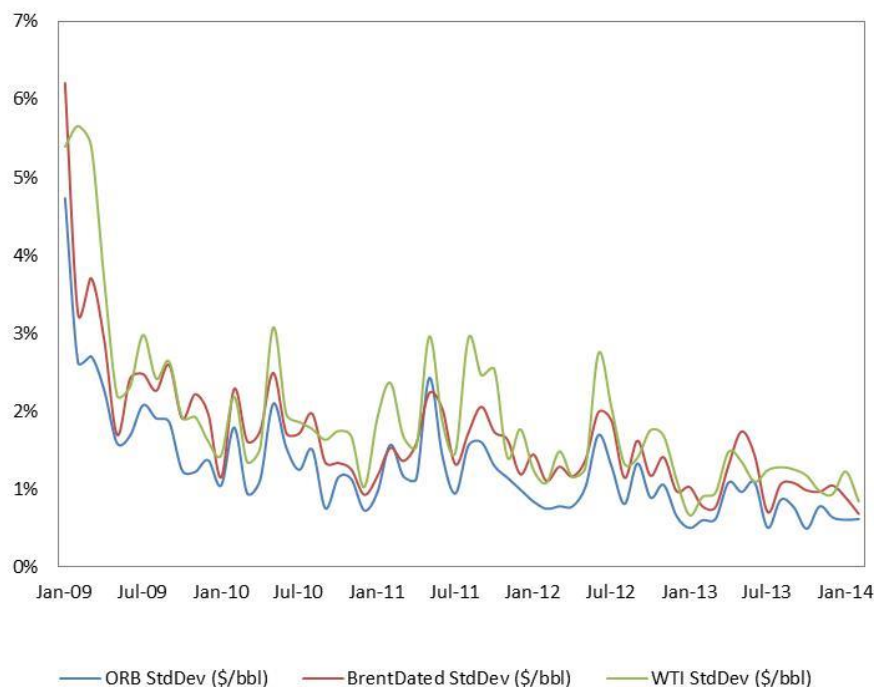
while supply from Norway, UK and Mexico is expected to decline. OPEC crude oil and NGL supply, despite disruptions, remained above 36 mb/d in 2013.

The refining sector is expected to remain under pressure with increasing refining capacity amid moderate growth and shifting patterns in product demand. Refineries with lower complexity and higher procurement costs are increasingly exposed to significant disadvantages in the integrated global market. This situation will mainly impact the OECD region, especially affecting Europe and OECD Asia-Pacific countries, while opportunities for exports of refined products to Latin America and access to cheaper feedstock and energy will continue to give a competitive advantage to refineries in the US.

In addition to comfortable crude stock levels in the OECD region, especially in OECD North America, there has been a steady stock build in the non-OECD area. Last year alone, non-OECD commercial and SPR stocks have risen by around 100 mb to nearly 1,900 mb.

Price volatility has eased markedly over recent years (see Figure 1). So far in 2014, oil prices have been moving in a narrower range than in 2013. Brent quotations ranged from \$105–111/b since the beginning of the year, driven mainly by the fluctuations to supply disruptions, sensitivity to geopolitical events, as well as financial market activities and the underlying fundamentals framework. The spread between ICE Brent and Nymex WTI changed notably over the course of the year. After reaching as much as \$23/b in 2013, it narrowed steadily to below \$10/b due to the availability of new pipeline capacity, relieving the supply pressure in the US pricing hub of Cushing, Oklahoma.

Figure 1
Crude oil price volatility (2009 – 2014)



These recent developments make the significance of dialogue and co-operation all the more evident. This background paper has been developed to support the process by highlighting some of the key issues that will be addressed in the sessions of the 14th IEF Ministerial, and is relevant to both the industry's producer-consumer dialogue and broader global and multilateral discussions.

3. WORLD OIL OUTLOOK: OVERVIEW OF THE REFERENCE CASE

Economic growth expectations are central to the outlook for oil and energy demand. The rate of global recovery from the recession has been a key focal point, and since the 13th IEF Ministerial, in March 2012, a more delayed recovery has emerged compared to what had been expected. Global GDP growth in both 2012 and 2013 was close to 1% lower than was projected in the background paper submitted to that previous meeting. Nevertheless, the latest OPEC Secretariat Reference Case assumes that a turn-around is already underway, with average global economic growth rising from 3.5% p.a. in 2014 to 3.9% p.a. by 2018.

The US economy is supported by the improving housing market and generally rising consumer confidence, as well as the availability of cheap energy due to shale gas. The sovereign debt crisis in the Euro-zone, on the other hand, continues to cast a shadow over the magnitude and speed of recovery in OECD Europe. Growth in Latin America and Middle East & Africa has been revised upwards for the medium-term, reflecting higher oil revenues, low labour costs and rising foreign direct investments, particularly from China. There remain some uncertainties over India's ability to take advantage of its growth potential in the coming years. Economic growth in China remains high, albeit slowing, in the Reference Case. Economic growth rates in Russia over the medium-term are robust, at over 3% p.a.

Despite the expected recovery, world economic growth in recent years has been characterized by some remarkable changes that are expected to influence medium-term growth patterns, and to some extent, the long-term trend. Many economies are forecast to grow below potential in the coming years due to a continued high debt-burden in developed economies, as well as less monetary support, causing potentially lower growth for investments for some time, and consequently slowing emerging economies. Downside risks therefore still exist, as emphasized by the International Monetary Fund.²

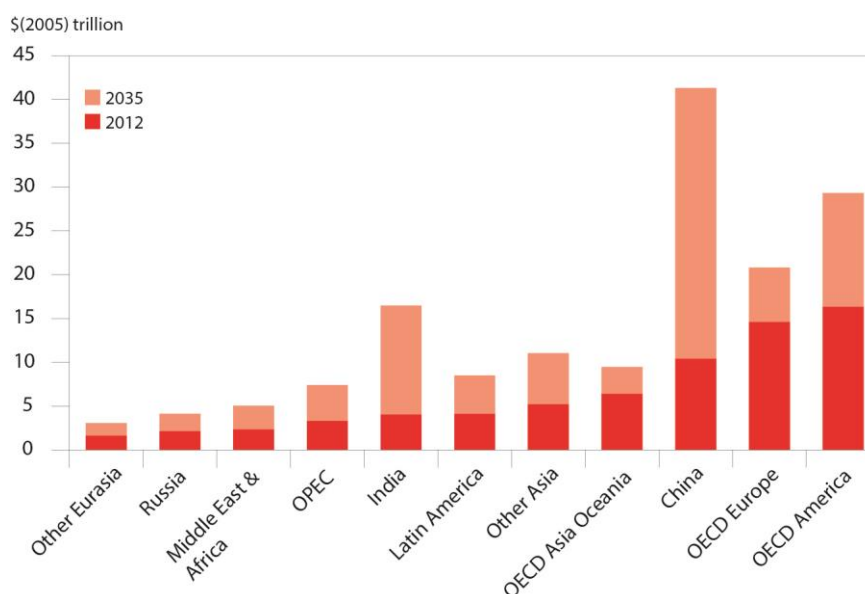
Looking to long-term economic growth assumptions, population developments (in terms of both volume and age structure) affect the potential for economic growth. UN estimates see the global population rising from 7.0 billion in 2012 to 8.6 billion in 2035 under its median scenario. The rise occurs mainly in developing countries. By 2021, India will have a larger population than China for the first time, becoming the world's most populated country. On top of these developments, age structure sees important changes: China's working age population, for example, is expected soon to peak and then start declining. Another important demographic trend is the expected rapid rise of urbanization. By 2035, 63% of the

² See World Economic Outlook, International Monetary Fund, October 2013.

global population is expected to be in urban areas, with developing countries experiencing close to 90% of the urban expansion over the period. This will have important implications in terms of energy use.

Long-term economic growth rates average 3.5% p.a. over the period 2013–2035. Growth rates in all regions are slower for the period 2021–2035 compared to 2013–2020, reflecting downward demographic and productivity trends. By 2035, the Chinese economy will be 41% larger than OECD America and double the size of OECD Europe (see Figure 2). India’s growth, which will average 6.3% p.a. to 2035, means that its share in global GDP doubles from 5.4% in 2010 to 10.6% by 2035. The share of developing Asian countries in the global economic activity rises in the Reference Case from 26% in 2010 to 44% by 2035. Despite these realignments in terms of GDP size, by 2035 OECD regions will still have higher levels of GDP per capita, followed by China and Russia.

