THIRD IEA-IEF-OPEC SYMPOSIUM ON ENERGY OUTLOOKS

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INTRODUCTORY PAPER
A COMPARISON OF THE MOST RECENT IEA AND OPEC OUTLOOKS

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This introductory paper was prepared by the IEF, in consultation with the IEA and OPEC.

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Executive Summary

This paper compares the short-, medium- and long-term energy outlooks recently published by the IEA and OPEC. It is intended as a reference for the Third IEA-IEF-OPEC Symposium on Energy Outlooks,* to be held in Riyadh on 22 January 2013, and discusses technical issues related with the estimation of demand, stocks and supply. It identifies the main convergences and divergences between these outlooks and addresses the reasons behind them, from definitions to methodologies, data sources and assumptions about future market trends and directions.

Highlights stemming from this comparative exercise include:

- While energy and environmental policies are key drivers for future energy demand and supply, they are also among the most uncertain variables.

- Differences in scenarios, estimation methodologies, the level and regional distribution of projected demand for crude, and regional cost assumptions translate into differences in the level of projected investments in producing fields and additional capacity that may be needed to satisfy demand by 2035.

This comparative exercise also points to a number of areas where there is scope to discuss how certain data are treated, analysed or categorised, not necessarily with the objective of reaching consensus, but with the goal of ensuring a more comprehensive understanding of each. For example:

- Assumptions regarding demand growth in some countries or regions, such as China, India and the Middle East.
- The expected impact of policy changes.
- The marginal cost of production and price assumptions.
- How spare capacity is defined.
- How bunker fuels, biofuels and natural gas liquids (NGLs) are defined and classified.
- Seasonality patterns in oil demand and supply.
- Thinking with regard to long-term non-OPEC supply.
- Assumptions regarding the outlook for shale and tight oil.
- Different viewpoints regarding processing gains.
- The links between GDP growth and oil demand.

What follows is a brief summary of the comparison of the IEA's and OPEC's outlooks over the various time horizons.

* Attachment II of the Cancun Ministerial Declaration, adopted in 31 March 2010, states that "The IEF will organise, in co-operation with the IEA and OPEC, an Annual Symposium at the IEF Secretariat in Riyadh, with participation from the main institutions that publish regular energy outlooks. The Symposium could cover the previous year's market behaviour, as well as the short-, medium- and long-term energy outlooks. To focus the discussion at the Symposium, the IEF will produce an introductory paper, in consultation with IEA and OPEC. The IEA, the IEF and OPEC will jointly produce a Symposium report."

Short-term Demand

The impact of economic growth on energy demand plays an important role in the projections of both the IEA's and OPEC's short-term outlooks.[1] Both outlooks highlight that the global economy experienced another year of deceleration in 2012, and they assume positive economic growth for 2012 and 2013 – with no double-dip recession incorporated in base scenario projections. However, both warn that various uncertainties warrant close monitoring given their individual and collective impact on energy demand, including the Eurozone debt crisis, the US fiscal situation, growth prospects in Japan and slowing activity in developing economies.

Throughout the course of 2012, the IEA and OPEC continually adjusted their oil demand projections downward, driven mainly by the slowdown in global economic growth and by tighter credit conditions – as well as by weather-related issues and revisions to baseline data. Despite these downward revisions, global oil demand growth remains positive and has so far shown great resistance to the weak global macroeconomic backdrop, attributing its entire growth to non-OECD countries.

Both outlooks expect positive short-term demand growth for 2012 and on into 2013. The IEA December 2012 report expects an increase in oil demand of around 0.87 million barrels per day (mb/d) in 2013, to reach a global demand total of 90.5 mb/d. OPEC's December 2012 report anticipates growth of 0.77 mb/d in 2013, to 89.6 mb/d for worldwide demand.

Short-term Supply

While numerous issues affecting non-OPEC supply in 2012 remain in play, overall prospects for non-OPEC supply in 2013 look healthier.

On the supply side, during 2012 the IEA and OPEC regularly adjusted their non-OPEC supply projections downward, and their expected growth for 2012 slid to around 0.50 and 0.48 mb/d to reach 53.3 and 52.9 mb/d respectively, mainly due to unexpectedly high production stoppage levels.

While numerous issues affecting non-OPEC supply in 2012 remain in play, overall prospects for non-OPEC supply in 2013 look healthier. Both the IEA and OPEC reports forecast non-OPEC supply to increase by 0.9 mb/d in 2013 to reach 54.2 and 53.8 mb/d, respectively. They also note steady growth in OPEC natural gas liquids (NGLs) and OPEC crude oil production in 2012, while spare production capacity remained at a reasonable level.

Medium-term Demand

Both the IEA and OPEC expect robust growth in global oil demand over the medium-term.

For the medium-term, the IEA's and OPEC's reports have somewhat different views on global economic growth and oil price assumptions. Differences between the two reports over prospects for medium-term economic growth are mainly rooted in assumptions about expected growth in non-OECD countries.

Both the IEA and OPEC expect robust growth in global oil demand over the medium-term. However, the IEA global medium-term oil demand projection for 2016 is higher than the OPEC figure by around 1.6 mb/d, mainly due to the difference in the base year demand level. The IEA expects global oil demand to average 94.5 mb/d by 2016, representing average annual growth of close to 1.1 mb/d through 2016, while OPEC puts global oil consumption in 2016 at 92.9 mb/d – representing annual average growth of just over 1.0 mb/d through 2016.

[1] IEA Oil Market Report, December 2012. OPEC Monthly Oil Market Report, December 2012.

At the regional level, both the IEA and OPEC expect oil demand to be driven by non-OECD countries. However, expectations regarding growth in individual non-OECD countries vary.

At the regional level, both the IEA and OPEC expect oil demand to be driven by non-OECD countries. However, expectations regarding growth in individual non-OECD countries vary – creating a difference in the oil demand projections at the regional level. The IEA's projection for demand in non-OECD countries in 2016 is 1.7 mb/d greater than OPEC's projection.

Medium-term Supply

Regarding supply, the IEA and OPEC both project high growth in global oil supply over the medium-term, to meet the projected demand increase by 2016. However, their medium-term global oil supply forecasts differ by around 1.6 mb/d through 2016, similar to how they differ when analysing oil demand.

There is a difference of around 1.3 mb/d between the WOO and MTOMR projections regarding supply coming from the US and Canada.

On non-OPEC supply growth, both reports have almost similar projections through 2016. At a regional level, the differences between both reports are substantial in some regions and small in others. For example, there is a difference of around 1.3 mb/d between the OPEC World Oil Outlook (WOO) and IEA Medium-Term Oil Market Report (MTOMR) projections regarding supply from the US and Canada. This gap results primarily from differing views on the level of shale/tight oil supply expected to come from the region, with the IEA more optimistic.

Finally, both reports expect an increase in OPEC crude production capacity over the medium-term (through 2016), but hold different assessments of the capacity increase level.

Long-term Outlook

Over the long-term, the IEA World Energy Outlook (WEO) and OPEC WOO expect that under all scenarios global primary energy demand will continue to grow, as economies expand, the global population grows and living standards across the world improve.

Energy and environmental policies will be key variables to watch over the forecast horizon, along with potential technological changes and adjustments to economic growth assumptions.

By 2035, the IEA Current Policies Scenario envisions that world primary energy demand will be 47% higher than today, while OPEC's Reference Case expects world primary energy demand will be 54% higher than its current level. Fossil fuels will continue to be the most widely used energy source, and existing resources are expected to be more than sufficient to meet the anticipated growth in demand (fossil fuels are expected to represent over 80% of total energy consumption in 2035). Both outlooks note that for oil and natural gas, an increasing share of global supply will come from non-conventional sources – such as those produced from shale and tight sands formations. Both outlooks expect that oil will continue to be the single largest component of primary energy demand throughout most of the projection period, although its share as a proportion of total fuels will fall.

Energy and environmental policies will be key variables to watch over the forecast horizon, along with potential technological changes and adjustments to economic growth assumptions.

A Note on Tight Oil

The IEA WEO report expects global production of crude oil and condensate from shale and tight formations to reach over 4.5 mb/d by 2025, subsequently declining to 3.7 mb/d by 2025. The OPEC Reference Case sees US shale oil supply increasing rapidly during the current decade to reach 2.0 mb/d by 2020, but expects its growth pace will slow afterward – with global shale oil supply expected to be at a level of 3.0 mb/d by 2035. Both outlooks acknowledge that the development of shale and tight oil resources faces many challenges and obstacles.

The IEA and OPEC outlooks form their long-term oil price assumptions, which affect the projected pace of supply and demand growth, based on their expectations for marginal costs of oil supply – among other considerations. However, they have diverse views on the level of these marginal costs, which engender varying views on long-term oil price assumptions and investments.

1. Background and Introduction

The IEA and OPEC regularly publish energy and oil outlooks covering the short-, medium- and long-term. In addition, on the occasion of the International Energy Forum, each organisation contributes by submitting a focused energy analysis to be presented to IEF Ministers.

