



Oil outlook to 2035

OPEC Secretariat background paper

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EXECUTIVE SUMMARY

Despite the recent market fluctuations there has been no shortage of oil

The year 2011 saw the oil market in a constant state of flux: the ups and downs of the global economic recovery, Japan's multiple disaster, unrest in parts of North Africa and the Middle East. What has been apparent, however, is that there has been no shortage of oil. Libya's shortfall in early 2011 was met by other OPEC Member Countries, and it is quickly returning its production and export capacity to the market. Overall spare capacity has been — and remains — at comfortable levels and investments will see these comfortable levels increase in the coming years.

Since the 12th IEF Meeting oil prices have settled at higher levels

Since the 12th IEF Ministerial Meeting — held in Cancun, Mexico, 30th–31st March 2010 — oil prices have risen to levels that reflect a number of factors. One is the behaviour of upstream costs. These initially fell in the second half of 2008 as the Great Recession took hold and bottomed out towards the end of 2009. However, costs have recently started to rise once more as oil supply activity has picked up following the recovery from the recession. In addition, speculation has also been a driving force in the price rise, with increasing investor interest in the crude oil paper market — particularly in ICE Brent contracts — also behind the rise in crude oil prices. Throughout most of 2011, the OPEC Reference Basket price remained around or slightly above \$100/b.

The effect of speculative behaviour on oil prices remains a concern

Speculative activity on the Nymex surged to record highs in the first quarter of 2011. Thus, a risk premium was embedded in the oil prices seen throughout much of 2011, partly reflecting such concerns. With the higher costs faced by producers, there is a clear perception that sustainable price levels must allow producers to invest to meet future demand and, at the same time, must not impede the global economic recovery. But speculative activities remain an issue in the market. This was seen in April 2011 as prices reached more than \$120/b. Excessive speculation is detrimental to both producers and consumers and can cause prices to detach from fundamentals.

Marginal costs drive oil price assumptions

For the OPEC Reference Case, it is generally accepted that long-term oil price assumptions should involve an assessment of marginal costs. It is assumed that, in nominal terms, prices stay in the range of \$85–95/b for this decade, an upward revision of \$15/b compared to the OPEC background paper prepared for the 12th IEF Ministerial Meeting in 2010. Longer-term, the price as-

sumption leads to values that reach \$133/b by 2035. It should be emphasized, however, that these figures are only assumptions. They do not reflect in any way a projection of likely or desirable prices.

There remain serious downside risks to the global economy

Since the previous IEF Ministerial, a more rapid recovery from the Great Recession emerged in 2010 than had been expected. However, the global economic recovery is increasingly showing signs of weakness. The most pressing issues are the widening deficits and ballooning sovereign debts in euro-zone countries. Medium-term growth prospects will depend on the ability of governments to maintain their various support measures for as long as it takes to solve their economic issues, and on the speed of return of confidence to the markets. In the Reference Case, average global growth over the period 2010–2015 is assumed to be 3.9% per annum (p.a.). However, there are serious downside risks to this assumption. Long-term economic growth rates in the Reference Case average 3.4% p.a. over the period 2011–2035.

Policies represent a major uncertainty for the outlook

The Reference Case in this background paper retains the principle that only policies already in place or widely anticipated are allowed to influence supply and demand patterns. The two key policies already factored in are the European Union (EU) package of measures for climate change and renewable objectives, and the US Energy Independence and Security Act (EISA). However, the development of policies represents a major uncertainty for the outlook.

Fossil fuels will remain key to the energy mix

Over the period 2010–2035, commercial primary energy demand in the Reference Case increases by 51%. Fossil fuels, currently accounting for 87% of primary commercial energy supply, will still make up 82% of the global total by 2035. For most of the projection period, oil will remain the energy type with the largest share. However, by 2035 it will have been overtaken by coal use in the Reference Case, which will represent 29% of total energy — similar to today — while oil's share will have fallen from 34% to 28%. Gas use will rise at faster rates — in both percentage terms and volumes — than either coal or oil, with its overall share rising from 23% to 25%.

80% of the rise in oil demand to 2035 is in developing Asia

While the central driver for medium-term oil demand is the economy, other important drivers come in to play in the long-term. The impact of policies, technologies, demographics and, to a lesser extent, oil price developments

will increasingly influence long-term demand patterns. In the Reference Case, demand increases by close to 23 mb/d over the period 2010–2035, reaching almost 110 mb/d by 2035. Fully 80% of the increase in global demand is in developing Asia, where demand reaches almost 90% of OECD demand levels by 2035.

Non-OPEC and OPEC liquids supply continues to rise over the medium-term...

Total non-OPEC supply increases steadily over the medium-term, rising by 3 mb/d over the period 2010–2015. The key drivers of this growth are the Caspian region, Brazil and Canada. Biofuels — mainly in Europe and the US — also make some contribution. These supply increases more than compensate for expected conventional oil declines in North America and the North Sea. An increase in OPEC natural gas liquids (NGLs) is also expected over the medium-term, rising from 4.8 mb/d in 2010 to more than 6 mb/d in 2015. The required amount of OPEC crude will rise gradually from 29.3 mb/d in 2010 to just over 31 mb/d by 2015.

...and long-term too, driven by non-conventional oil

Over the long-term, increases in conventional oil supply from the Caspian and Brazil — as well as steady increases in non-conventional oil, mainly from biofuels, oil sands and shale oil — will more than compensate for expected decreases in mature regions. Total non-OPEC non-conventional oil supply rises by more than 11 mb/d over the years 2010–2035. On top of this, total NGLs supply from both OPEC and non-OPEC increases by 6 mb/d over the same period, from 10.5 mb/d in 2010 to almost 17 mb/d by 2035. The total increase of non-crude liquids supply will satisfy more than three-quarters of the demand increase to 2035. Crude supply in the Reference Case only increases to 74 mb/d by 2025 and then stops rising. There is then no need for additional crude supply. Finally, OPEC crude supply in the Reference Case rises throughout the period to 2035, reaching just over 39 mb/d by 2035, including additional supply necessary for stocks. The share of OPEC crude in total supply by 2035 is 36%, which is not markedly different from current levels.

Capacity rationalization in the refining sector appears inevitable

The medium-term outlook for the downstream sector indicates sustained pressure for capacity rationalization, especially in OECD regions. The US and Europe are home to the largest capacity overhangs, but to date the industry is looking more to ‘sell’ rather than ‘close’ refineries. This is particularly true in Europe. The vast majority of required refining capacity expansions to 2035 are projected for the Asia-Pacific and Middle East regions at 9.8 and 3 mb/d, respectively, out

of a global total of 17.2 mb/d. Expansions in the Asia-Pacific region are dominated by China and India. In Latin America, projected capacity additions of 1.7 mb/d by 2035 exceed the estimated moderate demand growth of 1.3 mb/d for the same period. Capacity requirements in Africa and the FSU region, in turn, are in the range of 1 mb/d. The outlook in these regions differs markedly from those of industrialized countries, which see virtually no capacity expansion projects beyond those already under construction.

The Reference Case outlook implies substantial investment in the upstream...

Over the period 2010–2035, upstream oil investment requirements for additional capacity amount to \$3 trillion in 2010 dollars. It should be noted that this excludes investment in additional infrastructure such as pipelines. Most of this investment will be made in non-OPEC countries: On an annualized basis over the medium-term, non-OPEC will need to invest an average of \$77 billion p.a., rising to well over \$90 billion p.a. in the long-term. OPEC, on the other hand, would be expected to invest an average of \$25 billion p.a. over the medium-term, rising to over \$30 billion p.a. in the long-term. The OECD's share in global investment will be close to 40% in the longer term, given high costs and decline rates.