Figure 2
Real GDP by region in 2012 and 2035



Oil price assumptions constitute another input to the development of the Reference Case. In March 2012, at the time of the previous IEF Ministerial, the OPEC Reference Basket (ORB) was above \$120/b. This had been preceded by considerable flux, rising from below \$70/b in May 2010. Concern over the impacts of speculative activities was expressed at the time of this rise, and changes brought by regulatory reform effects were noted during the discussions at the Third Joint IEA-IEF-OPEC Workshop on Interactions between Physical and Financial Energy Markets, held in March 2013 (see www.opec.org for the Workshop report). In making assumptions for future price paths, an assessment of the degree to which speculation or supply and demand developments drive observable price movements has always been necessary. It is, however, the rising cost of supplying the marginal barrel that has been, and remains, one of the major factors in making assumptions for oil prices over the medium- and long-term. Upstream capital costs more than doubled over the 2004–2008 period. Downward cost pressures stemming from the

global recession were only temporary; and since the beginning of 2010 upstream capital costs have been rising again, albeit at a slow pace. The oil price assumption in the Reference Case reflects these cost developments. The nominal OPEC Reference Basket (ORB) price remains at an average of \$110/b over the period to 2020 and then rises, reaching a nominal value of \$160/b by 2035. In real terms, the ORB is \$100/b by that year.

Energy policies also shape the Reference Case. The Reference Case takes into account energy policies that are already in place. However, each successive year's projections entail monitoring new policies that have been enacted that year, as well as reassessing the impact of policies that were implemented in the past. A significant regulation that entered into force at the beginning of 2013 was related to energy efficiency levels for international shipping, which were mandated by the International Maritime Organization (IMO) in July 2011. These measures are an Energy Efficiency Design Index for new ships and a Ship Energy Efficiency Management Plan for all ships, with the former having long-term (and probably bigger) impacts and the latter having greater relevance for the medium-term. From the supply side, the viability of some policy targets is increasingly being questioned in light of on-going discussions about the sustainability of crop-based biofuels and the recent decision of the European Parliament that such biofuels should not exceed 6% of fuel used in the transport sector by 2020. These policy shifts, while reflected in the Reference Case, also add to the uncertainties in the outlook.

3.1 Energy and oil demand

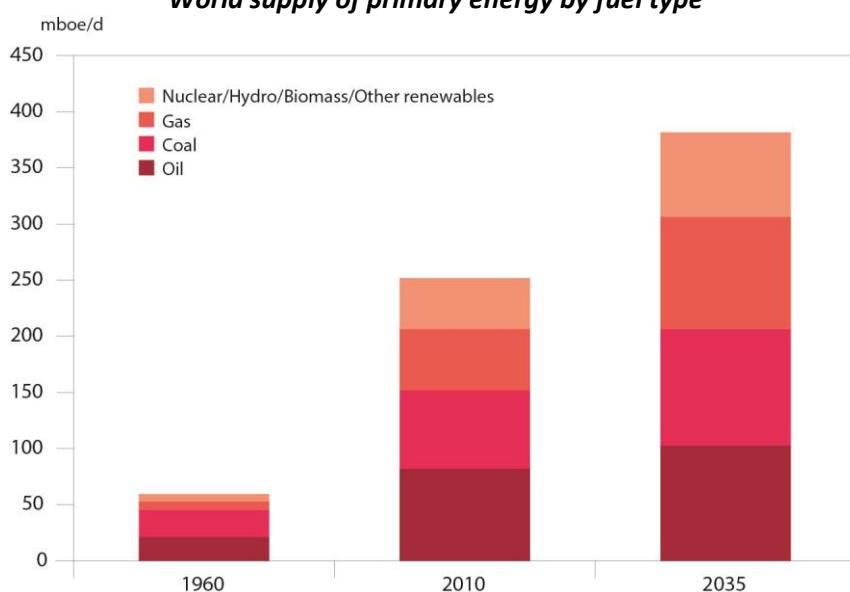
Over the projection period 2010–2035, energy demand in the Reference Case increases by 52% (see Figure 3). Fossil fuels accounted for 82% of energy supply in 2010, and will constitute 80% of the global total by 2035. Throughout most of the projection period, oil will remain the energy type with the largest share. However, towards the end of the period, in the Reference Case, each of the fossil fuel types converges towards a share of around 26–27% by 2035. In volume terms, natural gas use rises fastest among fossil fuels, and also rises faster in percentage terms than any fuel, except non-hydro renewables. The growth of natural gas use, to an extent, reflects the growing importance of shale gas. However, the assumption for this growth is a cautious one, given the considerable uncertainties surrounding the future expansion of shale gas. Indeed, it is possible that future energy patterns could see substantially more gas satisfying energy demand, compared to these figures.

The increased attention paid to natural gas is linked to the emergence of shale gas as a growing energy source of supply in the US and Canada. Low gas prices mean that gas is increasingly being used in the US for power generation. Even though coal remains the primary source of power supply in the US, in the last few years there has been a significant switch away from this source. This has led to lower coal prices and higher exports to Europe, where the combination of low coal and carbon prices made it more competitive in power generation than natural gas.

In the US, the recent boom in shale gas could promote a rapid expansion of the petrochemical sector. Developments so far have seen the growing use of NGLs as petrochemical feedstocks. The availability of ethane and propane at relatively low

prices enhances the competitive advantage of the US petrochemical sector. High ethane production and lower prices have made the ethane-based US petrochemical sector more competitive than in previous years, and it is now in a better position than the naphtha-based petrochemical sector of Europe and the Asia-Pacific, and second only to the Middle East in terms of its economics. The incremental NGLs co-produced with tight oil and shale gas, as well as the amount of ethane (and to a lesser extent propane) that is separated and made available to petrochemicals producers, together with the long-term supply price of these components of natural gas, will determine the overall implications.

Figure 3
World supply of primary energy by fuel type



The development of US shale gas has also led to a large price differential between North American and European markets, and raises questions about the prospects for LNG exports heading east across the Atlantic, something which is becoming a reality. However, Europe's high gas prices, at least during this decade, will limit the potential for gas demand, especially as low carbon prices in the EU are allowing rising quantities of coal from the US to displace European gas in the power generation sector.

Despite the rapid recent expansion of shale gas supply, and the evidently large resource base, there are many potential barriers to its continued supply rise in the medium- and long-term. One concerns the environmental impacts of the hydraulic fracturing process with the inherent risk of releasing toxic chemicals into groundwater. Other environmental issues include the possible surface spills of chemicals, the disposal of waste water and excessive water use, as well as rising traffic volumes. Other concerns involve the high initial decline rates and future costs. Another question focuses on the behaviour of future domestic gas prices, especially if significant volumes are allowed to be exported. And another significant uncertainty revolves around how fast infrastructure and refitting of commercial trucks can be undertaken that could make natural gas an important fuel in the transportation sector.

Despite these uncertainties, natural gas reserves are plentiful, particularly in the Middle East, North Africa and Eurasia (mainly Russia), accounting for 72% of the world's total, excluding shale gas. This, together with rising expectations for the potential of shale gas, underpins the buoyant gas demand in the Reference Case.

Coal resources are abundant. At current rates of production the reserves-to-production ratio is more than double that for oil or gas. The highest reserve levels are in the US, with 28% of the global total. Currently, coal is being displaced by natural gas in the US power generation sector, as shale gas supplies rise: coal-fired generation fell in 2011 by 6% and by more than 12% in 2012.

This is having knock-on effects for the European power generation sector, with cheap coal imports from the US displacing relatively expensive European gas. In fact, exports more than doubled between 2009 and 2012, rising to 126 million short tons, which has had the effect of reducing international coal prices. The coal exports have mainly been absorbed by European consumers, specifically because of the region's low CO₂ prices. In particular, Germany has expanded its coal use in the face of a decision to decommission the country's nuclear plants. Meanwhile, coal use in Japan continues to rise due to the closure of nuclear plants following the Fukushima disaster.