The First and Second Joint IEA-IEF-OPEC Symposia on Energy Outlooks were convened in Riyadh on 24 January 2011 and on the 23-24 January 2012, respectively. The Symposia noted that methodologies and definitions are important factors in identifying the reasons behind differences in the outlooks.

The two meetings provided a diversity of well-informed views from distinguished experts. Participants discussed energy market trends (energy supply, demand and prices) and associated drivers that influence these trends (environmental policies, economic conditions, and technological developments). They recommended harmonising definitions where possible and appropriate, and disclosing more data in a timely manner to enhance the comparability between the IEA and OPEC outlooks.[2]

Symposia participants acknowledged that better crude and products stocks data, particularly from countries experiencing high demand growth, would help in analysing short-term oil market behaviour and in reducing uncertainty over demand levels. More data on liquid supply, including NGLs, would also be welcome.

They recommended exploring the possibility of future joint meetings and/or Symposia to focus on more technical areas of shared interest, to help make the outlooks more directly comparable through a better understanding of points such as these:

- Differences in historical data;
- Uniform definitions of geographic regions;
- Non-OECD demand forecasts;
- Assumptions regarding energy intensity;
- Assumptions related to demand growth in some countries and regions, such as China, India and the Middle East;
- Assumptions and categorisations of costs, long-term price, bunker fuels, elasticity of supply and demand, and conversion factors;
- Outlooks concerning NGLs, unconventional oils and biofuels;
- The way in which data and information, including on upstream and downstream capacity expansion plans, are shared.

Finally, they suggested that similar events covering short-, medium- and long-term energy outlooks be held on a regular basis to help promote understanding, transparency and dialogue.

The Third IEA-IEF-OPEC Symposium on Energy Outlooks, to be held on 22 January 2013 at the IEF Secretariat in Riyadh, will offer a platform for sharing insights and exchanging views about energy market trends and short-, medium- and long-term energy outlooks, including analysis of market behaviour and discussion of key drivers of the energy

[2] Joint IEA-IEF-OPEC Report on the 1st Symposium Energy Outlooks, January 2011.
Joint IEA-IEF-OPEC Report on the 2nd Symposium Energy Outlooks, January 2012.

landscape and associated uncertainties. In addition, this year's Symposium will involve in-depth discussions on two important themes: oil inventories in non-OECD countries and the outlook for tight/shale oil.

The Symposium is part of a wider joint programme of work agreed by the three organisations and endorsed by energy Ministers at the 12th International Energy Forum (Cancun, March 2010) as part of the Cancun Declaration[3].

This introductory paper provides a comparison of various IEA and OPEC energy outlooks. It discusses technical issues related to demand, stocks, downstream and supply. It aims to accomplish the following objectives:

- Identify the similarities and major differences among the IEA's and OPEC's short-, medium- and long-term outlooks in terms of economic, demand and supply projections;
- Highlight the similarities and major differences between the assumptions used in determining the projections; and
- Note areas where improved comparability and understanding of the similarities and differences could be useful.

The comparison focuses on the short-, medium- (to 2016) and long-term (to 2035) projections. The publications and outlooks analysed are outlined below in Diagram 1.

Diagram 1: List of IEA and OPEC Outlooks analysed herein

	IEA	OPEC
Short-term	Oil Market Report (OMR), published December 2012	Monthly Oil Market Report (MOMR), published December 2012
Medium-term	Medium-Term Oil Market Report (MTOMR), published October 2012	World Oil Outlook (WOO 2012), published November 2012
Long-term	World Energy Outlook (WEO), published November 2012	World Oil Outlook (WOO 2012), published November 2012

2. Short-term Energy Outlooks

Given the clear link between economic performance and energy demand, this section addresses prospects for economic recovery in the world's major regions, reviews market developments from the past year, and covers the patterns of energy demand in major regions/countries. It also focuses on OPEC crude production, NGLs, recent developments in non-OPEC supply and future trends, as well as on the uncertainties surrounding the energy outlooks.

Key points from the IEA and OPEC short-term outlooks are summarised over the next few pages. As noted in Diagram 1, the IEA short-term projections are taken from IEA's Oil Market Report (OMR) published in December 2012 and OPEC's short-term projections are from its Monthly Oil Market Report (MOMR), also published in December 2012.

2.1 Economic Growth

The IEA report uses the International Monetary Fund (IMF) World Economic Outlook's gross domestic product (GDP) projections, alongside other secondary sources. OPEC's GDP data are assessed internally utilising a model-based approach, and incorporate a variety of sources including publications from both public and private institutions.

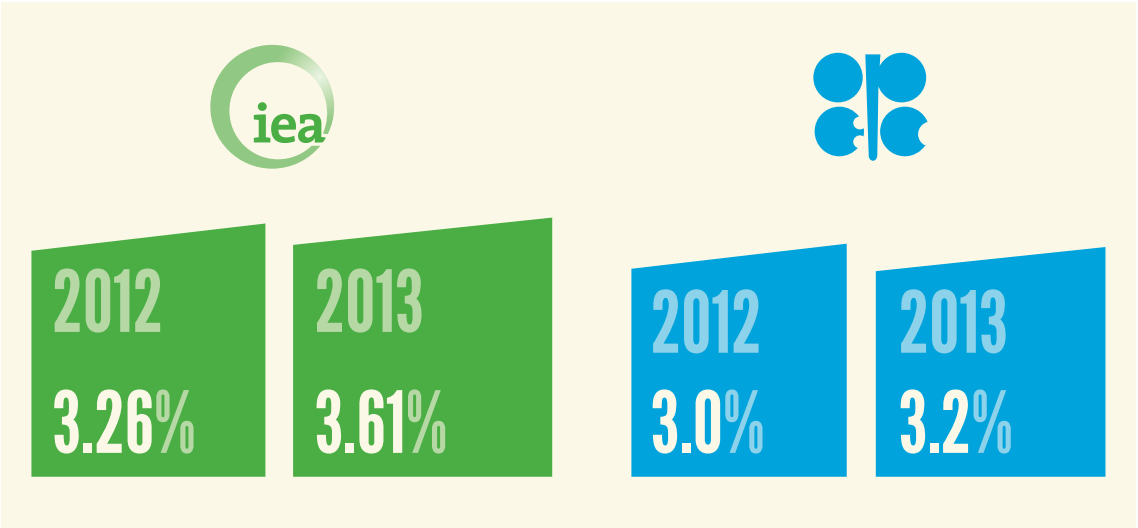
The two reports observe that in 2012 the global economy experienced another year of deceleration. They note that low growth and uncertainty in advanced economies are affecting developing economies through both trade and financial channels, adding to core weaknesses. This is mainly due to the sovereign debt crisis in the Eurozone, persistently high unemployment in some advanced economies, and inflation risks in the emerging economies. These developments contributed to the downward revision to world economic growth in 2012 and 2013. Both reports note that emerging economies continue to lead the way for global economic growth, but the rapid growth rates in recent years appear to be moderating to more sustainable levels.

Overall, both reports assume positive economic growth for 2012 and 2013, with no double-dip recession factored into base scenario projections. However, they warn that many uncertainties remain. Close monitoring of the following points is warranted: the Eurozone debt crisis, US fiscal issues, Japan's growth prospects, and slowing activity in developing economies. Finally, the two reports observe that some macroeconomic indicators suggest that the global economy turned the corner in the second half of 2012, and this positive momentum is likely to be carried over into 2013.

The IEA is slightly more optimistic than OPEC in its assumption for global economic growth prospects in 2012 and 2013 (See Diagram 2).

Diagram 2: Assumptions for Global GDP Growth (2012-2013)

The IEA is slightly more optimistic than OPEC in its assumption for global economic growth prospects in 2012 and 2013.