...and the downstream

Substantial capital investments are also required to expand and provide maintenance to the global refining system. In the period to 2035, investments are estimated at around \$1.2 trillion in the Reference Case, out of which \$210 billion is for investment in existing projects, \$300 billion for required additions, and close to \$700 billion for maintenance and replacement.

Scenarios underscore feasible alternatives to the Reference Case

However, beyond the Reference Case, it is important to explore developments that feasibly could emerge under realistic alternative assumptions to the drivers of supply and demand. These influences include technologies (particularly in transportation), policies, the environment and evolving efforts to combat the threat of climate change, and perceived concerns over energy security. OPEC's Accelerated Transportation Technology and Policy (ATTP) scenario assumes higher efficiency improvements to internal combustion engines; an accelerated shift to hybrids and, in some parts of the world, electric vehicles; and more aggressive support for alternative fuels. In the ATTP Scenario, more than 7 mb/d is removed from global oil use by 2035, when volumes reach around 102 mb/d. Non-OPEC supply is 3 mb/d higher by 2035, compared to the Refer-

ence Case. Consequently, the call on OPEC crude by 2035 is a reduction of more than 10 mb/d when compared to the Reference Case. Thus, in the ATTP scenario, there effectively will be very little room for additional future OPEC crude supply.

Economic growth uncertainties also have implications for oil demand

Further scenarios document how uncertainties over economic growth — in the short-, medium- and long-term — have very important implications for the evolution of oil demand. This further complicates the challenge of making appropriate investment decisions along the oil supply chain.

Dialogue and cooperation continue to support market stability

Finally, in a world of growing interdependence, the importance of dialogue is widely acknowledged. This is underscored in OPEC's LTS and in the 'Riyadh Declaration', which concluded the Third OPEC Summit in November 2007. OPEC has also been broadening and strengthening its dialogue with consuming and producing countries, as well as other international institutions. The issues at stake are broad, complex and inter-related — and require concerted efforts and, where appropriate, joint collaboration to find adequate, cooperative 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 energy poverty. In this regard, it is important to mention the joint collaborative efforts of the IEA/IEF/OPEC, such as the annual symposium on energy outlooks and workshop on financial markets. Expanded, in-depth dialogue builds confidence, aids long-term market stability and can address the concerns of both producers and consumers, particularly at times of high market volatility.

1. INTRODUCTION

The OPEC Secretariat has a long tradition of preparing a background paper for Ministerial Meetings of the IEF that analyses the outlook for oil demand and supply, associated current and future challenges, and their impacts. As in the past, today's context brings many of these challenges to the fore. This is particularly true of the recent history of extreme price volatility and the persistent uncertainties for the global economy.

This background paper is organized into four sections. The first section focuses on recent developments, particularly related to oil market behaviour. The second section develops OPEC's Reference Case outlook for oil supply and demand to the year 2035.¹ The third section addresses some of the challenges ahead, covering investment needs in particular and the type — and scale — of uncertainties. A fourth section offers some conclusions.

2. RECENT MARKET DEVELOPMENTS

The year 2011 saw the oil market in a constant state of flux: the ups and downs of the global economic recovery, Japan's multiple disaster, unrest in parts of North Africa and the Middle East. What has been apparent, however, is that there has been no shortage of oil. Libya's shortfall in early 2011 was met by other OPEC Member Countries, and it is quickly returning its production and export capacity to the market. Overall spare capacity has been — and remains — at comfortable levels and investments will see these comfortable levels increase in the coming years.

Since the 12th IEF Ministerial Meeting — held in Cancun, Mexico, 30th–31st March 2010 — oil prices have risen to levels that reflect a number of factors. One is the behaviour of upstream costs. These initially fell in the second half of 2008 as the Great Recession took hold and bottomed out towards the end of 2009. However, costs have recently started to rise once more as oil supply activity has picked up following the recovery from the recession. In addition, speculation has also been a driving force in the price rise, with increasing investor interest in the crude oil paper market — particularly in ICE Brent contracts — also behind the rise in crude oil prices. Throughout most of 2011, the OPEC Reference Basket price remained around or slightly above \$100/b.

That speculative activities remain an issue in the current market can be viewed in the respective sizes of the paper and physical markets. Since 2005,

¹ Based upon the OPEC World Oil Outlook 2011, published in November 2011 and available at <http://www.opec.org>.

there has been a sharp increase in the number of open interest futures and options contracts. At times it has surpassed three million contracts per day, equivalent to 3 billion b/d. This is 35 times the size of actual world oil demand. It should also be noted that, between 2009 and 2011, data shows an almost one-to-one correlation between WTI prices and the speculative activity of the net long positions of money managers. This is in terms of both volume and value. Excessive speculation is detrimental to both producers and consumers and can cause prices to detach from fundamentals. It is essential to avoid distorting the essential price discovery function of the market.

With the higher costs faced by producers, there is a clear perception that sustainable price levels must allow producers to invest to meet future demand and, at the same time, must not impede the global economic recovery. But speculative activities remain an issue in the market. This was seen in April 2011 as prices reached more than \$120/b. Excessive speculation is detrimental to both producers and consumers and can cause prices to detach from fundamentals. It is essential to avoid distorting the essential price discovery function of the market.

From the perspective of these recent oil market developments, the benefits of dialogue and cooperation are evident. The importance of this is underscored by this background paper, which has been developed to support the process. Its aim is to highlight some of the key issues that need to be addressed, both as part of the industry's producer-consumer dialogue and as part of broader global and multilateral discussions.

3. OIL OUTLOOK TO 2035

For the Reference Case, it is generally accepted that long-term oil price assumptions should involve an assessment of marginal costs. For example, the prices needed to support Canadian oil sands projects at internal rates of return above 10% suggest higher prices than previously assumed. It is assumed that, in nominal terms, prices stay in the range of \$85–95/b for this decade, an upward revision of \$15/b compared to the price range in OPEC's background paper prepared for the 12th IEF Ministerial Meeting. Longer-term, the price assumption leads to values that reach \$133/b by 2035. It should be emphasized, however, that these figures are only assumptions. They do not reflect in any way a projection of likely or desirable prices.

Since the previous IEF Ministerial, a more rapid recovery from the Great Recession emerged in 2010 than had been expected. However, the global economic recovery is increasingly showing signs of weakness. The most pressing

issues are the widening deficits and ballooning sovereign debts in euro-zone countries. If not cooperatively managed and resolved in a timely manner, this could lead to a worrisome banking crisis with potentially damaging systemic risk. There are also concerns over the relatively muted recovery in US private household demand and the recent economic slow-down — albeit moderate — in developing countries, particularly the deceleration in China and India, the economies of which remain largely dependent on either capital inflows from — or exports to — developed countries. Recent significant increases in inflation have forced the countries to make provisions to prevent their economies from overheating. The question remains as to whether this represents a well-managed ‘soft landing’ or is an early indication of future economic difficulties.

Medium-term growth prospects will depend on the ability of governments to maintain their various support measures for as long as it takes to solve their economic issues, and on the speed of return of confidence to the markets. In the Reference Case, average global growth over the period 2010–2015 is assumed to be 3.9% p.a. The recovery has been driven by stimulus packages and monetary policy, as well as expectations that developing countries will be a major factor supporting global economic growth. This is assumed to continue to be the case over the medium-term. However, as discussed, there are serious downside risks to this assumption.