Despite these recent developments, the main growth for coal use in the Reference Case is in non-OECD countries, and particularly India. However, recent coal shortages have increased imports – despite India having the fifth highest level of reserves in the world – and, together with plant shortages, led to severe electricity shortages and power cuts. China is by far the largest coal consumer, accounting for nearly half of the world's total, and will remain dominant over the long-term, increasing coal usage in power plants to address continued growth in electricity demand. In Russia, coal represents an important source of domestic energy use. Export potential has been relatively limited due to high transportation costs. Reserves are abundant at around 20% of the world's total, making Russia the second largest reserves holder. In Australia, black coal exports are one of the essential export commodities.

A general potential constraint to coal use would be more stringent controls over CO₂ emissions. Low carbon prices in the EU mean that its Emissions Trading Scheme is not putting a break on the gas-to-coal shift in Europe. Longer term, a significant shift to a more carbon-constrained world would clearly put pressure on coal use in electricity generation.

The Reference Case reflects the negative long-term effects for nuclear power in Japan and some European countries as a result of the Fukushima disaster in 2011. However, these effects are not assumed to be dramatic in the Reference Case. China is the country with the largest nuclear build programme worldwide, with 18 reactors in operation and 28 under construction.

Close to 60% of renewable energy use, other than hydropower and biomass, is currently in OECD countries. Globally, this has been rising at an average of 7% p.a. since 1980. The Reference Case sees slightly higher growth, at an average of 7.5%

p.a., which is faster than any other fuel type. However, with renewables starting from a low base, the global share of this energy type is still less than 3% by 2035. Hydropower is also expected to grow at robust rates, mainly in developing countries, with China accounting for approximately one half of the global increase.

Turning to oil, the recovery from the global recession in the Reference Case will contribute to increases in global oil demand for the period 2012–2018 at an average of 0.9 mb/d p.a., reaching 94.4 mb/d by 2018. Over this period, demand in OECD America is stable at around 24 mb/d, but falls in other OECD regions. It means that OECD aggregate demand falls gradually, having peaked in 2005. Demand in Russia and other Eurasia increases only very slowly. As in previous OPEC Secretariat projections, the main demand increases are found in developing countries, with an annual rise of 1.1 mb/d p.a. over this medium-term period. It is expected that, in terms of annual average, by 2015 non-OECD oil demand will be greater than OECD oil demand for the first time.

While the key driver and source of uncertainty for medium-term oil demand is economic growth, long-term oil demand in the Reference Case is also increasingly affected by policies, technological development and penetration, oil prices and consumer choice, particularly in the transportation sector. As shown in Table 1, global oil demand increases by close to 20 mb/d over the period 2012–2035, reaching 108.5 mb/d by 2035. Of this increase, developing Asia accounts for 88% of the growth, and demand in China, India and other developing Asia reaches 94% of that of the OECD by 2035 (Figure 4).

Table 1

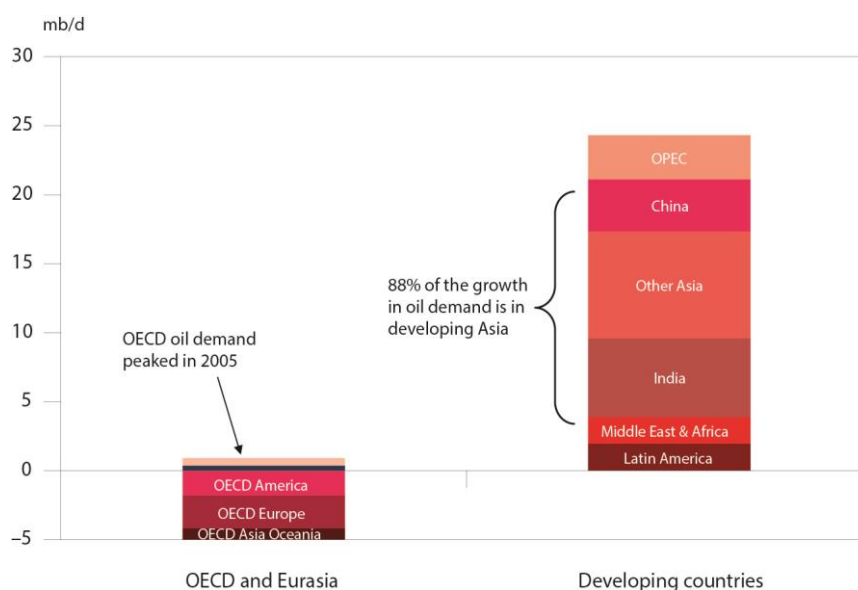
Long-term oil demand outlook in the Reference Case

mb/d

	2012	2015	2020	2025	2030	2035
OECD	46.0	45.2	44.2	43.1	41.8	40.4
Developing countries	37.8	41.1	46.6	51.8	57.0	62.1
India	3.7	4.0	5.0	6.2	7.6	9.3
China	9.7	10.8	12.7	14.4	16.0	17.5
Eurasia	5.0	5.3	5.5	5.7	5.8	6.0
World	88.9	91.6	96.3	100.7	104.6	108.5

Oil use in all forms of transportation – road, aviation, internal waterways and international marine – increased by an annual average of 0.7 mboe/d over the period 1980–2010 and was clearly the key source of the increase in demand. Over these three decades, 41% of the demand increase in transportation was in developed countries. The relative importance of transportation in developing countries is, however, set to dominate even further. Over the period 2010–2035, OECD demand in this sector will fall and Eurasia will increase only gradually. It will be developing countries that witness a significant rise, by 0.7 mboe/d p.a. It is, therefore, of key importance to understand how transportation demand in non-OECD countries will rise in developing the oil demand outlook.

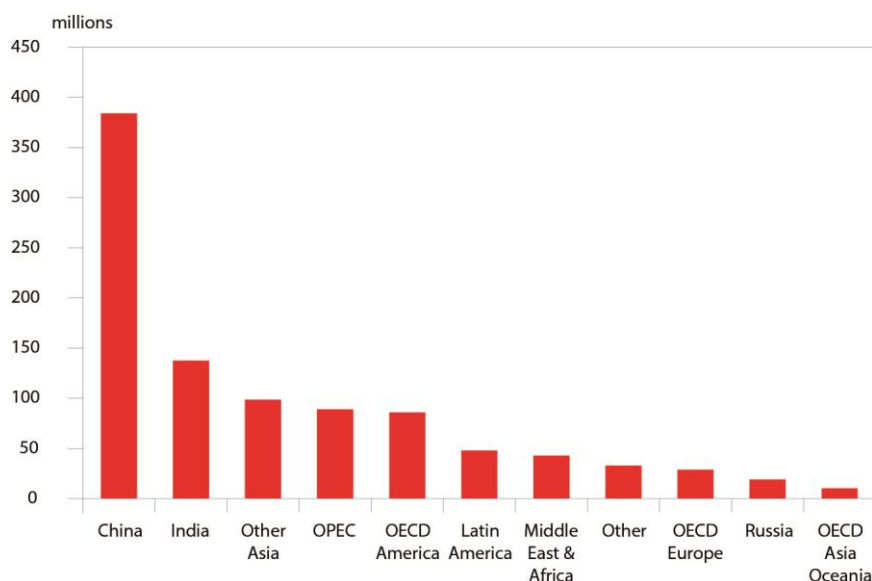
Figure 4
Growth in oil demand, 2012–2035



A key factor in the growth in oil demand is the rise in passenger car ownership in non-OECD countries. The ten countries with the greatest increase in passenger car ownership levels over the period 2000–2010 are primarily made up of non-OECD countries. The most dramatic recent increase occurred in China, where car ownership has risen by 50 million during the decade 2000–2010. The BRIC countries accounted for 39% of the global rise. In the Reference Case projections the number of passenger cars more than doubles by 2035, reaching almost 1.9 billion cars. Fully 64% of the increase in car ownership will be in developing Asia. By 2028, there will be more cars in developing countries than in the OECD. China sees the largest rise by far in the volume of passenger car ownership, increasing by more than 380 million over 2010–2035 (see Figure 5) as it moves from 43 cars per 1,000 people in 2010 to 320 cars per 1,000 in 2035. This is similar to the rate seen in Japan in the early 1990s. Developing Asia is also the key source of growth in the number of commercial vehicles.