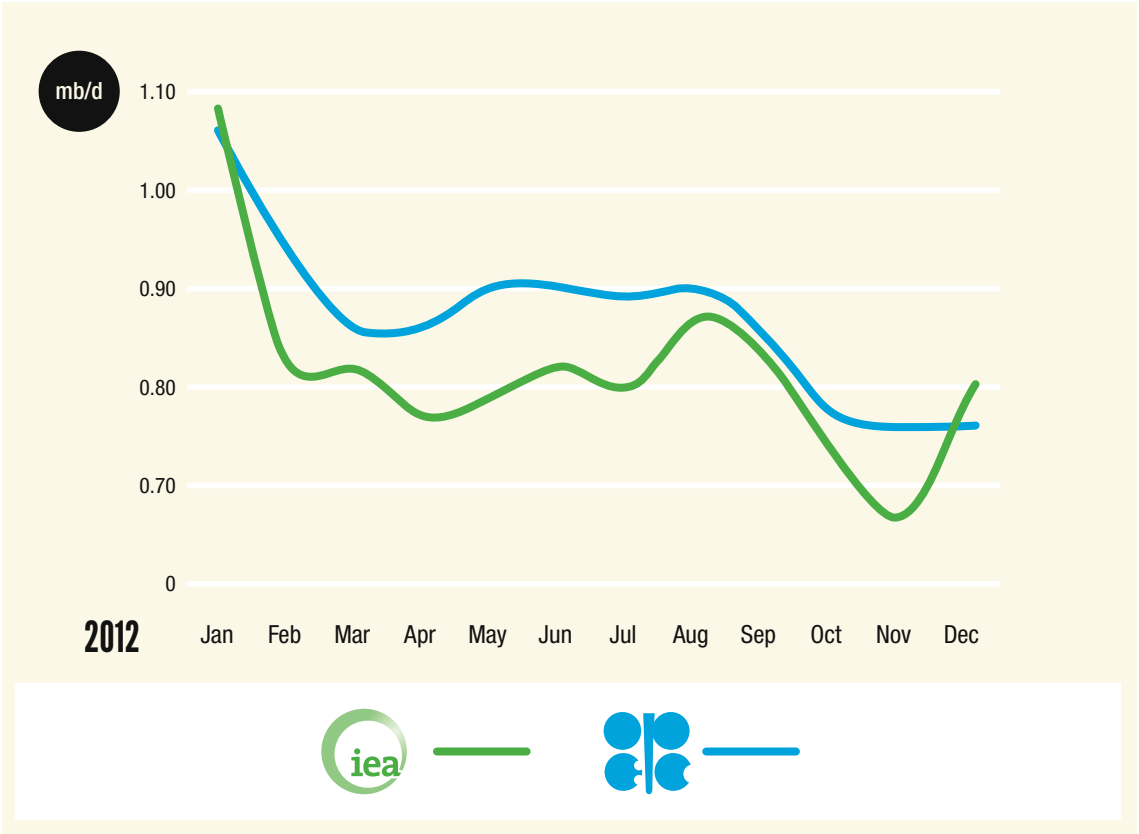
In light of economic uncertainty and a number of related cautionary signs, the IEA OMR also tests the impact on oil demand projections of a one-third lower GDP sensitivity.

2.2 Oil Demand

For the most part, during 2012 the IEA and OPEC continually adjusted their oil demand projections downward (Figure 1), driven mainly by the slowdown in global economic growth and tighter credit conditions (as well as weather related issues and revisions to baseline data). The main reason expressed for the slowdown of demand growth is the shaky state of the US and Eurozone economies, and efforts by China and India to moderate growth in fuel consumption. Unlike 2011, the downward revision to oil demand growth last year was not confined primarily to the Organisation for Economic Cooperation and Development (OECD) member economies, but occurred in China as well. In contrast, Japan's shutdown of almost all of its nuclear power plants led the country to rely more heavily on other types of energy – thereby boosting oil consumption.

Figure 1: IEA and OPEC Revisions of World Oil Demand Growth Projections for 2012

A weak macroeconomic performance and tight credit conditions drove the IEA and OPEC to adjust their oil demand projections downward during 2012.

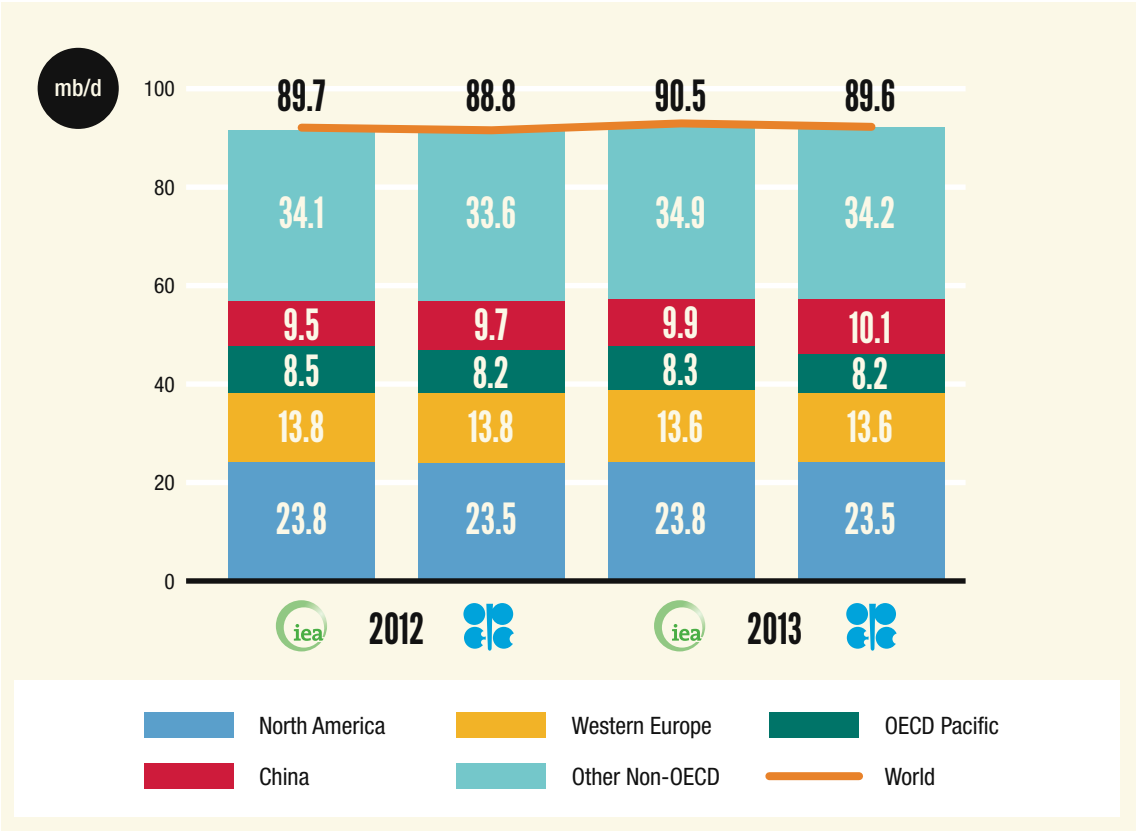


Despite downward revisions, global oil demand growth remains positive and has so far shown great resistance to weak global macroeconomic tides – attributing its entire growth to non-OECD countries. Both reports forecast healthy demand growth for 2012, and on into 2013.

As set forth in Diagram 3 and Figure 2, the IEA December 2012 report expects an increase in oil demand of around 0.79 mb/d in 2012, to reach 89.7 mb/d. OPEC's December 2012 report expects growth of 0.76 mb/d to a global demand total of 88.8 mb/d.

Diagram 3: 2012 Oil Demand Growth and Total Daily Demand (in mb/d)

Figure 2: World Oil Demand



Nevertheless, despite the uncertainty clouding the global economy, the IEA and OPEC expect demand growth to pick up slightly in 2013 versus 2012 (Figure 3). They both add the caveat that the high level of anticipated risk in the world economy in 2013 creates a large degree of uncertainty regarding their respective world oil demand assessments. Indeed, the balance of risks for the global economy and oil demand growth have increased over the past several months, amidst concerns about the two greatest threats to global economic and oil demand growth: the Eurozone debt crisis and US fiscal challenges.

Figure 3: Oil Demand Growth Forecasts

Oil demand growth in the non-OECD region -- mainly driven by China, India and the Middle East -- is expected to outpace a fall in oil demand from the OECD economies.

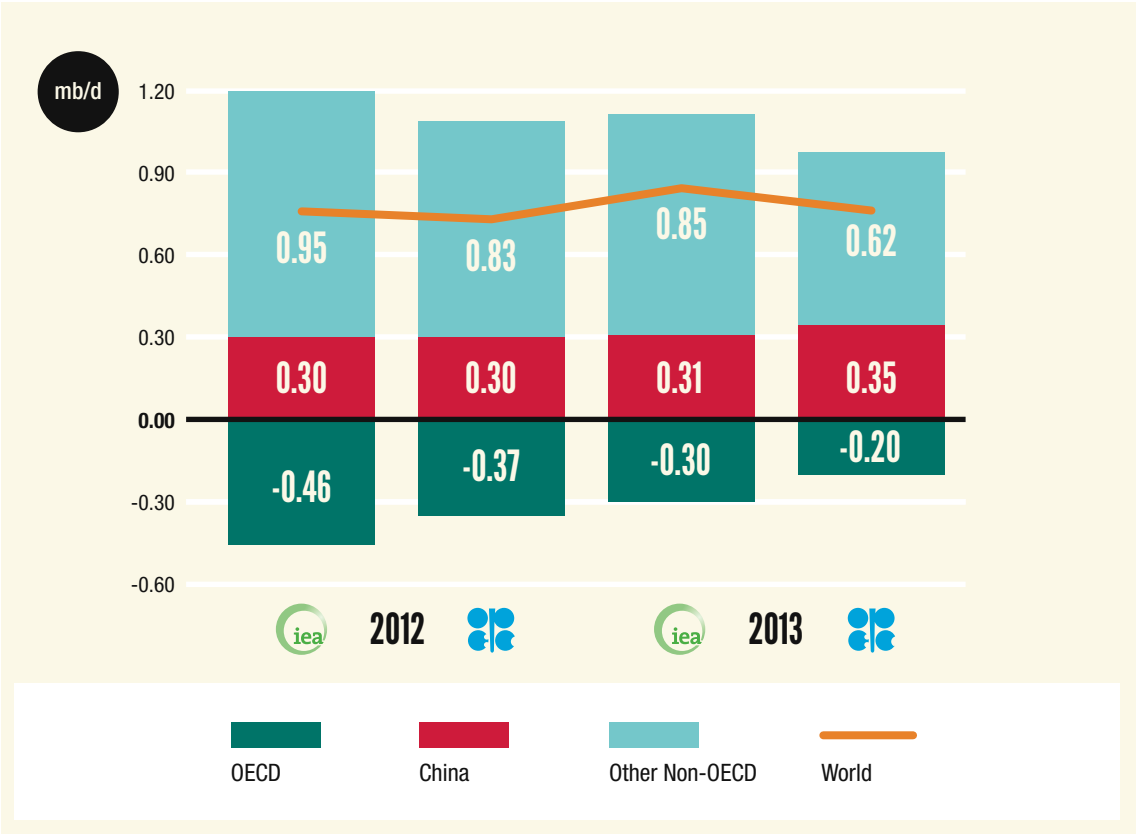


Diagram 4 below and Figures 2 and 3 highlight OPEC's and the IEA's oil demand growth expectations for 2013. Oil demand growth in the non-OECD region – mainly driven by China, India and the Middle East – is expected to outpace a fall in oil demand in the OECD region (Figure 3).