Demographic trends are important for determining long-term economic growth potential and energy demand. There will be a slowing of population growth — or even a contraction in some regions — over the long-term, and we are now observing other demographic features such as rising urbanization and a generally ageing population. The world population increases from just over 6.9 billion in 2010 to almost 8.6 billion in 2035. Only 110 million of the increase over the period 2010–2035 is in member countries of the Organisation for Economic Co-operation and Development (OECD), while close to 1.6 billion more people will be living in developing countries.

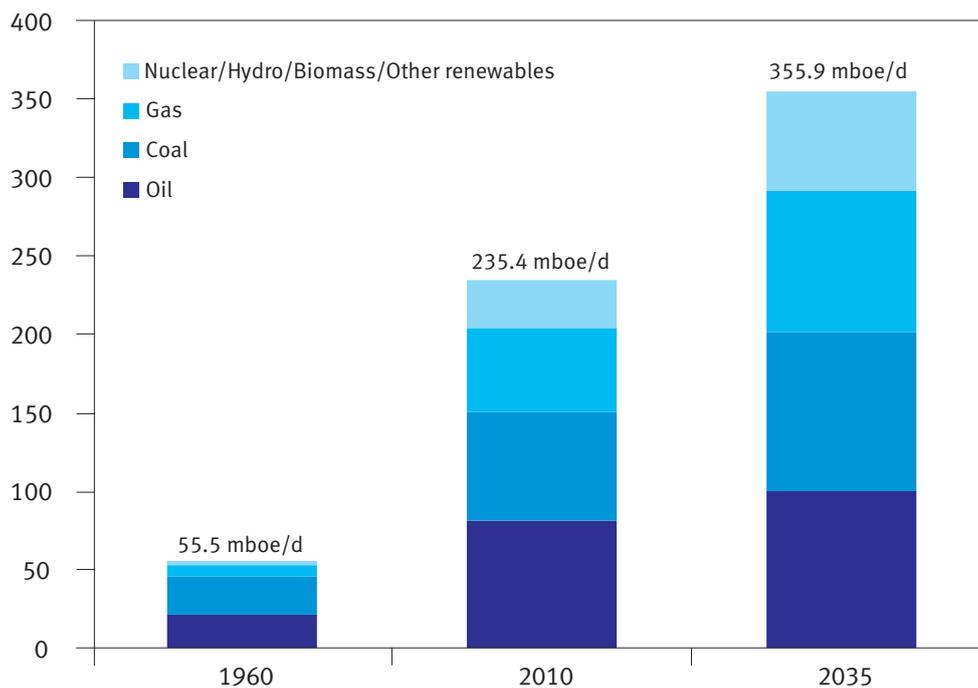
These demographic developments — together with assumptions of future factor productivity growth in line with the continuation of globalization — lead to long-term economic growth rates in the Reference Case averaging 3.4% p.a. over the period 2011–2035. Global economic growth is assumed to average 3.7% p.a. for this decade, falling to 3.2% p.a. for the period 2021–2035. By 2035, the Chinese economy accounts for 27% of global GDP, approximately double that of Western Europe. The share of developing countries in the world’s economic activity is set to rise from 40% in 2010 to 57% by 2035, with Asian developing countries alone accounting for 43% of global GDP.

The Reference Case in this background paper retains the principle that only policies already in place or widely anticipated are allowed to influence supply and demand patterns. The two key policies already factored in are the European Union (EU) package of measures for climate change and renewable objectives, and the US Energy Independence and Security Act (EISA). China’s recently announced 12th Five-Year Plan (FYP) for the period 2011–2015 includes a focus on increasing energy efficiency, decreasing carbon intensities, reducing the share of fossil fuels in the energy mix, pushing battery cell technology development and sustaining economic growth at an average of 7% p.a. over the next five years. In general, however, this FYP appears to be a continuation of past developments in China’s energy sector and does not have major implications for the Reference Case.

3.1 Oil demand

Over the period 2010–2035, commercial primary energy demand in the Reference Case increases by 51% (see **Figure 1**). Fossil fuels, which currently account for 87% of primary commercial energy supply, will still make up 82% of the global total by 2035. For most of the projection period, oil will remain the energy type with the largest share. However, by 2035 it will have been overtaken by coal use in the Reference Case, which will represent 29% of total energy, similar to today, while oil’s share falls from 34% to 28%. Gas use will

Figure 1
World supply of primary energy by fuel type



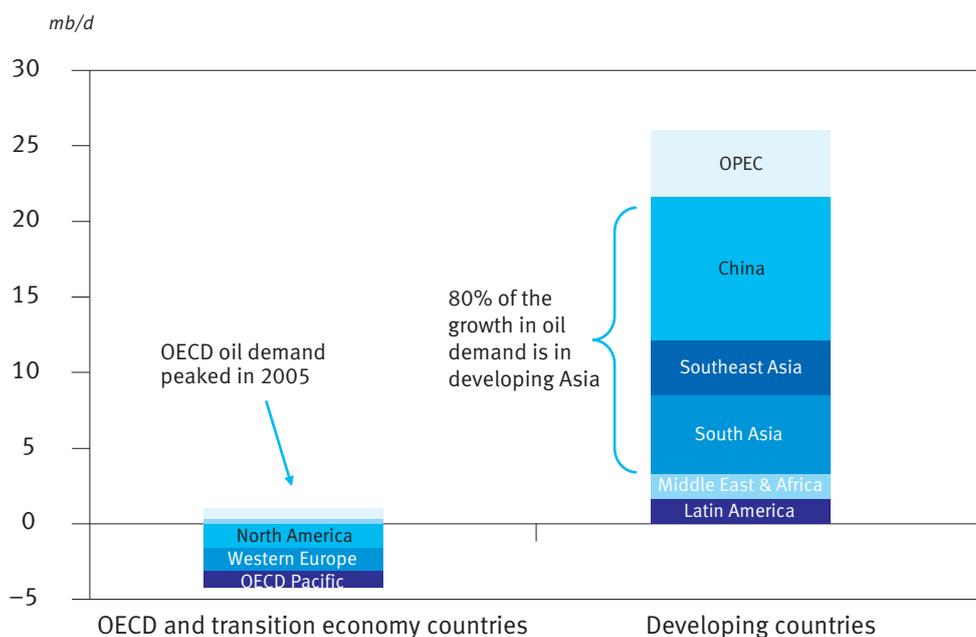
rise at faster rates than either coal or oil — in both percentage terms and volumes — with its overall share rising from 23% to 25%.

The prospects for nuclear energy have clearly been affected by the devastating accident at the Fukushima nuclear plant in Japan in 2011. The Reference Case reflects the immediate aftermath of the nuclear accident, when shut-in nuclear power in Japan was replaced by other fuels. Moving forward, it is assumed that the long-term prospects for nuclear power in Japan have been negatively affected. Possible adverse impacts can be expected elsewhere, too. In the Reference Case, nuclear energy still expands at an average rate of 1.7% p.a., although its long-term contribution has been revised down slightly from previous estimates.

In terms of oil demand, the Great Recession had enormous implications for projections in both the short- and medium-term. Risks now appear rather skewed towards the downside, given the widening global macro-economic uncertainties. However, with the initial recovery swifter than expected, the medium-term oil demand outlook reflects an upward revision from the previous assessment. The Reference Case now foresees demand reaching 92.9 mb/d by 2015, an upward revision of 1.9 mb/d.

While the central driver for medium-term oil demand is the economy, other important drivers come in to play in the long-term. The impact of policies, technologies, demographics and, to a lesser extent, oil price developments

Figure 2
Growth in oil demand, 2010–2035



will increasingly influence long-term demand patterns. In the Reference Case, demand increases by close to 23 mb/d over the period 2010–2035, reaching almost 110 mb/d by 2035. OECD demand actually seems to have peaked in 2005 and the Reference Case sees a steady demand decline in the entire OECD region. Fully 80% of the increase in global demand is in developing Asia, where demand reaches almost 90% of OECD demand levels by 2035 (see **Figure 2 and Table 1**).