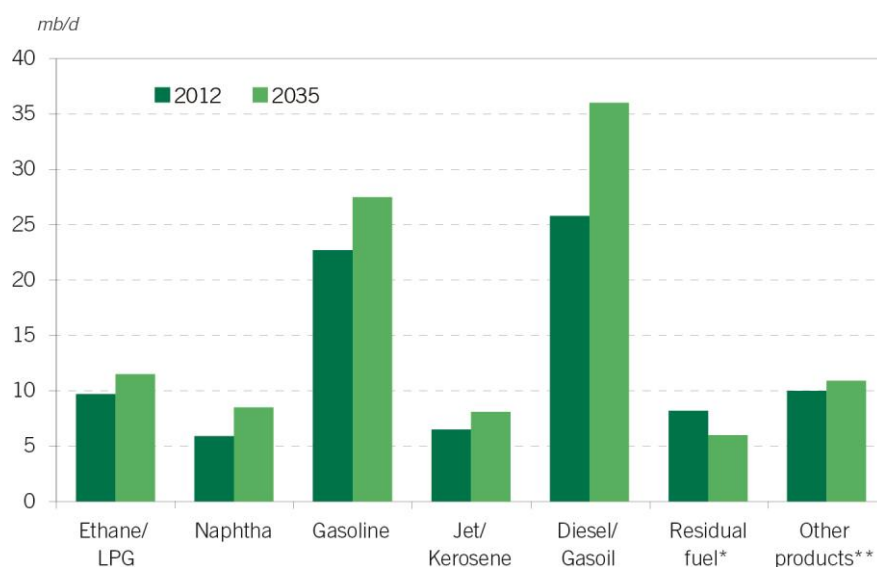
Beyond volume patterns, oil demand in the road transportation sector is determined by the efficiency of the vehicle fleet using internal combustion engines (ICE), and the pace of development and penetration of vehicle technologies, including hybrids and non-petroleum-based engines. The efficiency of ICE vehicles will be determined by policies, technological developments and consumer preferences, as well as scrappage rates, the choice between gasoline and diesel for passenger cars, and possible changes in the scope for efficiency improvements in commercial vehicles. Possibilities for alternative technologies in the transportation sector include hybrids (seen as the most likely to emerge over the projection period to 2035), Plug-in Hybrid Electric Vehicles (with their high price remaining a key challenge), Battery Electric Vehicles (though they also have a high price, as well as significantly shorter vehicle range and long charging time) and natural gas vehicles (which are limited by available refuelling infrastructure, despite growth in some markets).

Figure 5
Increase in the number of passenger cars, 2010-2035



The importance of the road transport sector for oil demand growth – and corresponding use of gasoline and diesel – means that out of 23 mb/d of additional demand by 2035, compared to the 2010 level, around 57% is for middle distillates and another 40% is for gasoline and naphtha. For the rest of the products, a decline in residual fuel is broadly offset by an increase in ethane/LPG and the group of ‘other products’. A consequence of these demand trends is a progressive change in the make-up of the future product demand slate. Middle distillates will not only record the biggest volume increase, they will also increase their share in the overall slate from the current 36% to 41% by 2035 (see Figure 6).

Figure 6
Global product demand, 2012 and 2035



3.2 Liquids supply

Turning to liquids supply, it is important to understand what has happened in the recent past. The primary source of recent non-OPEC supply growth has been from the tight oil and oil sands projects in the US & Canada. Some supply growth has also been observed in Russia and China, but most other non-OPEC regions have seen declines.

The strong rise in tight oil supply in the US – and to some extent Canada, which accounts for a little under 10% of OECD America tight oil supply in 2012 – is expected to continue to contribute to the medium-term non-OPEC supply increases. The current expectation is that the increase in OECD America tight oil of 2.5 mb/d between 2010 and 2013 will be followed by a further rise of 1.6 mb/d by 2018. However, tight oil supply in the US is expected to plateau by 2017–2018. This is due to a number of inherent constraints and challenges, such as steep initial decline rates, a transition away from ‘sweet spots’, environmental concerns, availability of equipment and skilled labour, and the likelihood of rising costs.

It is difficult to forecast tight oil supply outside North America where very limited drilling activity has been undertaken up to now. It is also difficult to replicate the US experience. Tight reservoirs – particularly shale – are heterogeneous between wells, even at a small-scale. Petrophysical characteristics, organic richness, thermal maturity, fracability, geological complexity, reservoir pressure, areal extension and thickness are some of the below-ground parameters that are important to consider. Above-ground parameters – such as the availability and efficiency of drilling and petroleum services, availability of water resources, skilled labour, fiscal terms (mineral rights of landowners in the US), drilling costs, oil and gas transportation infrastructure, and oil and gas prices – are no less important. The Reference Case considers that tight oil production will remain limited to North America throughout the projection period.

Total non-OPEC supply increases steadily over the medium-term, rising by 5.7 mb/d over the six years 2012–2018. While the key sources of supply growth are tight oil and oil sands, there are other regions expected to register increases, primarily crude oil from Latin America, mainly Brazil and Columbia, the Middle East & Africa, although this will be sensitive to political developments, the Caspian, and Russia. There will also be some increases in biofuels supply, mainly from Brazil and Europe. These increases more than compensate for expected oil supply declines in OECD Europe (North Sea) and Mexico. OPEC NGLs supply is also expected to continue to increase over the medium-term. It has risen from under 3 mb/d in 2000 to 5.5 mb/d in 2012, and a further rise is anticipated to 6.4 mb/d by 2018.

Combining medium-term demand projections with those for non-OPEC supply and OPEC NGLs means that, in the Reference Case, the amount of OPEC crude required will fall from 30.3 mb/d in 2013 to around 29 mb/d in the period 2015–2017. It will only start to rise again in 2018. Although concerns exist that huge investments might be made in capacity that might not be needed, OPEC Member Countries remain committed to supporting oil market stability. OPEC Member Countries are investing and will continue to invest in additional capacities. On top of

the huge capacity maintenance costs that Member Countries are faced with, they continue to invest heavily in new upstream projects and in projects along the whole oil supply chain – in exploration, development, refining and transport.

Looking to the longer term supply picture, the Reference Case sees tight oil supply going into decline after 2017–2018, falling to 2.7 mb/d by 2035, 1.4 mb/d lower than the peak in 2018. Nevertheless, total supply from the US & Canada continues to rise, because although crude and NGLs supply gradually falls in line with the resource constraint, the rise in oil sands and, to a lesser extent, biofuels, more than compensates for this. Elsewhere, the other main long-term increases in supply are expected to be from Latin America and the Caspian ('other Eurasia'). Declines are expected in mature regions where the resource constraint will be increasingly felt, in particular OECD Europe and Mexico, but also in Asia. Russia, although in possession of plentiful resources, is assumed to achieve a production plateau of close to 11 mb/d throughout the projection period. Although non-OPEC crude supply actually declines over the period 2020–2035, the increases in non-crude liquids supply more than compensate for this, so that total non-OPEC supply rises from 53 mb/d in 2012 to approach 62 mb/d by 2035 (see Table 2).

Throughout the projection period, crude output from non-OPEC regions exceeds that of OPEC. After the medium-term steady call on OPEC crude of around 29 mb/d, OPEC crude supply over the long-term rises in the Reference Case. By 2035, the call on OPEC crude oil is 37 mb/d, more than 6 mb/d higher than in 2012. The overall increase in non-crude liquids supply will satisfy 75% of the demand rise to 2035. Total crude supply in the Reference Case ranges between 72 and 75 mb/d.