Diagram 4: 2013 Oil Demand Growth and Total Daily Demand (million barrels/day)

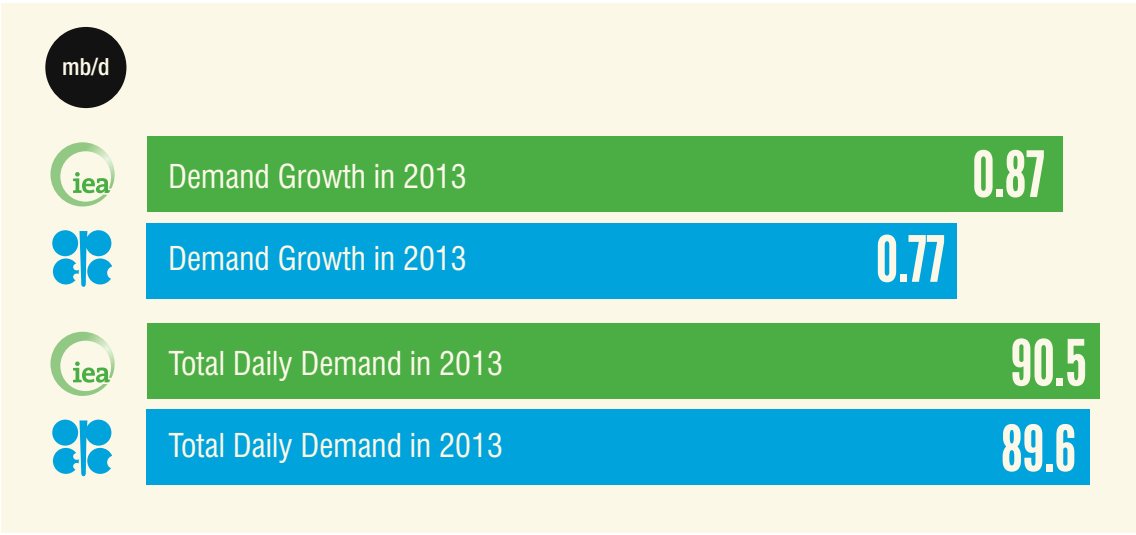
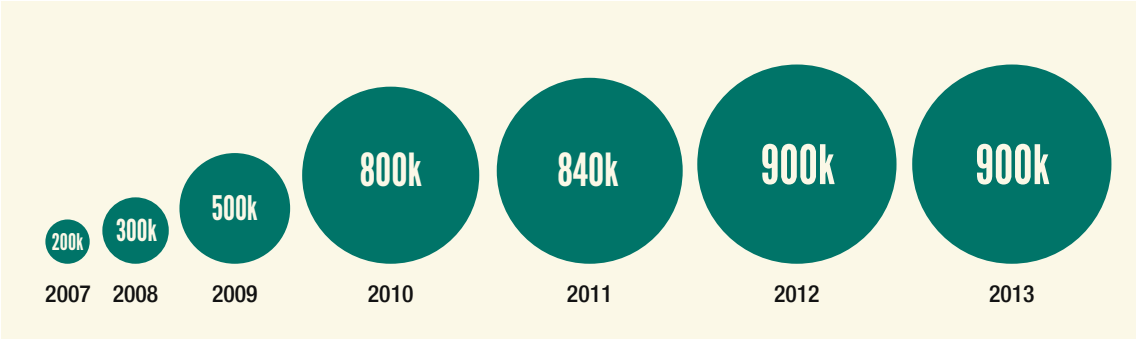


Diagram 5 highlights the fact that the gap between the IEA's and OPEC's global demand figures has risen steadily since 2007. Part of this trend can be explained by definitional differences in how demand is measured in some regions, and how stocks in apparent consumption are treated.

Diagram 5: Differences between IEA and OPEC Global Demand Figures (barrels/day)

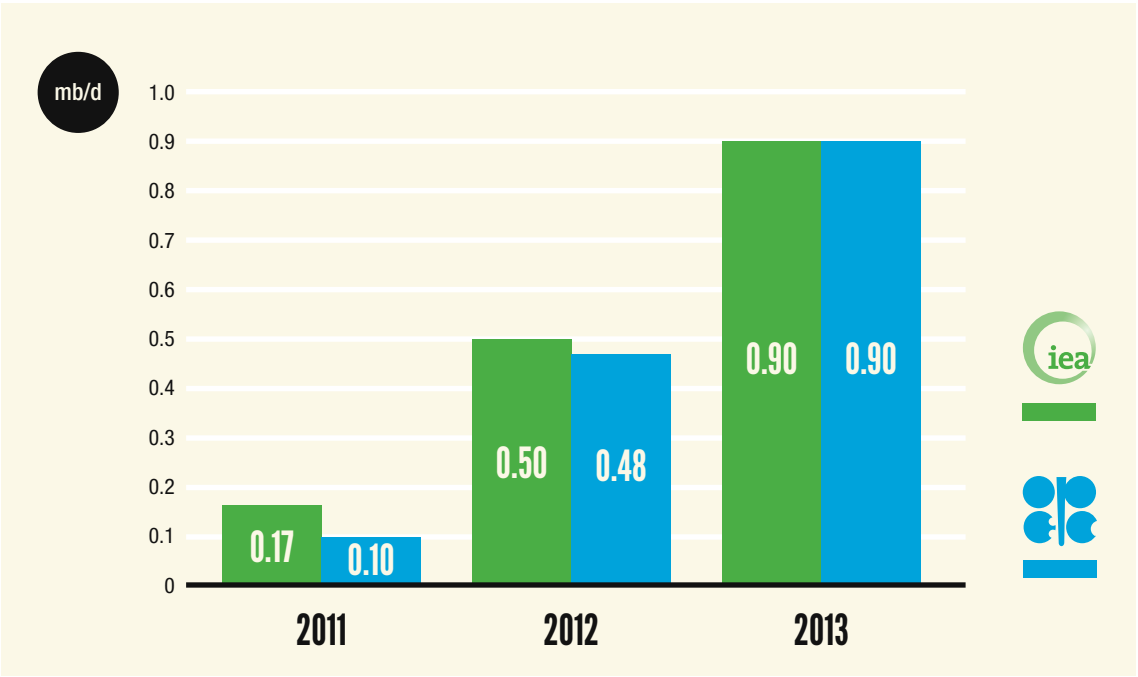
The gap between the IEA's and OPEC's global demand figures has risen steadily since 2007. Part of this trend can be explained by definitional differences in how demand is measured in some regions and how stocks in apparent consumption are treated.



2.3 Oil Supply

Figure 4 shows that the growth in non-OPEC supply in 2011 is fairly similar in both the OPEC and IEA reports. Weak growth in non-OPEC supply in 2011 is largely the result of unexpectedly high levels of production stoppages. Indeed, more than 600,000 b/d of non-OECD production capacity was off-stream over the second and third quarters of 2011, due to equipment failures in the North Sea, problems with up-graders in the Canadian oil sands, technical and fiscal issues in the Caspian, political unrest in the Middle East, strikes in Argentina and Gabon, and tropical storms in Australia.

Figure 4: Non-OPEC Annual Oil Supply Growth



In 2012, the IEA and OPEC reports continually adjusted their non-OPEC supply projections downward, mainly due to unexpectedly high levels of production stoppages (see Diagram 6 and Figure 5 below). Indeed, since the start of 2012, non-OPEC supply suffered various setbacks due to technical, geological, weather and geopolitical factors. In 2012, North America led supply growth (Figure 6), while supply from the OECD Western Europe, Africa, and the Middle East contracted.

Diagram 6: 2012 Non-OPEC Oil Supply Growth and Total Daily Supply

Figure 5: Revisions of non-OPEC Supply Growth Projections for 2012

Production stoppages help explain why the IEA and OPEC reports continually adjusted their non-OPEC supply projections downward in 2012.