Table 1
World oil demand outlook in the Reference Case

mb/d

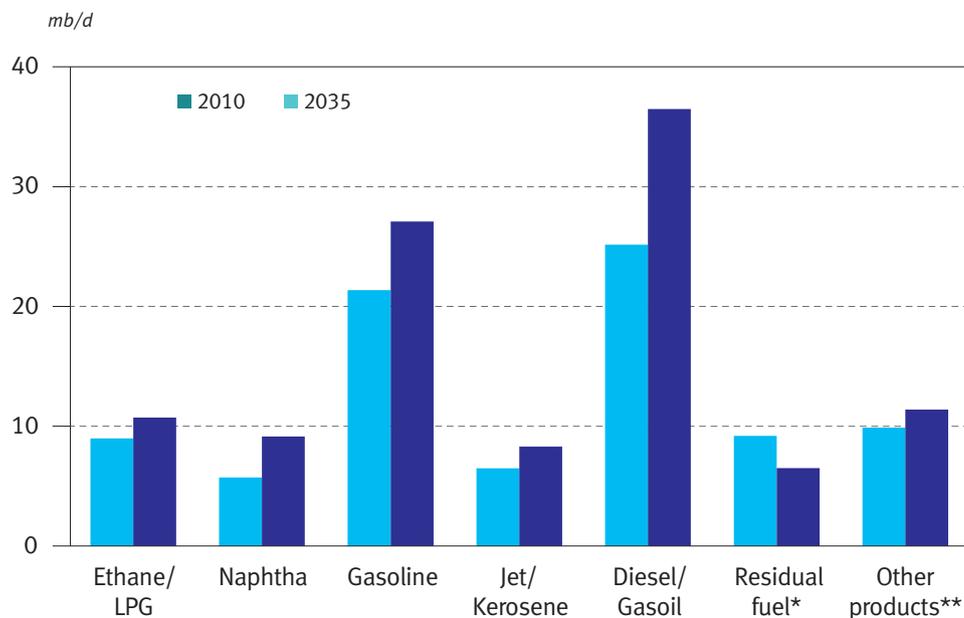
	2010	2015	2020	2035
OECD	46.1	46.0	45.2	41.9
Developing countries	35.9	41.8	47.2	61.9
Transition economies	4.8	5.1	5.3	5.9
World	86.8	92.9	97.8	109.7

Transportation in non-OECD countries is central to future global demand growth, accounting for close to 90% of the increase over the period to 2035. Developing countries are also expected to see some rise in oil use in other sectors, particularly in industry and the household/commercial/agriculture sector. Globally the small amount of oil that is still used for electricity generation is expected to fall. In OECD countries, the declining use of oil is dominated by the fall in demand for road transportation, as vehicle fuel economies improve and the rate of increase for car ownership slows.

Conventional powertrain technology is expected to continue to act as a source of substantial efficiency gains. This is true for diesel engines and probably even more for gasoline engines in the future. Hybrid and plug-in vehicles will also begin to have an impact on the vehicle sales mix. In these areas, however, technology and infrastructure are still in their infancy and customer habits will need time to change. With regard to heavy-duty vehicles, the focus is turning to fuel consumption targets, with Japan leading the way, although steps towards implementing fuel efficiency standards in other markets are gradually emerging. Alternative technologies — especially hybrids — are expected to face some commercial and technical challenges in this heavy-duty vehicle segment. Conventional technology improvements and the take-up of new powertrain technologies are anticipated to affect the average fuel consumption of new passenger vehicles. The figure will be close to 20% for trucks due to lower levels of hybridization, limited opportunities for plug-ins and constraints to improvements in mainstream diesel engine technology.

Growth in the road transport sector — which is steering demand for gasoline and diesel — is projected to sustain the gasoline-diesel imbalance that has emerged in the past decade. This is clearly evident in the fact 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 (**Figure 3**).

Figure 3
Global product demand, 2010 and 2035



* Includes refinery fuel oil.

** Includes bitumen, lubricants, waxes, still gas, sulphur, direct use of crude oil, etc.

3.2 Oil supply

3.2.1 Upstream

Total non-OPEC supply increases steadily over the medium-term, rising by 3 mb/d over the period 2010–2015. The key drivers of this growth are the Caspian region, Brazil and Canada. Biofuels — mainly in Europe and the US — also make some contribution. These supply increases more than compensate for expected conventional oil declines in North America and the North Sea. An increase in OPEC natural gas liquids (NGLs) is also expected over the medium-

Table 2
World oil supply outlook in the Reference Case

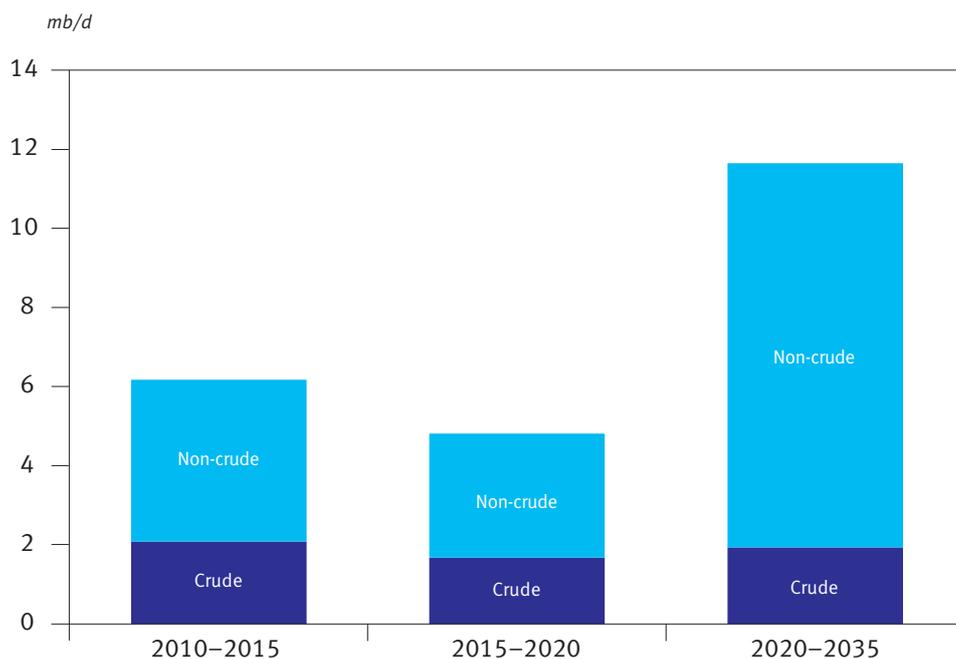
mb/d

	2010	2015	2020	2035
OECD	19.9	20.3	20.4	22.2
Developing countries	16.9	18.4	19.4	19.3
Transition economies	13.4	14.3	14.9	16.1
Non-OPEC	52.3	55.3	57.3	60.5
OPEC NGLs	4.8	6.2	7.2	9.4
OPEC GTLs	0.1	0.3	0.4	0.6
OPEC crude	29.3	31.3	33.2	39.3

term, rising from 4.8 mb/d in 2010 to more than 6 mb/d in 2015. The required amount of OPEC crude will rise gradually from 29.3 mb/d in 2010 to just over 31 mb/d by 2015 (**Table 2**).