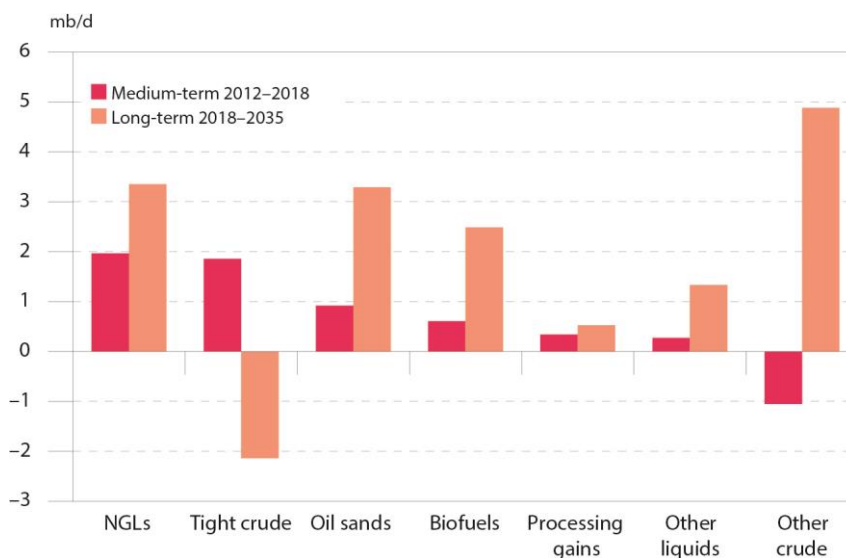
Table 2
Long-term liquids supply outlook in the Reference Case mb/d

	2012	2015	2020	2025	2030	2035
OECD	21.1	22.8	23.4	23.7	23.9	24.1
<i>of which: tight oil</i>	<i>2.5</i>	<i>4.4</i>	<i>4.7</i>	<i>3.9</i>	<i>3.3</i>	<i>2.7</i>
DCs, excl. OPEC	16.3	17.4	19.1	19.4	19.2	19.2
Eurasia	13.4	13.9	14.3	14.6	14.9	15.3
Total Non-OPEC inc. proc. gains	52.9	56.4	59.3	60.4	60.9	61.6
OPEC (incl. NGLs)	36.8	35.5	37.2	40.5	43.9	47.1
<i>OPEC crude</i>	<i>31.1</i>	<i>29.2</i>	<i>29.9</i>	<i>32.3</i>	<i>34.8</i>	<i>37.5</i>

It is useful to step back from these details and separate the medium-term from the long-term as far as perceiving the key contributions to supply increases. As can be seen from Figure 7, over the medium-term (2012–2018) tight crude is expected to add more to non-OPEC supply than any of oil sands, biofuels or other liquids. In this sense, the tight crude experience can be seen as a short- to medium-term phenomenon, at least in the Reference Case. However, when we look at the longer term picture (2018–2035), tight oil is far less significant. In fact, it will contribute less to supply than any of those other categories of supply. Even including tight NGLs, which should continue to grow, and is included in the total NGLs figure,

does not change the notion that tight oil does not contribute to long-term rises in liquids supply.

Figure 7
Reference Case additions to liquids supply over the medium-term (2018 vs 2012)
and the longer term (2035 vs 2018)

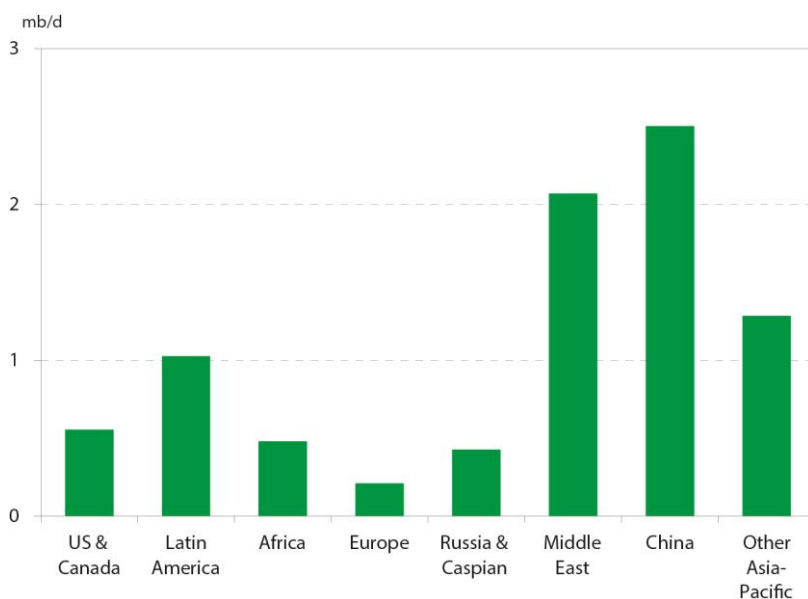


3.3 Downstream

Developments in the downstream sector are marked by existing surplus distillation capacity, mainly in the OECD regions, and capacity expansion in developing countries. Recent estimates indicate that more than 9 mb/d of new distillation capacity will be added globally in the medium-term largely concentrated in two regions: Asia-Pacific and the Middle East (Figure 8).

The potential incremental crude runs resulting from this additional capacity compared with the required additional crude runs resulting from demand increases means that potential production from new projects exceeds the incremental ‘call on refining’ every year, making for a cumulative overhang of 4 mb/d by 2018 (Figure 9). This points to a period of severe international competition for product markets and the need to continue refinery closures on a significant scale in the next few years, particularly in the OECD.

Figure 8
Distillation capacity additions from existing projects, 2012–2018



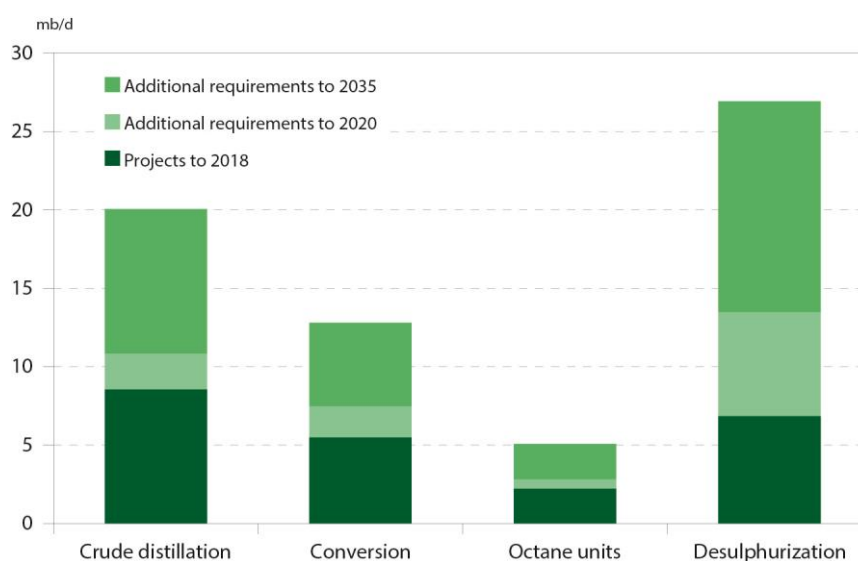
In addition to increasing surplus distillation capacity, new projects will also produce excess gasoline and naphtha. While there is some uncertainty and flexibility in the product yields that will result from any one refining project, balances show a continuation of projects that produce too much naphtha/gasoline, with a cumulative surplus of 2 mb/d by 2018, almost half of the total surplus. The data indicate residual fuel in surplus as well, with more than 1 mb/d globally by 2018 but also, interestingly, distillates at over 0.5 mb/d. This is a new development, and reflects both the industry shifting to add more distillate capacity and a trimming back in the estimates for distillate demand growth. While this implies margins relative to crude for naphtha/gasoline are likely to remain weak, those for distillate may now also be less strong in the medium-term as the global supply/demand system adjusts.

Figure 9
Additional cumulative refinery crude runs, required and potential*



In the long-term, required cumulative capacity additions (i.e. firm projects plus total further model additions) are projected to reach 20 mb/d by 2035. The vast majority of these expansions are projected as needed in the Asia-Pacific and the Middle East, 10.5 and 3.0 mb/d, respectively. In Latin America, projected capacity additions of 2.4 mb/d by 2035 are closely aligned with the projections for demand growth for the same period. Refining capacity in Africa is projected to rise by 1.3 mb/d followed by Russia & Caspian which will require 1.3 mb/d of additional crude units by 2035.