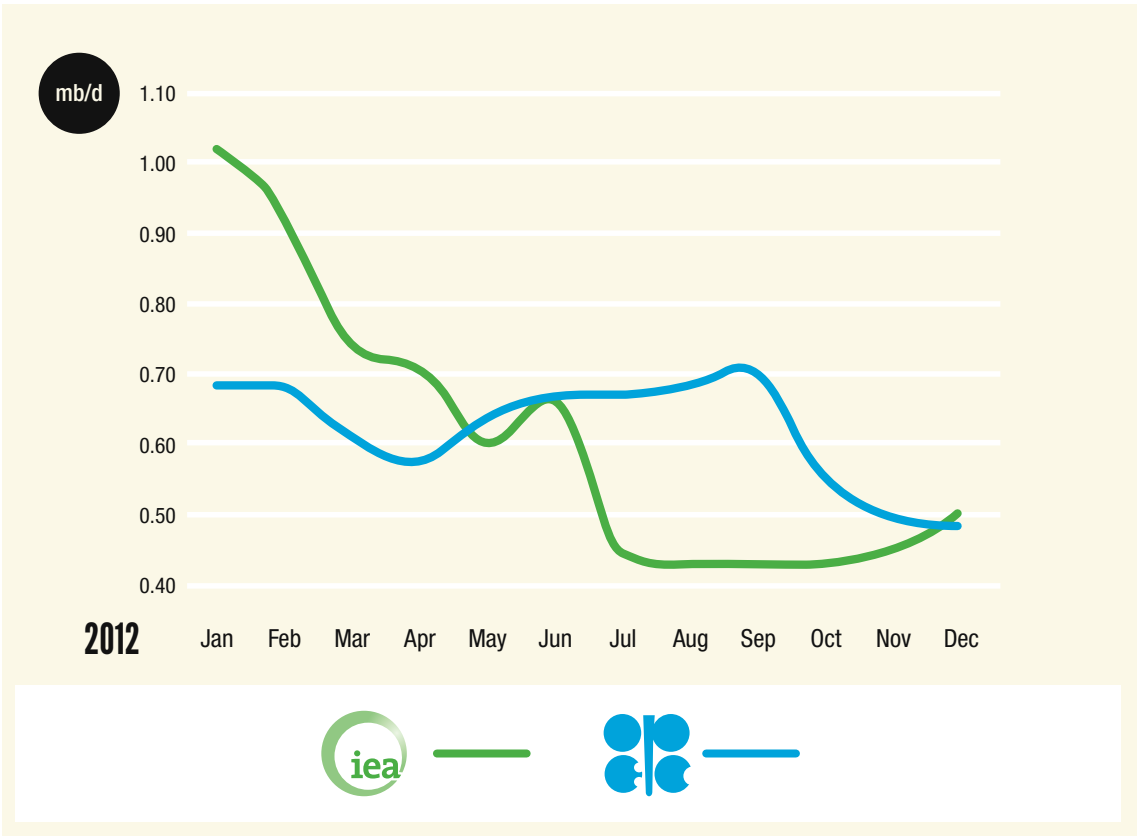
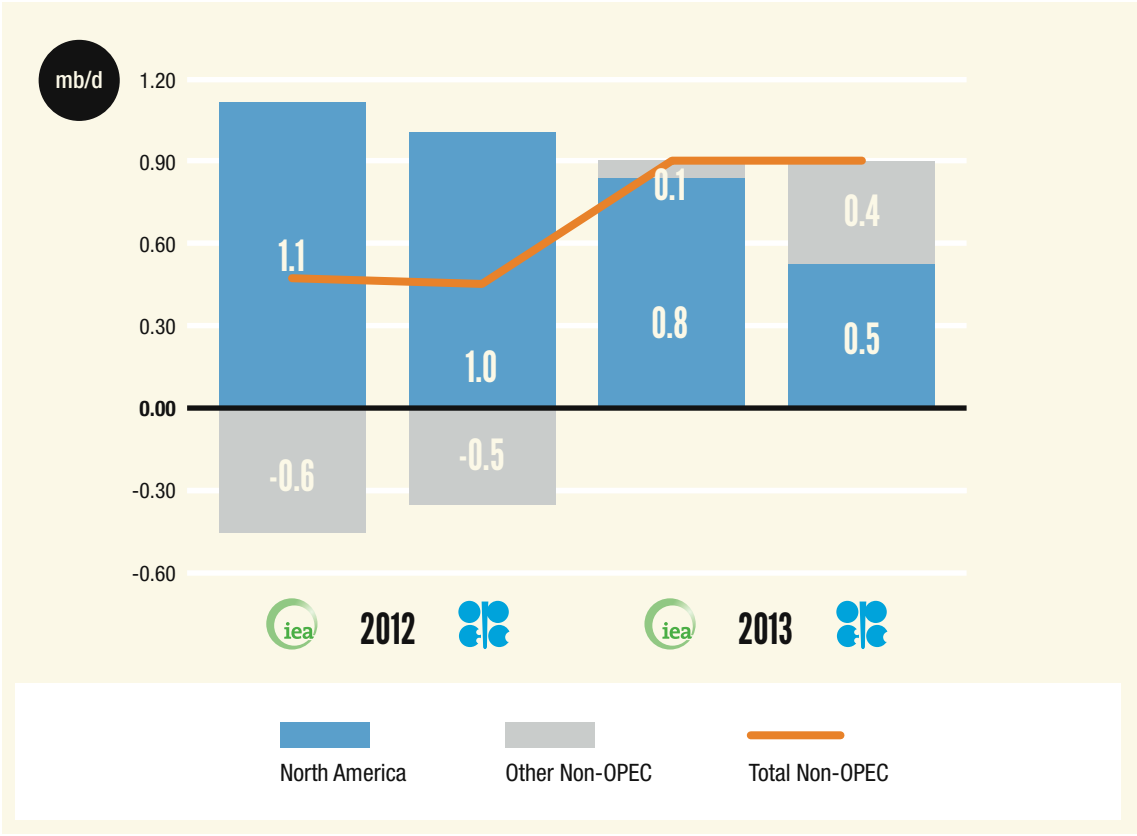


Figure 6: Non-OPEC Supply Growth by Region

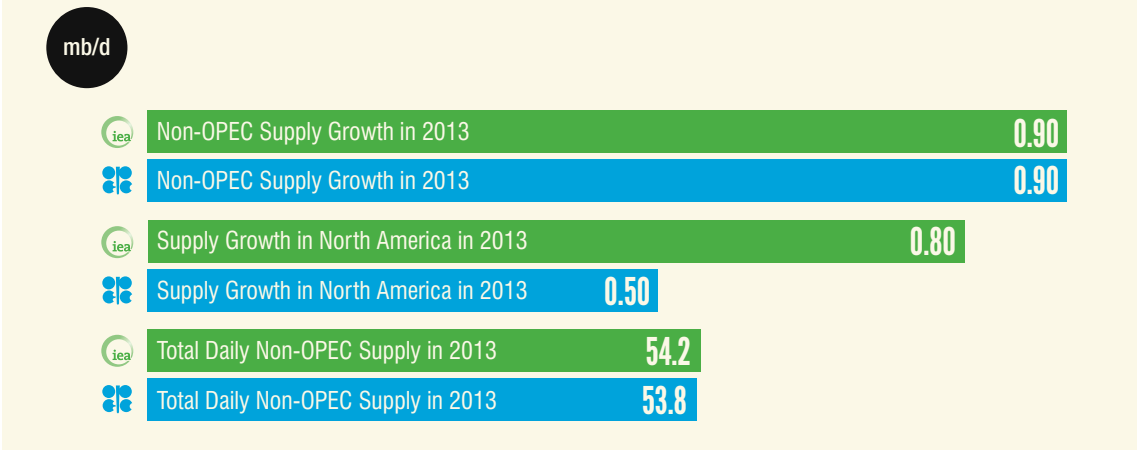
North America leads expected non-OPEC supply growth.



While many of the issues that affected non-OPEC supply in 2012 are still in play, the peak maintenance period has now passed. Further, the overall prospects for non-OPEC supply in 2013 look healthier than in 2012. The confluence of technical, geopolitical and structural problems that weighed on non-OPEC supply in 2012 is not assumed to repeat in 2013. The majority of production cutbacks in 2012 were attributable to unplanned outages in Sudan/South-Sudan, Syria, Yemen and the UK (the Buzzard field).

Both the IEA and OPEC reports forecast non-OPEC supply to increase in 2013, as highlighted in Diagram 7 below.

Diagram 7: 2013 Non-OPEC Oil Supply Growth and Total Daily Supply (mb/d)



Both reports note that output growth remains concentrated in few a non-OPEC countries including Brazil, Russia, Colombia, the US and Canada. Elsewhere, new developments are relatively much smaller (Figure 7). The IEA is rather more optimistic than OPEC on North American growth in 2013, with its supply increasing by 0.8 mb/d according to the IEA report versus 0.5 mb/d in OPEC's report, as shown in Figure 6.

Figure 7: Short-term World Oil Supply

Demand for OPEC crude is expected to decline in 2013, as expected increases in non-OPEC supply and OPEC NGLs will exceed demand growth.