Over the long-term, increases in conventional oil supply from the Caspian and Brazil — as well as steady increases in non-conventional oil, mainly from biofuels, oil sands and shale oil — will more than compensate for expected decreases in mature regions. Total non-OPEC non-conventional oil supply rises

Figure 4
Incremental crude and non-crude oil supply in the Reference Case

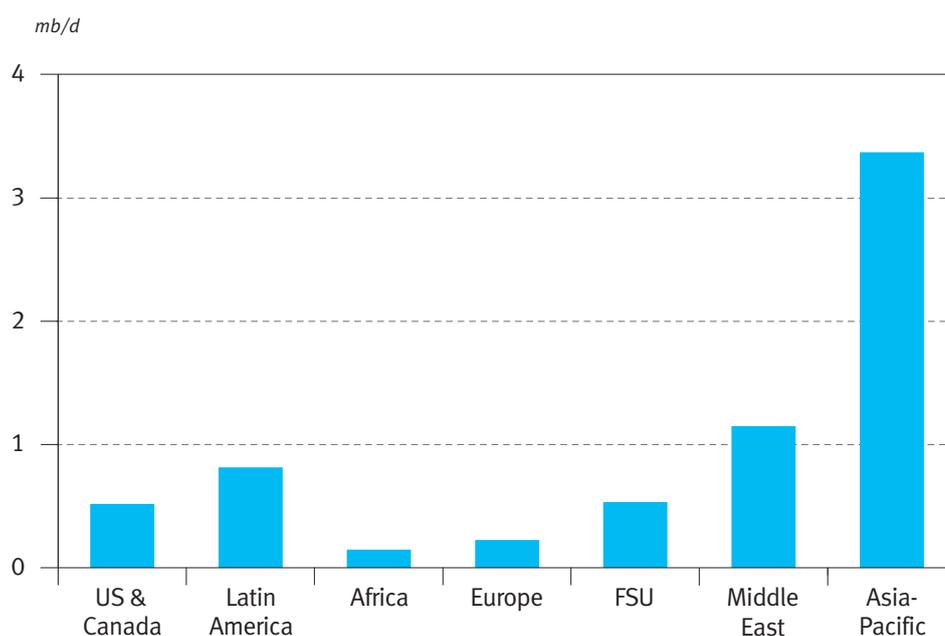


by more than 11 mb/d over the years 2010–2035. On top of this, total NGLs supply from OPEC and non-OPEC increases by 6 mb/d over the same period, from 10.5 mb/d in 2010 to almost 17 mb/d by 2035. The total increase of non-crude liquids supply will satisfy more than three-quarters of the demand increase to 2035 (**Figure 4**). Crude supply in the Reference Case only increases to 74 mb/d by 2025 and then stops rising. There is then no need for additional crude supply. Finally, OPEC crude supply in the Reference Case rises throughout the period to 2035, reaching just over 39 mb/d by 2035, including additional supply necessary for stocks. The share of OPEC crude in total supply by 2035 is 36%, which is not markedly different from current levels.

3.2.2 Downstream

Recent assessments indicate that around 6.8 mb/d of new crude distillation capacity (excluding gains achieved through capacity creep) will be added to the global refining system in the period to 2015 compared to 2010 base. The highest portion of this new capacity is expected to materialize in the Asia-Pacific region — mainly in China and India — accounting for 50% of additional capacity or 3.4 mb/d (**Figure 5**). While investments in Asian refining capacity are predominantly driven by domestic demand, in the Middle East and Latin America where capacity additions to 2015 are also high, the incentive is a combination of local demand and a policy of benefiting from the value added through refining

Figure 5
Distillation capacity additions from existing projects, 2011–2015

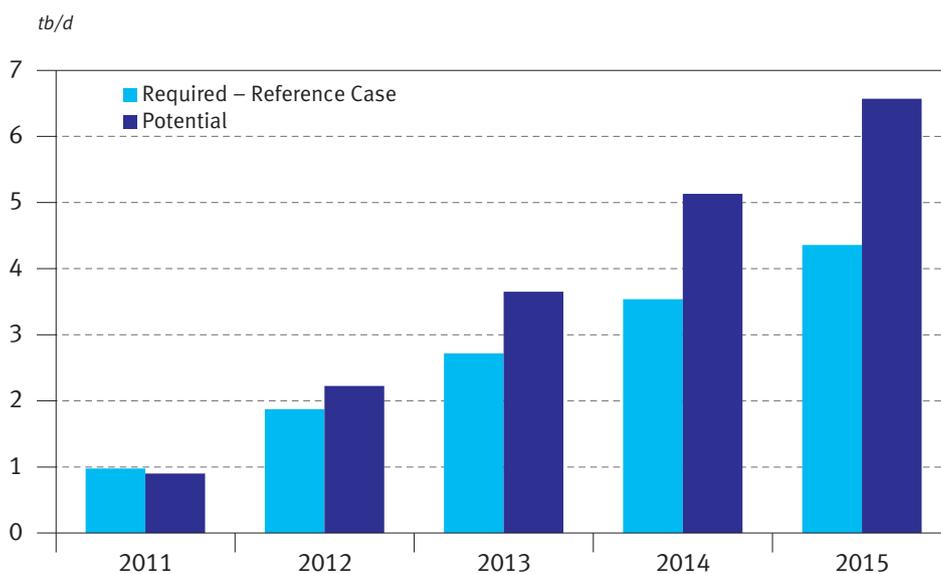


‘at home’. This has contributed to increasing supplies of domestic heavy crude streams. Overall, of the global 6.8 mb/d of new refining capacity by 2015, the world’s developing regions will see an increase of almost 5.5 mb/d.

The scale of new refining capacity in developing countries stands in stark contrast to that assessed to come on stream in developed countries. North America and Europe, show a combined increase of 0.7 mb/d for the period to 2015. This does not take into account any planned or potential capacity closure. In addition to crude distillation capacity, a relatively high proportion of secondary process units will be added to the global refining system in the medium-term. Additions to conversion units, for example, are estimated at 4.4 mb/d driven by strong demand for light products, especially middle distillates. In addition, desulphurization capacity additions exceed those for new distillation capacity, reflecting the continuing worldwide trend for low and ultra-low sulphur fuels.

The net effect of assessed ‘firm’ projects is that compared to current levels — and assuming no refinery closures — excess refinery capacity is expected to grow by 2.5 mb/d by 2015. It is important to recognize that this projected expanding medium-term surplus builds on the surplus created in 2009. This reinforces the expectation of a challenging period for the industry, with lower refinery utilizations and weaker margins. Crude distillation capacity additions are thereby projected to exceed requirements in the medium-term (**Figure 6**). In turn, this

Figure 6
Additional cumulative refinery crude runs, required and potential*



* Potential: based on expected distillation capacity expansion.
 * Required: based on projected demand increases.

will exacerbate the need for capacity rationalization, especially in the regions with the largest capacity overhang and the lowest utilization rates. Moreover, strong regional differences will apply, notably between the continuing growth requirements in non-OECD regions — especially Asia — and surpluses in the US, Europe and Japan.

In 2009, the collapse in oil demand, combined with refinery capacity additions, led to substantially lower throughputs. These shifted effective ‘spare capacity’ in the global refining system to a level of more than 7 mb/d. This was last seen in the industry at the end of the 1980s. In 2010, the situation was somewhat reversed as a resurgence in refinery runs outpaced refining capacity additions, which reduced spare capacity levels, albeit moderately. However, new projects coming on stream over the next five years are expected to override this 2010 reversal. The overall refining surplus could approach 10 mb/d by 2015 unless some capacity is closed. Thus, today’s refinery projects — and those assessed to come on stream in the next few years — potentially represent a substantial proportion of the total additions needed over the next 10–15 years.