Figure 10
Global capacity requirements by process type, 2012–2035



The Reference Case projections highlight a continuing need to increase conversion capacity relative to distillation (Figure 10). Against a conversion to distillation ratio of 40% that applies globally today, both existing projects and total additions of almost 13 mb/d of conversion capacity requirements through 2035 exhibit a conversion to distillation ratio of 64%. Substantial additions to desulphurization capacity will also be necessary to meet future specifications for sulphur content. These are estimated at close to 27 mb/d by 2035.

With respect to the key inter-regional oil movements, emerging trends clearly indicate the sensitivity of the global oil trade system to the development of new export/import routes. From the perspective of crude trade, the two areas that deserve special attention, and which could potentially have a significant impact on future oil flows, are Eurasia and North America. Developments that primarily expand pipeline capacity in these continents appear critical because a significant part of the oil supply there is located deep inland and far from consuming markets, whether at home or abroad. Therefore, the directions in which future transport routes will be developed have the potential not only to reshape future oil flows but also to impact price differentials.

Projections of future oil flows underscore the Middle East’s future role as the major crude oil exporter, despite the slight crude export decline in the medium-term,

which will mainly be compensated by higher products exports from new refineries in the region. Beyond the medium-term, total crude oil exports from the region will grow continuously, drawn by rising demand in Asia-Pacific, which will develop as a major trade partner. Total crude exports from the Middle East are projected to surpass the 20 mb/d mark by the end of the forecast period. For Asia-Pacific, however, the Middle East will not be an exclusive partner to cover its crude demand; growing Asia-Pacific demand will result in an increase in crude imports from practically all producing regions. In absolute numbers, the biggest change over the forecast period relates to crude oil imports from the Middle East, which will increase by 5 mb/d from 2012–2035, followed by Russia & Caspian (2.6 mb/d), Africa and Canada (each around 1 mb/d). Asian imports from Latin America are projected to be around 1 mb/d.

Crude imports to the US & Canada is set to decline and its composition will be determined by the type of additional barrels that are expected to be produced in the region. The medium-term is dominated by a greater portion of increased light tight oil production in the region. This will gradually displace part of the current imports from Africa and the North Sea. The key factors in the long-term are the gradual decline of tight oil, which will stabilize imports from Africa at lower levels, and the rise in heavy streams from Canada. These factors will work against imports from heavy crude exporters.

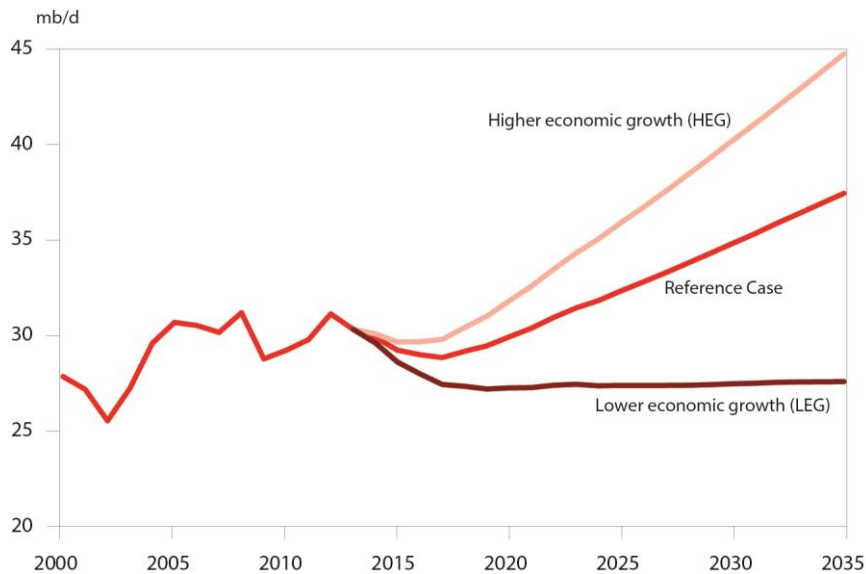
4. THE OIL OUTLOOK: UNCERTAINTIES, CHALLENGES AND OPPORTUNITIES

4.1 Economic growth scenarios

The impacts of alternative assumptions for economic growth explore both downside risk and upside potential. Many elements combine to produce a given increase in medium- and long-term economic activity, and each of these is subject to ambiguities and uncertainties. There are demographic factors, both in terms of the growth of the working population, as well as retirement age and education levels; and questions about factor productivity, which is affected by the extent of free trade, investments in R&D, and the quantity and quality of capital. In the different scenarios, the range of economic growth reflecting these uncertainties is allowed to vary across regions, and downside risks are assumed to be greater than the upside potential. Average global economic growth thereby ranges from 3.0% to 3.9% p.a. in the low and high economic growth rates, respectively.

By 2035, oil demand remains below 100 mb/d in the low economic growth scenario. This is 10.1 mb/d lower than in the Reference Case. By 2025, the reduction is already 5.1 mb/d. However, the distribution across the countries is not uniform: 77% of the decline in demand is in developing countries. If OPEC absorbs all of this loss in demand, the call on OPEC crude oil falls to 27 mb/d by 2020 and then stays approximately constant at that level throughout the period to 2035 (see Figure 11). The higher economic growth scenario sees additional demand of 7.5 mb/d by 2035 compared to the Reference Case. Demand exceeds 100 mb/d between 2020 and 2025, more than ten years earlier than under the Lower Economic Growth (LEG) scenario. By 2035, it reaches 116 mb/d.

Figure 11
OPEC crude oil supply in the economic growth scenarios

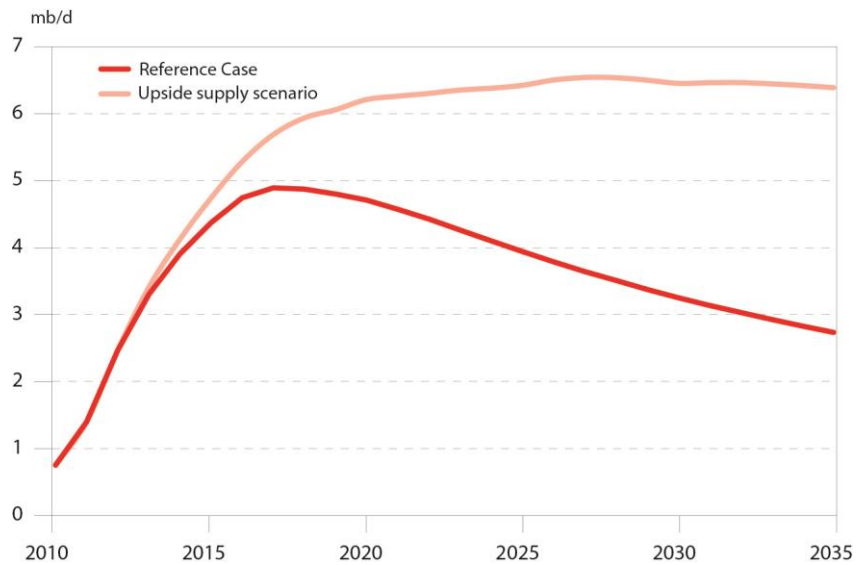


4.2 An Upside Supply scenario

An additional scenario looks at the possible impacts of higher non-OPEC supply than in the Reference Case. The Upside Supply (UPS) scenario includes considerations over the future path of tight oil supply in North America but also the possibilities of developments in other non-OPEC countries outside of North America. This scenario takes a more optimistic view of the level of ultimately recoverable resources than in the Reference Case. The scenario sees tight oil supply 1.3 mb/d higher than in the Reference Case already by 2020, with a further widening thereafter, reaching 2.5 mb/d higher than the Reference Case by 2035. In addition to the potential for a more rapid expansion of supply from North American tight oil (Figure 12), there are also additional tight oil resources in other non-OPEC countries, particularly Russia, Argentina and China (Figure 13).