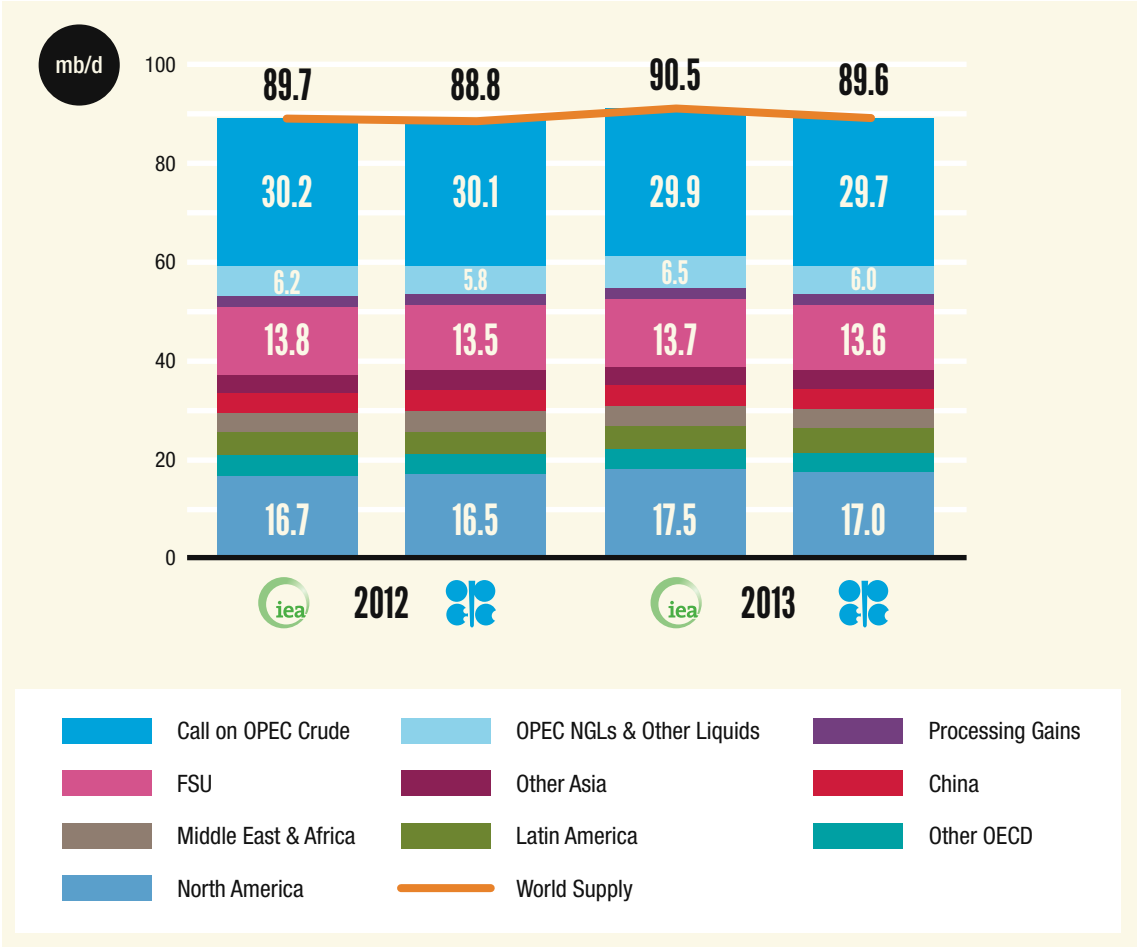


***Figure 7 Notes**: Biofuels are "re-included" in the countries and regions* [4]

As Figure 7 shows, the IEA expects OPEC NGLs and non-conventional oil supply to average 6.2 mb/d in 2012 and 6.5 mb/d in 2013, representing growth of 0.4 and 0.3 mb/d for 2012 and 2013 respectively – slightly higher than OPEC's figure. However, the absolute levels for 2012 and 2013 differ by around 0.5 mb/d for both years, as the IEA report reported more OPEC NGLs and other liquids in 2010 and 2011.

In addition, there is a gap of around 0.35 mb/d in the IEA's and OPEC's 2011 non-OPEC supply figures, which adds to the differences in 2012 and 2013. This difference stems mainly from differing views on the expected levels of North America and Russian production. Adding this figure to the difference in the OPEC NGLs mentioned in the above paragraph will result in a difference of more than 0.8 mb/d in the IEA and OPEC annual supply projections. That said, in general their forecasts for demand for OPEC crude in 2013 are very similar, as both expect this level will help balance the oil markets during the year and will allow daily stocks

[4] For the IEA report, the IEF re-included biofuels in the countries and regions to make it comparable with OPEC's report.

to be replenished – given that demand growth is expected to continue to remain weak. For the whole of 2013, the IEA expects global demand for OPEC oil and/or stock change to be at 29.9 mb/d, while OPEC forecasts demand for OPEC crude at 29.7 mb/d.

On the supply side, both short-term outlooks for 2013 are quite comparable, and the incremental oil demand in 2013 should be met by the increase in non-OPEC supply and OPEC NGLs. In addition, both outlooks envisage that there is sufficient spare capacity in place to offset any unforeseen production losses or increase in demand.

3. Medium-term Outlooks

As noted in Diagram One, the IEA medium-term projections presented herein are taken from the IEA Medium-term Oil Market Report (MTOMR) published in October 2012, and from OPEC's World Oil Outlook 2012 published in early November 2012. OPEC's mid-term projection range is through 2016, which is the comparison year used in this paper. The IEA presently takes its medium-term projections out to 2017.

3.1 Oil Prices and Economic Growth

Medium-term economic growth outlooks are based primarily on IMF projections, with some adjustment to reflect information available from regional, national and other sources. The IEA report assumes that the pattern of global economic growth shows slower output in the short-term (3.26% in 2012) before strengthening through the remainder of the forecast period (growing by an average of 4.0% annually during 2013-2017).

The key difference between the two reports over the medium-term stems from assumptions about expected economic growth in non-OECD countries.

OPEC's WOO 2012 assumes that the global economy grows by 3.0% in 2012, and thereafter by an average of 3.6% per annum through 2016. However, it is assumed that decisive policy action is taken in a timely manner to ensure the global economy remains on the path of recovery. The key difference between the two reports over the medium-term stems from assumptions about expected economic growth in non-OECD countries. The IEA assumes more growth for China, India and Eurasia than OPEC does.

OPEC's WOO 2012 assumes that the OPEC Reference Basket nominal price will remain at an average of $100/bbl over the years in the medium-term, which is $10/bbl higher than in last year's outlook.

The oil price assumptions of both the IEA and OPEC over the medium-term are somewhat different. The IEA medium-term update employs a crude oil price assumption that is some $11 per barrel lower for 2017 than the level assumed in the IEA's June 2011 medium-term outlook, with nominal Brent crude expected to fall from $107/bbl in 2012 through to $89/bbl in 2017 (based on the prevailing futures strip). OPEC's WOO 2012 assumes that the OPEC Reference Basket nominal price will remain at an average of $100/bbl over the years in the medium-term, which is $10/bbl higher than in last year's outlook.

3.2 Medium-term Oil Demand

Both the IEA and OPEC expect robust growth in global oil demand over the medium-term, though the IEA projection is higher than OPEC's figure by around 1.6 mb/d by 2016 (Figure 8). The higher IEA demand figures can be traced to the difference in the base year demand level mentioned earlier.[5] In terms of demand growth, the IEA's medium-term projection is higher than OPEC's growth figure by 0.4 mb/d, despite the IEA's assumptions for higher economic growth.

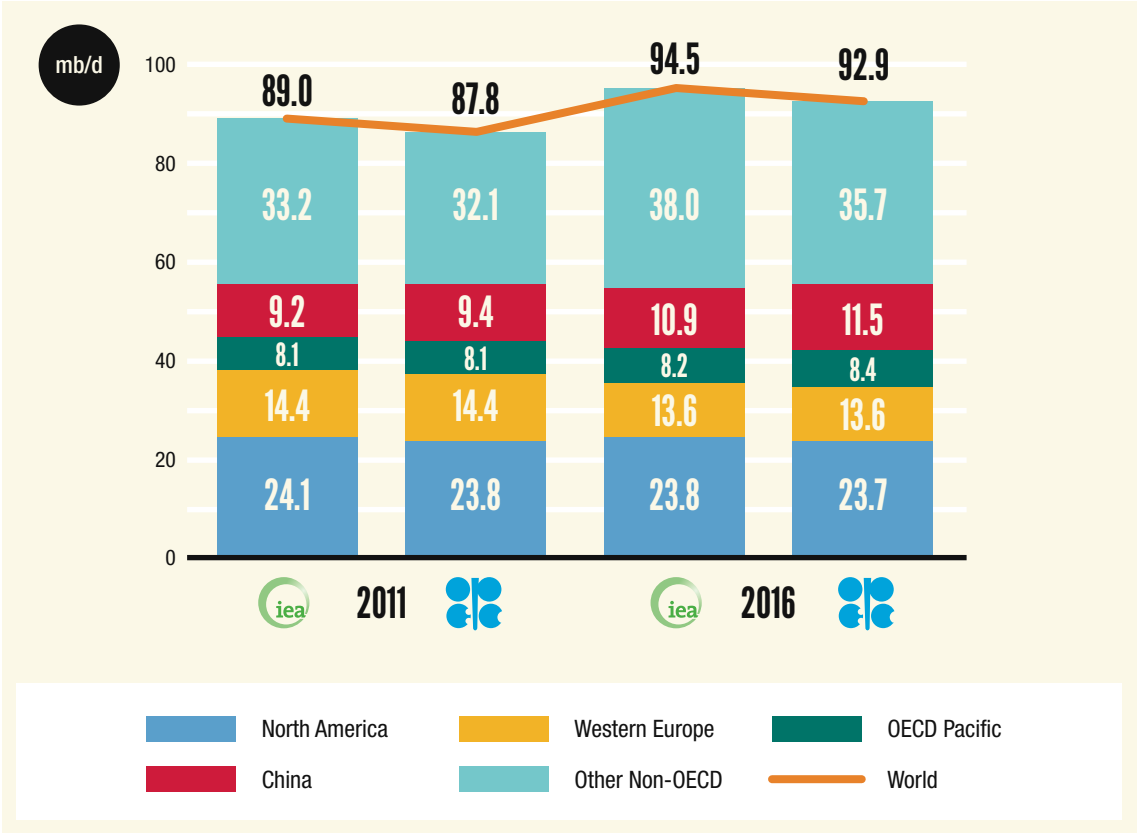
The IEA expects global oil demand to average 94.5 mb/d by 2016, representing average annual growth close to 1.1 mb/d over the years to 2016, while OPEC puts 2016 global oil