The medium-term outlook for the downstream sector indicates sustained pressure for capacity rationalization, especially in OECD regions. The US and Europe are home to the largest capacity overhangs, but to date the industry is looking more to ‘sell’ rather than ‘close’ refineries. This is particularly true in Europe. The prevailing trend in Europe has been to undertake extended maintenance or enact temporary shutdowns. Nevertheless, refineries totalling some 1 mb/d are reportedly up for sale and there has been a fairly active market, both in terms of selling refineries and turning some of them into terminals. While the better quality refineries can be expected to remain in operation, it is the smaller, less complex refineries that appear to be the most vulnerable to closure. In the US, a combination of expanding local crude production, healthy margins due to wide WTI differentials, rising export opportunities and the absence — at least for now — of any climate change legislation outside of California could act to support capacity, leading to only minor closures over the next few years. However, it remains to be seen how long this situation will prevail. The one country where closures currently look set to occur at scale is Japan where up to 1 mb/d of distillation capacity could eventually be closed by 2015. China is another case where legislation is likely to have an impact. However, this is related to the goal of eliminating the country’s small refineries with capacities below 40,000 b/d. The elimination of very small refineries could also be expected in Russia.

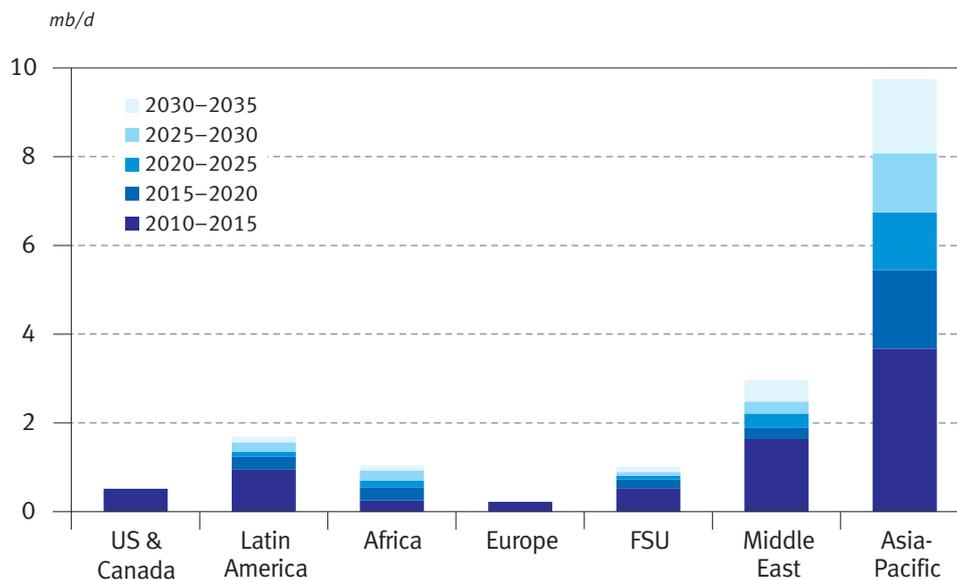
It is significant that, beyond the 6.8 mb/d of known projects expected to be on stream by 2015, the Reference Case shows that only an additional 10.5 mb/d of cumulative additions will be needed by 2035. In the period after 2015,

the required level of capacity additions average only around 0.4 to 0.5 mb/d per year. The underlying reason for this trend is that non-crude supplies increase faster than demand and as a proportion of total supply. This means that less incremental refining is needed per barrel of incremental liquids demand. Indeed, by 2035 it is expected that the total supply of around 110 mb/d will be met by close to 82 mb/d of crude-based supplies and 27 mb/d of non-crudes (including processing gains).

The vast majority of required refining capacity expansions to 2035 are projected for the Asia-Pacific and Middle East regions at 9.8 and 3 mb/d, respectively, out of a global total of 17.2 mb/d (**Figure 7**). Expansions in the Asia-Pacific are dominated by China and India. In Latin America, projected capacity additions of 1.7 mb/d by 2035 exceed the estimated moderate demand growth of 1.3 mb/d for the same period. Capacity requirements in Africa and the FSU region, in turn, are in the range of 1 mb/d. The outlook in these regions differs markedly from those of industrialized countries, which see virtually no capacity expansion beyond projects already under construction.

Recent projections highlight a sustained need for incremental hydro-cracking — some 10 mb/d out of the 14 mb/d of global conversion capacity requirements by 2035 — since it is the primary means to produce incremental distillate once straight run fractions from crude have been maximized. The need to keep investing in additional hydro-cracking capacity — with its associated high

Figure 7
Crude distillation capacity additions in the Reference Case by period, 2010–2035

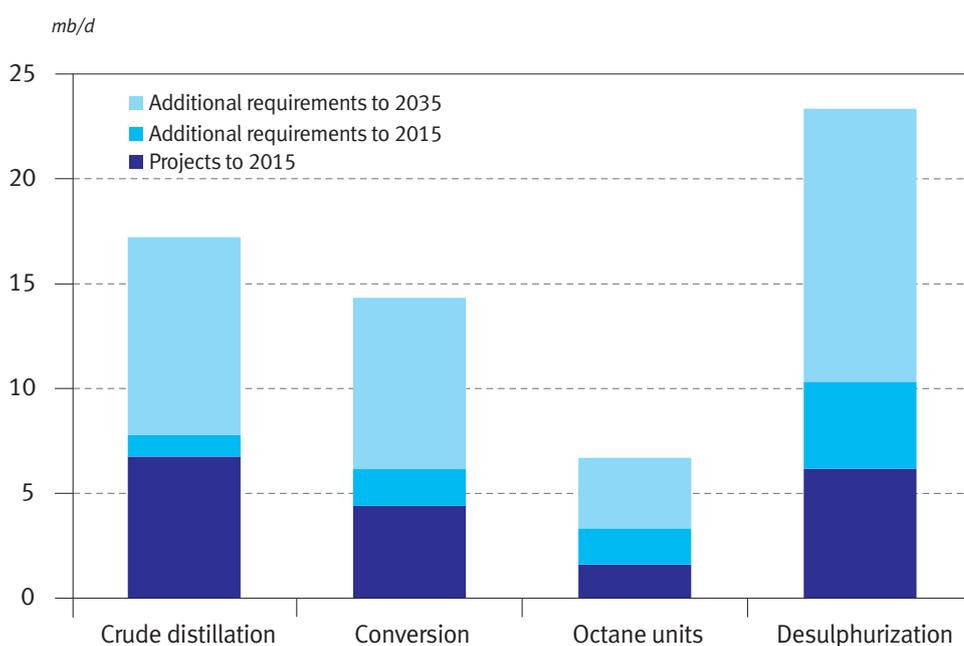


process energy and hydrogen costs — is expected to help support wide distillate margins relative to crude oil and to other light products well into the future.

In contrast, recent substantial coking capacity additions, together with limited medium-term exports of heavy sour crudes, has led to a coking surplus, which is expected to further expand as new projects come on stream. Therefore, between 2015 and 2035, less than 1 mb/d of further additions are projected.

The outlook for catalytic cracking is similar. It is adversely impacted by relatively slow gasoline demand growth and rising ethanol supply in the Atlantic Basin. Moreover, total conversion additions above ongoing projects — at close to 10 mb/d — are almost 100% of distillation capacity additions (**Figure 8**). This reflects the need to increase production of light products for every barrel of crude processed. Substantial desulphurization capacity additions will also be necessary to meet sulphur content specifications, as non-OECD regions in particular move progressively towards low and ultra-low sulphur standards for domestic fuels — often following the Euro III/IV/V standards. In addition, these regions can be expected to use this new capacity for exports to countries that already have advanced ultra-low sulphur standards. Over and above existing projects of 5.8 mb/d, a further 4.2 mb/d is projected to be needed by 2015 and some 13 mb/d from 2015–2035.