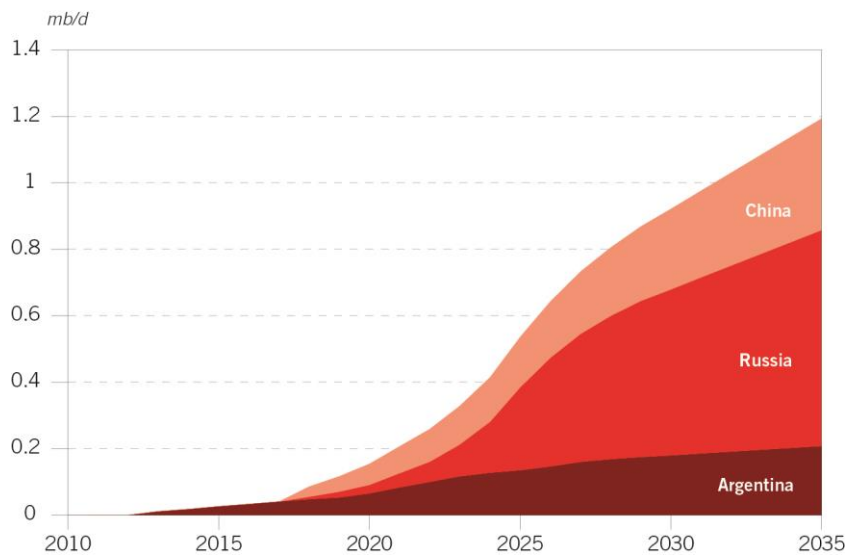
Prospects for upside production assumptions for other crude oil and NGLs seem also possible in Brazil and Russia. The scenario emphasizes the potential scale of development and production of the pre-salt play in Brazil. Since Russia's resource base is also sufficient to support more crude supply than in the Reference Case, the UPS scenario explores the scope for a slightly higher plateau of Russian supply. Finally, the scenario foresees higher supply from biofuels. The highest potential for additional biofuels exists in the US and two other key regions: Europe and Brazil. In total, the UPS scenario adds 5.7 mb/d additional non-OPEC liquids supply by 2035 compared to the Reference Case.

Figure 12
Assumption for tight oil supply in North America
in the Upside Supply scenario



If we assume that this additional supply is fully absorbed by OPEC in the form of lower crude supply, then OPEC supply of crude will be 31.7 mb/d by 2035. OPEC crude supply would then remain below 28 m/b until 2021, falling steadily throughout the rest of the decade. However, as with the economic growth scenarios, the lower OPEC crude path may not be deemed feasible or sustainable.

Figure 13
Additional tight oil supply from outside North America
in the Upside Supply scenario



4.3 Climate change-related policies and measures

The upstream oil industry faces uncertainties associated with how future climate change-related policies and measures might affect the use of fossil fuels in general and oil in particular. In 2011, Parties to the UNFCCC meeting in Durban, South Africa, decided to “launch a process to develop a protocol, another legal instrument or an agreed outcome with legal force under the Convention applicable to all Parties, through a subsidiary body under the Convention” to be known as the Ad Hoc Working Group on the Durban Platform for Enhanced Action (ADP). The ADP is expected to complete its work by 2015 and the agreed outcome is to enter into force by 2020.

It is still too early to know about the precise components of this future agreement – uncertainties in the pre-2020 mitigation commitments and pledges may also influence the post-2020 agreed outcome. However, since the agreed outcome is “under the Convention”, it is clear that it will have to comply with all the principles and provisions of the UNFCCC, particularly the principles of historical responsibility, common but differentiated responsibilities and respective capabilities, equity, and take fully into account that economic and social development and poverty eradication are the first and overriding priorities of the developing country Parties.

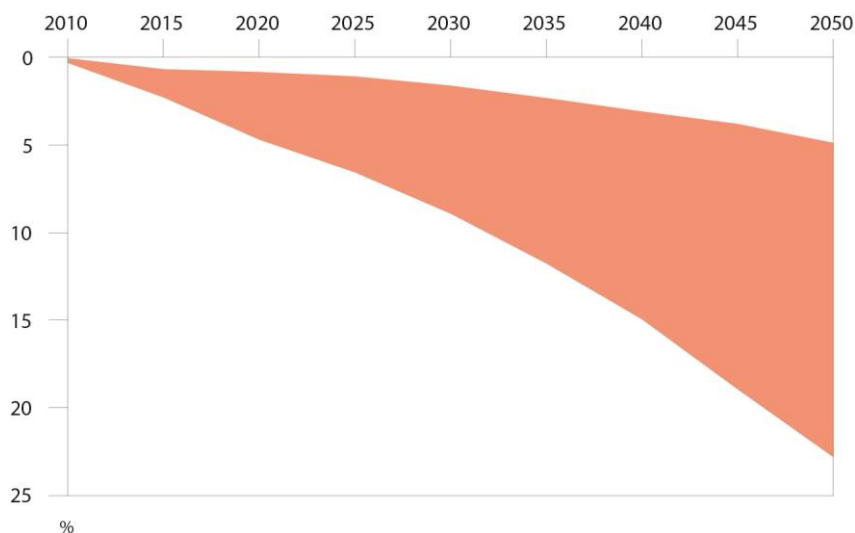
Another major uncertainty relates to the nature, extent and impacts of mitigation policies and measures. Since the energy industry is capital-intensive and of a long-term nature, such uncertainties result in large economic risks. An economy-wide approach to mitigation provides a broad array of policy options and measures for emissions reduction. Opting for those mitigation policies and measures that have a lower cost for the global economy, but which also avoid or minimize the adverse effects on developing countries, would thus be important and desirable.

In order to assess potential impacts of future mitigation policies, a computable general equilibrium model of the world economy has been used to develop scenarios. Under 550 ppm GHG stabilization scenario, model results indicate that reducing emissions by targeting the transportation sector is costlier than using other climate change mitigation alternatives. In such a case, world GDP is 6.7% lower and OPEC's GDP is reduced by 24.8% from its 2050 level in the Reference Case, which is much higher than the 17.7% OPEC GDP reduction foreseen in the scenario where regional carbon trading is permitted.

Across scenarios, the range in oil demand decline relative to the Reference Case is large (see Figure 14). At the low end, with full global carbon trading, the emphasis of GHG reduction is on the electricity generation sector, involving both a switch away from coal as well as widespread implementation of CCS technologies. Additionally, forestry becomes a major factor in reducing net emissions. In this case, oil demand by 2050 is just 5% lower than in the Reference Case. At the other extreme, policies that target regulation of the transportation sector result in far higher losses in oil demand, which falls 23% by 2050 relative to the Reference Case. There are ‘win-win’ policies and measures that can deliver effective mitigation in a cost effective manner, and that have the least adverse effects on oil producers and the

global economy. However, it is far from clear whether these least-cost mitigation policies and measures will be pursued.

Figure 14
Impact of mitigation scenarios on oil demand:
range of percentage change in oil demand relative to the reference case



4.4 The importance of alleviating energy poverty

The Rio+20 Conference in 2012 set a landmark by recognizing the importance and positive contribution of ‘energy’ in combating poverty. While poverty alleviation is essential for achieving sustainable development, poverty cannot be alleviated without addressing energy poverty. The Rio+20 outcome document set the stage for a comprehensive approach to addressing this.

Poverty is a multidimensional phenomenon: one type of poverty often leads into another. Energy is a cross-cutting element in poverty’s various dimensions. The UNDP’s Multidimensional Poverty Index takes into account the interconnectedness of poverty’s different dimensions. Countries high on the index are among the poorest; these are largely in Sub-Saharan Africa and South Asia. Lessons learned during the implementation of development programmes and in pursuit of the Millennium Development Goals confirm the indispensable role of energy in addressing the different aspects of poverty.

Access to electricity and the use of modern fuels for home cooking and heating are two aspects of energy poverty that are considered high impact areas and for which a better quantitative picture is available. In 2010, there were about 1.2 billion people worldwide that had no access to electricity; and some 2.8 billion used solid fuels for cooking. Most of those without access to electricity live in Sub-Sahara Africa (590 million) and in South Asia (418 million); and of those who use solid fuels for their cooking, nearly 37% live in South Asia (1 billion), 34% in East Asia and Southeast Asia (945 million), 24% in Sub-Saharan Africa (690 million).

Energy for productive uses and income generation by the poor should be an integral part of energy poverty alleviation efforts. Farming and labour are the main sources of subsistence and income in situations of multidimensional poverty. In fact, countries with lower per capita income are usually more dependent on the agricultural sector for their income and the employment of their citizens. Therefore, increasing energy use in the agriculture sector can assist income generation by the poor.