[5] The difference between IEA and OPEC's global demand figure for the base year (2011) is around 0.8 mb/d.

consumption at 92.9 mb/d, which translates to annual average growth of just over 1.0 mb/d through 2016. The OPEC WOO 2012 expects medium-term global oil demand to be 1.0 mb/d lower than expected in the WOO 2012, citing lower economic growth than it expected in the previous year's report. The biggest factor sending demand growth downward is China's projected economic performance.

Figure 8: Medium-term Oil Demand Outlook

The IEA and OPEC expect robust growth in medium-term global oil demand, driven by non-OECD countries.



At the regional level, both the IEA and OPEC expect oil demand to be driven by non-OECD countries. However, expected growth in non-OECD countries differs, creating a difference in the oil demand projections at the regional level. As shown in Figure 8, the IEA projection for demand in non-OECD countries (China plus other non-OECD) in 2016 is 1.7 mb/d greater than OPEC's projection – although part of this is can be explained by differences in historical data.

For other non-OECD countries, comparing regional breakdowns among specific non-OECD regions is challenging, as OPEC defines its member countries as a unified region, while the IEA classifies OPEC members within their respective geographical regions (for example, OPEC excludes Venezuela and Ecuador from its Latin America figures, as both countries are included in the consolidated OPEC figure). The IEA report expects that the total non-OECD oil demand will overtake OECD oil demand by 2014, while OPEC expects this shift to occur in 2015.

When considering the OECD region through 2016, the IEA expects oil demand in OECD countries to decline more steeply than OPEC does, with a 1.1 mb/d decline in IEA projections from 2011 to 2016 versus 0.6 mb/d for OPEC. Again, the biggest difference stems from the

short-term growth for 2012 and 2013. Within the OECD region, most of the difference in expected demand in 2016 stems from differing views on projections of North America demand growth.

3.3 Medium-term Oil Supply

Over the medium-term, the IEA and OPEC both project high growth in the global oil supply to meet the expected demand increase by 2016. However, their medium-term global oil supply forecasts differ by around 1.6 mb/d (shown in Figure 9 as 1.5 due to rounding) through 2016, in line with their different views on oil demand (Figure 9).

Figure 9: Medium-term Global Oil Supply Outlook

The IEA and OPEC both project high growth in the global oil supply over the medium-term, though demand for OPEC crude will stay relatively flat.

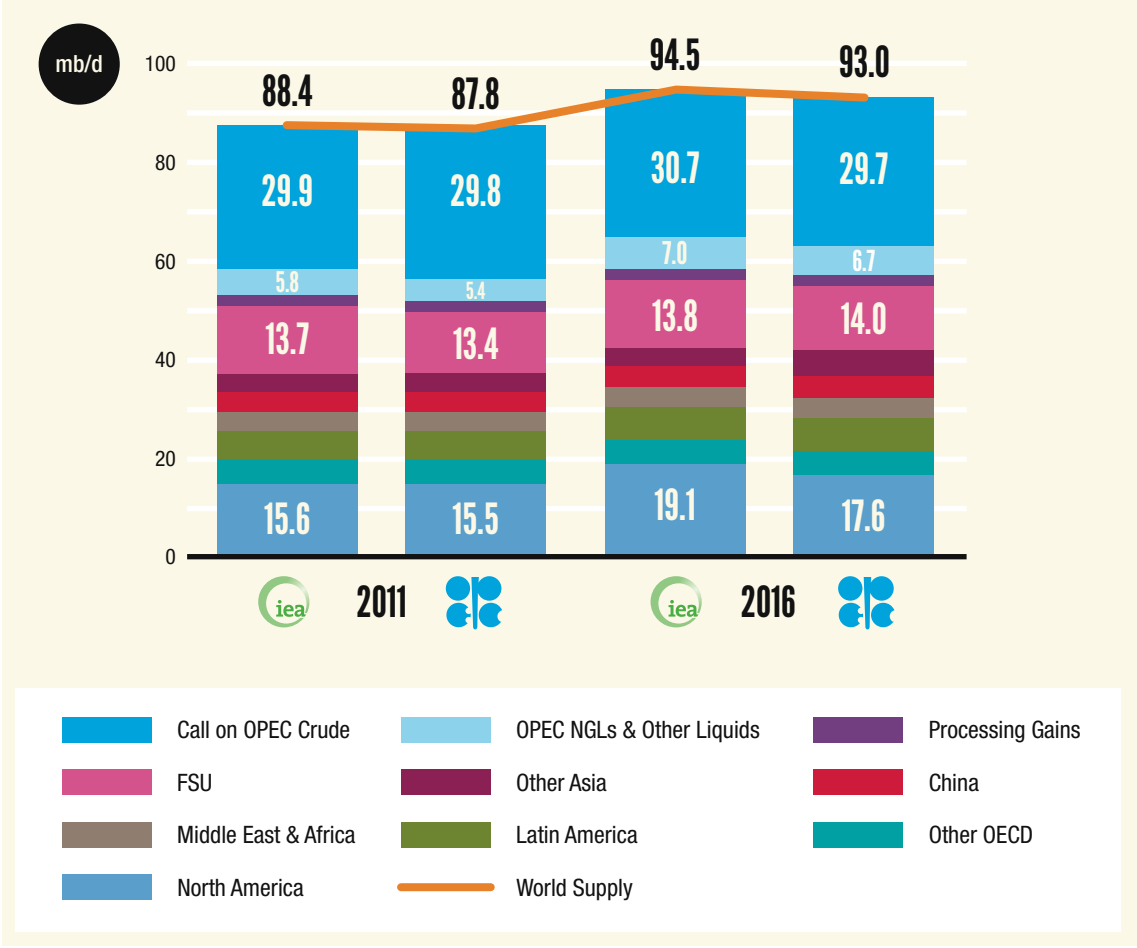


***Figure 9 Notes**: Biofuels are re-included in the countries and regions* [6]

[6] For the IEA report, we re-included the biofuels in the countries and regions to make it comparable with OPEC's report.

Figure 10: Medium-term non-OPEC Supply Outlook

The IEA and OPEC have differing views on expected supply growth in North America.