Figure 8
Global capacity requirements by process type, 2010–2035



Substantial capital investments are also required to expand and provide maintenance to the global refining system. In the period to 2035, investments are estimated at around \$1.2 trillion in the Reference Case, out of which \$210 billion is for investment in existing projects, \$300 billion for required additions, and close to \$700 billion for maintenance and replacement. This excludes related infrastructure investments beyond the refinery gate in projects such as port facilities, storage and pipelines.

These investments are, however, subject to a number of uncertainties. A refining sector that is being squeezed by the rising supply of non-crudes could become even more pressured by further liquids supply growth — notably from NGLs — given the emergence of shale gas. In addition, biofuels represent a further ‘wildcard’, especially if second and third generation biofuels evolve faster than expected. On the demand side, while non-OECD demand looks robust, transportation efficiency measures in industrialized regions could lead to steeper declines there and policy measures could reshape the demand slate. And if the crude oil-to-natural gas price ratio remains wide enough, LNG could become an attractive option for marine fuels replacement — especially in the long-term — and on new build ships. Moreover, there are the uncertainties surrounding possible capacity shutdowns. All these uncertainties point to a cautionary approach with respect to future refining investment decisions.

4. INDUSTRY CHALLENGES

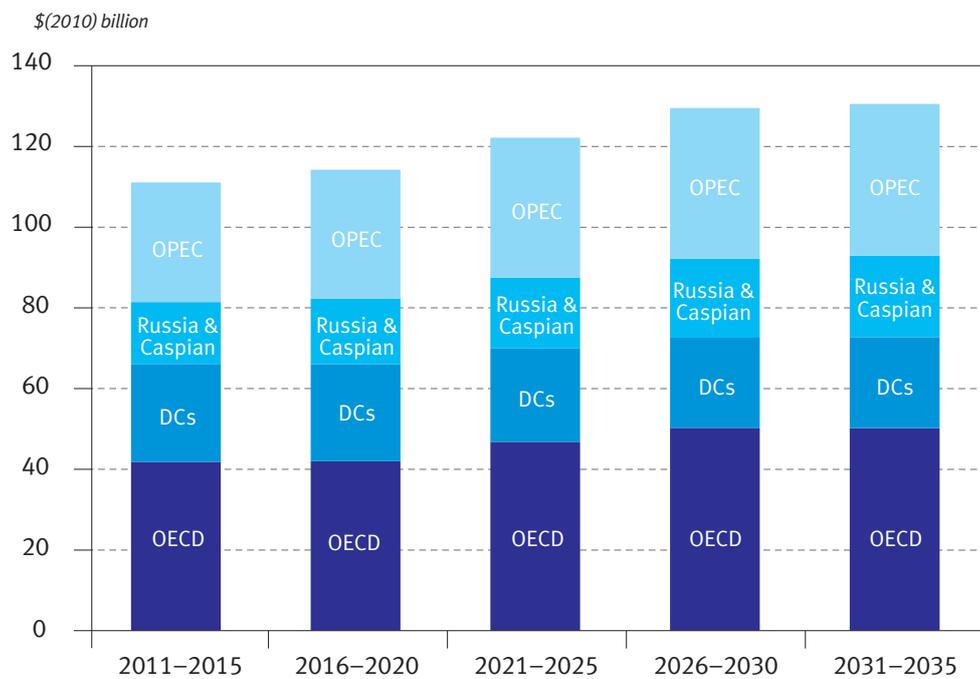
4.1 Reference Case investment requirements

In the assumptions section of this background paper, the behaviour of upstream costs was addressed. These costs increased by 130% from the first quarter of 2004 to the third quarter of 2008. Costs then fell as the economy faltered but bottomed out at the end of 2009. Since then they have begun to rise once more.

This behaviour was due to both cyclical and structural factors. There are evidently uncertainties as to how costs will pan out, but the evidence appears to suggest that a continuous future upward trend — at least in real terms — is not to be expected. This, however, is only a broad conclusion and the impact of the technology versus depletion battle will almost certainly vary across regions. For example, North Sea production prospects are very much limited by the resource base. For this region, it is expected that the costs per b/d of additional capacity will gradually rise. In regions where the resource base is more plentiful and where it is not expected that oil will be supplied from much more hostile environments — for instance, the Caspian Sea and Russia — costs are expected to rise very little or not at all in real terms.

Over the period 2010–2035, upstream oil investment requirements for additional capacity amount to \$3 trillion in 2010 dollars. It should be noted that this excludes investment in additional infrastructure such as pipelines. Most of this investment will be made in non-OPEC countries: On an annualized basis over the medium-term, non-OPEC will need to invest an average of \$77 billion p.a., rising to well over \$90 billion p.a. in the long-term. OPEC, on the other hand, would be expected to invest an average of \$25 billion p.a. over the medium-term, rising to over \$30 billion p.a. in the long-term (**Figure 9**). The OECD’s share in global investment will be close to 40% in the longer term, given high costs and decline rates.

Figure 9
Annual upstream investment requirements for capacity additions in the Reference Case, 2011–2035



4.2 Alternative scenarios point to considerable uncertainty

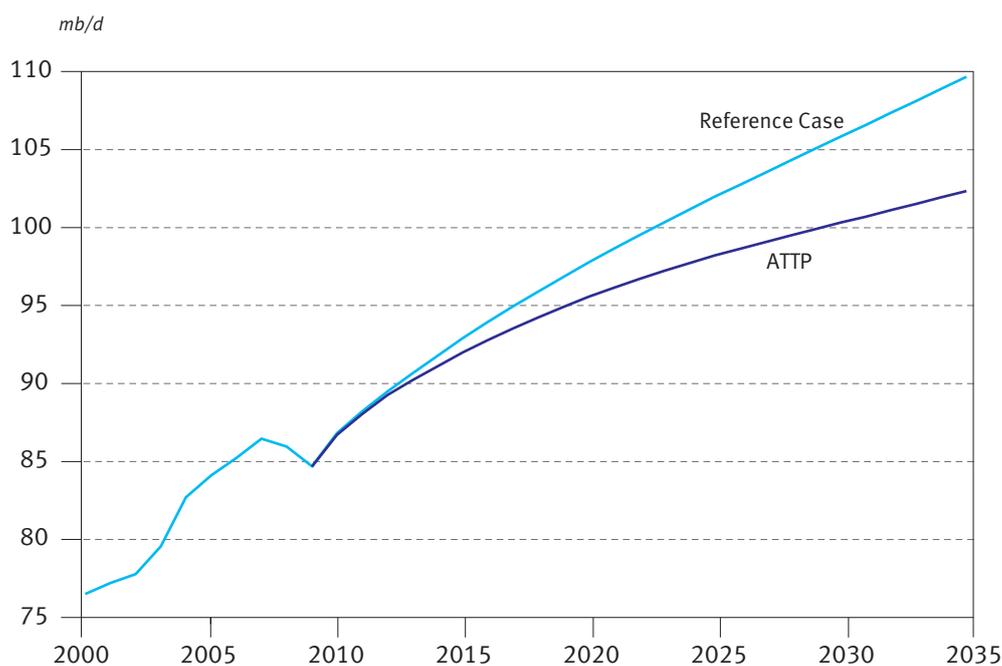
Beyond the Reference Case, it is important to explore developments that feasibly could emerge under realistic alternative assumptions to the drivers of supply and demand. Indeed, the question arises whether the Reference Case is a ‘most-likely’ scenario. In reality, it is not to be interpreted as such: It is essentially a ‘dynamics-as-usual’ world, but these dynamics are clearly subject to a variety of influences and bring with them a wide range of potential qualitative and quantitative impacts on supply and demand. These influences include

technologies (particularly in transportation), policies, the environment and evolving efforts to combat the threat of climate change, and perceived concerns over energy security.