Furthermore, energy use in agriculture increases food production and food availability. Modern food systems are highly energy intensive. Three key agricultural activities are energy intensive: the use of chemical fertilizers, the use of agricultural machinery in various stages of crop production and processing, and irrigation in arid and semi-arid environments. In addition, modern livestock and poultry production are also major consumers of energy in agriculture. Thus, improving energy use in these activities can significantly assist the poor in escaping the poverty trap.

The Rio+20 outcome document provides a comprehensive approach to sustainable development. It is, therefore, important to address energy poverty in a broader context: one that addresses poverty under all the three pillars of sustainable development – that is, social, environmental and economic.

4.5 Availability of skilled manpower

The oil and gas industry is known for being capital-intensive and technology driven; but it also employs a diverse workforce with a range of abilities and highly specialized skills. But recent global trends have put pressure on the industry to find and recruit necessary manpower. This has put the issue of human resource bottlenecks on the agenda of many companies and organizations. In a recent study, almost 80% of oil and gas companies at the global level reported significant manpower shortages in key technical areas. There are also fewer skilled graduates entering the industry, in part the result of the unattractiveness of the industry as a workplace but also a consequence of the poor record that universities have of offering relevant studies in technical areas important to the oil and gas industry.

In combination with the industry's ageing trend, this has resulted in an important distribution gap between the large number of senior professionals who will be retiring soon and the smaller numbers of new professionals who will be starting, resulting in fewer mid-career employees, especially those with more than 20 years of work experience. In addressing the challenge of manpower bottlenecks and skills shortages, stakeholders in the oil and gas industry need to address structural problems in education and training, and improve the industry's image. Governments, in turn, need to better understand the employment gap, facilitate and support international mobility and provide support to educational initiatives. In addition, broader shared solutions would be useful, particularly since the oil and gas sector will remain essential for the global economy in the 21st century and for the foreseeable future.

4.6 Technology and R&D

For the future of the oil industry, technology will play a significant role, as it has over the decades. This relates, on the one hand, to how reserves are identified,

developed, produced and delivered, leading to a massive growth in recoverable resources and supply, in converting crude into desirable fuels and products. Technology also helps improve efficiencies and to continually improve environmental credentials of both the production processes and at the consuming level.

Improved quantity and quality of information available about different geological structures has enhanced the likelihood of finding oil, as well as gas, and extended the reach of surveyors, geologists and explorers into harsher environments, and remoter and challenging locations in the 'frontier areas'. In terms of drilling, the industry has progressed from drilling tens of metres to many kilometres below the surface. Drilling offshore is now a mainstay of the industry. And as well as drilling vertically, technology now allows the industry to drill horizontally, as well as great distances from the drilling rig, through extended reach drilling.

The industry also has a long history of technologies helping to successfully reduce its environmental footprint. For example, in drilling, gas flaring reduction and cutting plant emissions. From OPEC's viewpoint, Member Countries have invested billions of dollars over the past decades in flared gas recovery projects.

It will also be important to look at technological options that allow the continued use of fossil fuels in a carbon-constrained world. In this regard, carbon capture & storage (CCS) is a proven technology that can be cost effective, and has the potential to contribute significantly to emissions reductions.

Technology will remain at the heart of the industry in helping it to overcome both existing and new challenges. Thus, it will be essential that the required technology is available, and at the right cost, meaning that significant investment in research and development is paramount. To this end, OPEC Member Countries are collaborating among themselves, as well as with companies and international research and technology development institutions, to identify gaps and opportunities in technologies in the petroleum industry.

4.7 Dialogue and co-operation

OPEC continues to engage in focused activities in international dialogue and co-operation. A prime example is the proactive participation of OPEC in the IEF, which plays an important role in the strengthening of energy co-operation and dialogue between producers and consumers. This has been pursued through a programme of joint work, including three regular events; the Joint Organisations Data Initiative (JODI), which has now been expanded to include both JODI Oil and JODI Gas; and other regional dialogue summits. Moreover, the 14th IEF Ministerial Forum, for which this background paper has been prepared, is an important biennial high-level event.

The global energy dialogue among consumers, producers and other market stakeholders continues to strengthen and deepen. The IEF has proved to be a highly significant focal point of these efforts, providing an inclusive and neutral platform for producers and consumers to meet to discuss issues of shared concern, while promoting an environment of greater mutual trust and understanding. As such, the

IEF represents an established and effective framework for enhancing co-operation and co-ordination in the energy market. A key element of this has been the programme of joint work being carried out by the IEF, IEA and OPEC to enhance understanding of important energy market developments and evolving market dynamics.

In this regard, the IEF, IEA and OPEC jointly organize three regular events. The Symposium on Energy Outlooks offers a unique forum to share views regarding short-, medium- and long-term energy outlooks, as well as to consider the key challenges and uncertainties impacting the oil market. OPEC and the IEA have also taken the opportunity to hold technical meetings to help identify areas where definitions, data, and regional groupings can be harmonized to make forecasts more comparable. This close co-operation not only strengthens oil market transparency, but also helps reduce uncertainties regarding future developments and the future needs of the market, and thus providing an important contribution to enhancing security of energy demand and supply. More recently, the three organizations also began to organize a Symposium on Gas and Coal Market Outlooks, which seeks to improve transparency in these important energy markets. The IEA, IEF and OPEC also host a joint Workshop on the Interactions between Physical and Financial Energy Markets. This event was established to better understand the evolving inter-linkages between the physical and financial energy markets, particularly following the increased financialization of the commodity markets and the emergence of oil as an asset class.

OPEC is one of the main drivers of the JODI programme and currently participates in both JODI Oil and JODI Gas, along with other as partner organizations, under the co-ordination of the IEF Secretariat.

As part of the on-going EU-OPEC Energy Dialogue, recent activities included the joint EU-OPEC Roundtable on the Safety of the Offshore Oil and Gas Industry, as well as a study to assess Potential Manpower Bottlenecks in the Petroleum Industry, followed by a roundtable on the subject. The study identified the key challenges and issues faced by the petroleum industry in sourcing and attracting the required human resources in different regions of operation. The 10th EU-OPEC Ministerial Meeting was held in Vienna in November 2013.

Within the established OPEC-Russia Energy Dialogue, OPEC participated in the Second Summit of Heads of States and Government of the Gas Exporting Countries Forum in Moscow in July 2013. This was followed by the second high-level meeting of the OPEC-Russia Energy Dialogue, which took place in Moscow in October 2013. Discussions there focused on the current state of the world energy market, its long-term perspectives and associated challenges.

OPEC, along with the IEA and IEF, has also played an active role in several energy related programmes of the G-20. On-going workstreams include the initiative on Oil Price Reporting Agencies; efforts to increase transparency in gas and coal markets; commodity price volatility and improving functioning/transparency of physical and financial commodity markets; rationalising and phasing-out inefficient

fossil fuel subsidies that encourage wasteful consumption over the medium term; and the Global Marine Environment Initiative.

The on-going engagement in the global energy dialogue continues to confirm to market stakeholders that a process of interaction and exchange of views can lead to balanced and sustainable outcomes, with broad support, that reflect the spirit of good work and co-operation.

5. CONCLUDING REMARKS

OPEC continues to highly value the importance of a co-operative and constructive approach to dialogue that is beneficial for market stability both in the short- and the long-term, recognizing that security of demand and security of supply are two faces of the same coin. This is all the more important in the future, for all stakeholders, given the many challenges as well as opportunities that lie ahead, and which this background paper tries to underline. The importance of dialogue is underscored in OPEC's Long-Term Strategy as well as in the 'Riyadh Declaration', which concluded the Third OPEC Summit in November 2007. The issues at stake are broad, complex and inter-related – and require concerted efforts and, where appropriate, joint collaboration, to find adequate, co-operative and sustainable solutions. Close engagement with major stakeholders at various levels is essential to advance mutual understanding on common challenges – such as security of supply and demand, investments, cleaner fossil fuel technologies, environmental protection, the role of petroleum in promoting sustainable development and alleviating energy poverty. In this regard, the joint collaborative efforts of the IEA/IEF/OPEC represent an important element for building confidence and supporting long-term market stability, as well as address the concerns of both producers and consumers.