OPEC has developed an Accelerated Transportation Technology and Policy (ATTP) scenario. This assumes higher efficiency improvements to internal combustion engines; an accelerated shift to hybrids and, in some parts of the world, electric vehicles; more rapid penetration in some regions of natural gas in the transportation sector; and an accelerated move to regulate efficiencies in commercial vehicles. It also includes more aggressive support for alternative fuels — particularly biofuels, CTLs, biomass-to-liquids, gas-to-liquids and compressed natural gas — and the effect of international marine bunker regulations, which lead to more efficient fuel use.

In the ATTP scenario, more than 7 mb/d is removed from global oil use by 2035, when volumes reach around 102 mb/d (**Figure 10**). Non-OPEC supply is 3 mb/d higher by 2035, compared to the Reference Case. Consequently, the call on OPEC crude by 2035 is a reduction of more than 10 mb/d when compared to the Reference Case. Thus, in the ATTP scenario, there effectively will be very little room for additional future OPEC crude supply. Indeed, by 2035, the amount of OPEC crude needed will be less than current levels. This means that OPEC upstream investment requirements are subject to huge

Figure 10
World oil demand in the ATTP scenario



uncertainties. While the Reference Case in 2025 sees upstream investment requirements of \$480 billion (in 2010 prices), the ATTP scenario points to requirements of just \$290 billion. This demonstrates the genuine concerns over security of demand. These estimates do not include investments required in the mid- and downstream industries of OPEC Member Countries.

Other scenarios that have been developed examine the global economy, documenting how uncertainties over economic growth in the short-, medium- and long-term have very important implications for the evolution of oil demand. This further complicates the challenge of making appropriate investment decisions along the oil supply chain.

Uncertainties over economic growth have been brought to the fore by the recent Great Recession. Looking ahead, countries burdened by heavy government debt will be hampered in their growth prospects if fiscal consolidation is not properly managed. In addition, there are increasingly longer term questions being raised over economic growth rates in the face of a possible retreat of globalization. However, economic growth uncertainties could also point to upside potential among, for example, emerging markets, which are not as financially constrained as major OECD countries and which may increasingly become the motor of world growth.

Scenarios have been developed with both higher and lower economic growth rates of 0.5% p.a. In the lower growth scenario, oil demand reaches slightly over 100 mb/d by 2035, which is about 9 mb/d lower than in the Reference Case. Because of slightly softer oil prices, non-OPEC oil supply is about 2 mb/d lower than in the Reference Case by 2035. This means that the call on OPEC crude oil by 2035 is 7 mb/d lower than in the Reference Case. In this scenario, OPEC crude oil rises slowly to around 32 mb/d by the mid-2020s, where it stays approximately constant. In the higher economic growth scenario, global oil demand rises more swiftly, reaching over 112 mb/d by 2030 and nearly 119 mb/d by 2035. This further demonstrates the uncertainty over future oil demand — from both the upside and downside perspective — due to economic growth. Economic growth uncertainties are, therefore, probably at least as big a concern with regards to security of demand as the development of policies and technologies, especially over the short- to medium-term.

4.3 Adverse impacts of climate change mitigation response measures

No international agreement has yet been reached in identifying a long-term goal for greenhouse gas (GHG) emissions reduction. Nevertheless, much work has been undertaken to explore the implications of limiting the global average

temperature to a rise of less than 2°C above pre-industrial levels and corresponding atmospheric GHG concentrations. Although there is uncertainty over the fundamental relationship between GHG concentrations and temperature rises, it is clear that mitigation response measures could lead to large oil demand reductions, relative to the Reference Case.

An important issue is the type of policies and measures that are undertaken to satisfy a given GHG emission limitation/reduction path. The other important question is how the loss in oil demand would be shared between OPEC and non-OPEC in terms of lower supply and the effect on the oil price. Under all circumstances, the implications for net OPEC crude oil export revenues would be substantial: Cumulative net export real revenue losses would be measured in trillions of dollars and revenue per capita in OPEC Member Countries would continuously fall. They would also be lower than historical levels. Other adverse impact channels include lower domestic demand, lower GDP, more expensive imports, increased financing costs, job losses and lower competitiveness. The importance of such adverse effects, actual and potential, on all developing countries — particularly those identified in Article 4, paragraph 8, of the Convention — suggests an urgent need to establish a permanent forum on response measures under the Conference of the Parties to the UNFCCC.

4.4 The importance of alleviating energy poverty

Figures from the United Nations show that 1.4 billion people have no access to electricity and some 2.7 billion rely on biomass for their basic needs. Moreover, according to the World Health Organization, the reliance on biomass results in 1.45 million premature deaths per year — most of them children. This death toll is greater than that caused by malaria or tuberculosis. It is essential that the world effectively tackle the issue of energy poverty as a means of achieving the Millennium Development Goal (MDG) of halving the proportion of people in poverty by 2015. That is why sustainable development is a high priority agenda item for OPEC Member Countries. It is also the main objective of the assistance they provide to other developing countries — directly through their own aid institutions, as well as through the OPEC Fund for International Development (OFID). In total, they have provided close to \$350 billion (in 2007 prices) in development assistance to other developing countries in the period 1973–2010. This amounts to nearly \$10 billion a year.² A significant portion of this amount — about \$69 billion — has been devoted to energy related projects, covering a diverse portfolio of energy sources that includes financial support to renewable energy sources. This year's Rio+20 is a great opportunity to take stock — particularly in terms of the MDGs — and

² See www.ofid.org.

to define improved processes, structures and means for achieving sustainable development.

4.5 The crucial importance of human resources

The future availability of qualified technical talent remains a major challenge for the oil industry. The Great Recession has had a significant impact in terms of job losses and a lack of job creation. However, the origins of this talent shortfall can be found in the 1980s and 1990s, when the oil and gas industry saw a wave of cost cutting and redundancies. The result was that many technical people who were then entering their mid-career stage left the industry permanently. The industry will need more qualified people in the years ahead. This raises the question: How can the industry find, hire, train and retain talented people? The industry needs to be made more attractive, more acceptable and oil companies need to be seen as inclusive and forward-looking workplaces. A related issue is that of local content, which is of particular relevance to many oil and gas producing developing countries. Local content is a crucial role as it can — and should — provide a strong platform for a country's economic and social development.

5. CONCLUDING REMARKS

In a world of growing interdependence, the importance of dialogue is widely acknowledged. This is underscored in OPEC's Long-Term Strategy as well as in the 'Riyadh Declaration', which concluded the Third OPEC Summit in November 2007. OPEC has also been broadening and strengthening its dialogue with consuming and producing countries, as well as other international institutions. The issues at stake are broad, complex and inter-related — and require concerted efforts and, where appropriate, joint collaboration, to find adequate, cooperative 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 energy poverty. In this regard, it is important to mention the joint collaborative efforts of the IEA/IEF/OPEC, such as the annual symposium on energy outlooks and workshop on financial markets. Expanded, in-depth dialogue builds confidence, aids long-term market stability and can address the concerns of both producers and consumers, particularly at times of high market volatility.