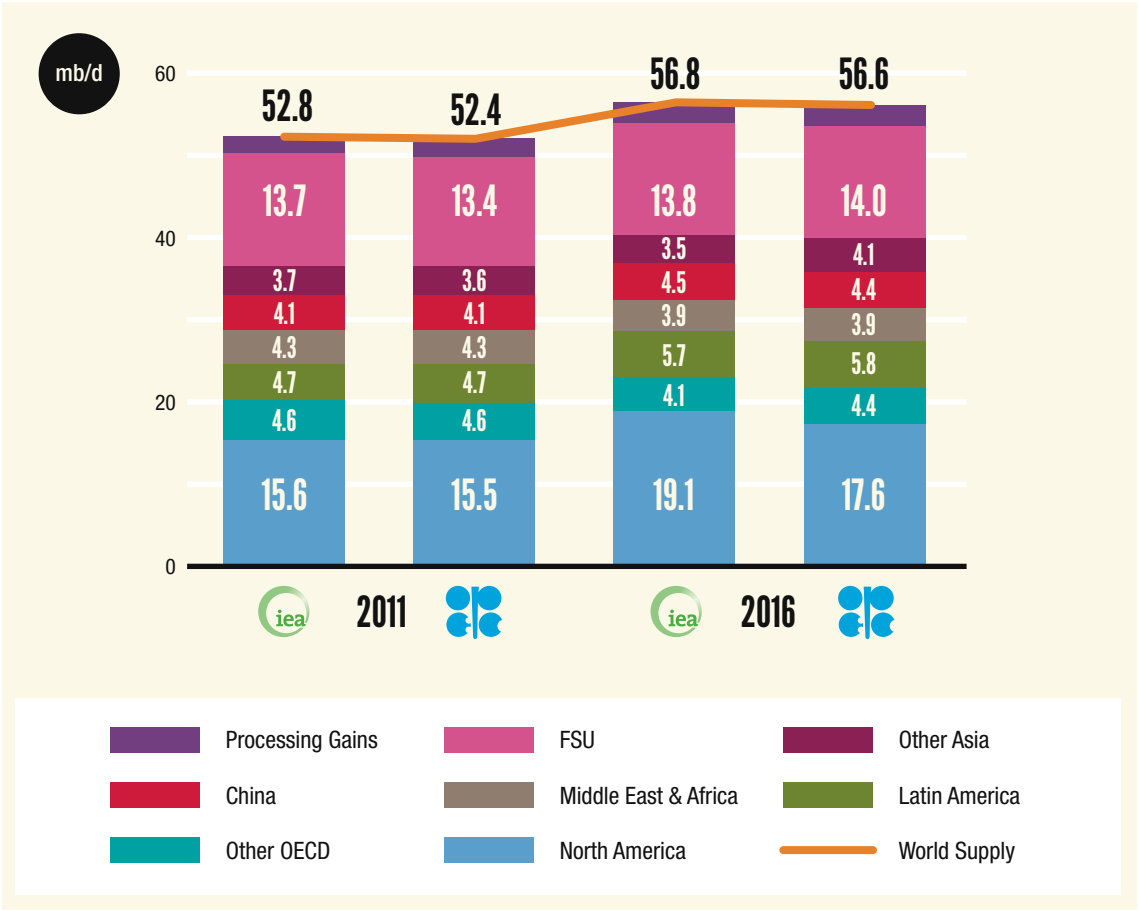


***Figure 10 Notes**: Biofuels are re-included in the countries and regions* [7]

Figure 10 shows that the IEA and OPEC have similar projections regarding growth in non-OPEC supply over the medium-term, with the IEA expecting it to reach 56.8 mb/d by 2016 versus OPEC's 56.6 mb/d. Both reports project more or less the same growth in non-OPEC supply of around 4.0 mb/d (OPEC slightly higher at 4.2 mb/d) by 2016, or around 0.8 mb/d per year from 2011 to 2016. The minor difference in absolute terms is due to the difference in non-OPEC supply figures used by the IEA and OPEC for the base year, 2011.

At the regional level, the differences between IEA and OPEC projections through 2016 are substantial in some cases and small in others. For example, there is a difference of around 1.4 mb/d between the OPEC's WOO and IEA's MTOMR projections for supply from the US and Canada, compared to an overall difference in supply projections for non-OPEC regions of 0.2 mb/d. On the other hand, OPEC's medium-term projection for the Middle East & Africa, other FSU and other Asia regions is around 0.9 mb/d higher than the IEA's medium-term forecast for these regions.

Over the medium-term, the IEA report expects 3.9 mb/d growth from Canada and the US, 1.0 mb/d from Brazil and Colombia, and 0.7 mb/d from China, other FSU and processing gains, while it sees Mexico, Western Europe, Middle East & Africa and other Asia declining by 0.3, 0.5, 0.4 and 0.2 mb/d respectively. The IEA report cites the mature field decline and/or investment uncertainty as explanations for declines in these regions.

[7] For the IEA report, we re-included the biofuels in the countries and regions to make it comparable with OPEC's report.

Diagram 8: Regional Medium-term (2011 through 2016) Annual Supply Growth (mb/d)

	IEA	OPEC	DIFFERENCE
North America	3.5	2.1	1.5
Other OECD	-0.5	-0.2	-0.2
Latin America (mainly Brazil & Colombia)	0.9	1.1	-0.2
Middle East & Africa	-0.4	-0.4	0.0
China	0.3	0.3	0.0
Other Asia	-0.2	0.5	-0.6
FSU	0.1	0.6	-0.5
Processing gains	0.2	0.3	-0.1
OPEC NGLs & other liquids	1.2	1.3	-0.2
Call on OPEC Crude	0.8	-0.1	0.9

On the other hand, OPEC's report expects 2.6 mb/d growth over the period 2011-2016 from Canada and the US (1.4 mb/d less than the IEA report), another 1.1 mb/d from Latin America (mainly Brazil and Colombia), and 0.4 mb/d from other FSU. It also expects 1.3 mb/d growth coming from China, other Asia, Russia and the processing gains. OPEC's report expects a 0.8 mb/d decline from Western Europe and Mexico.

The 1.4 mb/d difference between the two reports regarding supply growth from the US and Canada stems mainly from differing views on the shale/tight oil supply outlook, with the IEA report more optimistic. Looking at the US, the IEA expects the production of crude oil and condensate from shale and tight formations to increase by 2.5 mb/d over the medium-term, from 0.84 mb/d in 2011 to 3.3 mb/d in 2017; in addition, the IEA sees these volumes driving a 5% annual increase (0.8 mb/d in total) in NGLs supplies. OPEC expects the production of US crude oil from shale oil to reach 2.0 mb/d by the end of the decade.

The IEA expects OPEC NGLs and non-conventional supply to average 7.0 mb/d by 2016, representing growth of 1.2 mb/d over the forecast period. This growth is slightly lower than OPEC's growth figure of 1.3 mb/d. While the absolute levels for 2016 differ by some 0.3 mb/d, (Figure 9), this is largely because the IEA reports more OPEC NGLs and other liquids in 2011.

OPEC expects the call on OPEC crude to stay flat over the medium-term forecast period, at around 29.8 mb/d. While the IEA report expects the call on OPEC crude to rise slowly over the medium-term (from 29.9 mb/d in 2011 to 30.7 mb/d by 2016), it also projects a larger increase in oil demand than OPEC over the medium-term.

The IEA and OPEC are both expecting an increase in OPEC crude production capacity over the medium-term through 2016, but with slightly different assessments of the level of capacity increase. The IEA expects OPEC crude capacity to increase by 3.34 mb/d, from 2011 to 2016 (from 34.21 mb/d to 37.55 mb/d) versus close to 4.0 mb/d from OPEC.

Consequently, OPEC foresees a steady increase in OPEC spare capacity over the medium-term (reaching close to 8.0 mb/d by 2016). OPEC's outlook is around 1.0 mb/d higher than the IEA's estimate; the IEA expects implied OPEC spare capacity to reach 6.9 mb/d by 2016. However, if we consider the IEA effective spare capacity figure, the difference will reach around 2.0 mb/d by 2016. According to the IEA report, Iraq will account for more than 50% of the increased capacity, followed by Libya (mainly due to recovering after recent turmoil), the UAE and Angola.

The variations in medium-term OPEC spare capacity figures put forward by the two organisations can be explained by the differences in their demand level forecasts for the call on OPEC crude and the IEA's use of the concept of effective capacity – which has the effect of lowering nominal spare capacity by about 1.0 mb/d. [8]

Both reports foresee an easing of tightness in the world oil market in the medium-term, with greater OPEC spare production capacity, OPEC NGLs, non-conventionals and non-OPEC supply.

4. Long-term Energy Outlooks

This section addresses assumptions behind the IEA's and OPEC's long-term outlooks including population growth, price patterns, economic growth, energy and environmental policies, and technological developments. The section also covers issues related to non-conventional resources, shale oil, second generation biofuels, peak oil (in supply and demand), investment levels, decline rates, oil intensity, energy efficiency, sources and quality of data, and several other factors.

This part of the paper will also cover energy demand growth in the OECD region, the regional shift in energy demand toward emerging markets (non-OECD region), and the impact of energy and environmental policies on energy outlooks and markets.

Again, the long-term projections from the IEA are taken from the World Energy Outlook (WEO) and from OPEC's World Oil Outlook (WOO), both released in November 2012.

4.1 Basic Assumptions for the Long-term Outlooks

The IEA's WEO 2012 maintained the **New Policies Scenario** as its central outlook. This scenario takes into account recent government policy commitments announced by countries worldwide aimed at tackling environmental and energy-security concerns, even though in some cases the specific measures to implement high-level commitments have yet to be defined. In addition to the New Policies Scenario, the WEO presents three other scenarios, differentiated by underlying assumptions about government policies:

- **Current Policies Scenario**: assumes no new policies are added to those in place as of mid-2012;
- **450 ppm Scenario**: assumes implementation of the high-end of national pledges and stronger policies after 2020 to limit the concentration of greenhouse gases in the atmosphere to 450 parts per million (ppm) of CO_2 equivalent;
- **Efficient World Scenario**: assumes that all energy efficiency investments that are economically viable are made, and all necessary policies to eliminate the market barriers to energy efficiency are adopted.

[8] IEA's concept of effective spare capacity is based on the assumption that over the last decade around 1 mb/d of nominal spare capacity in some OPEC countries has not been available to the market for different reasons.

The WEO 2012 emphasises that none of the scenarios it presents should be interpreted as forecasts. Instead, they should be viewed as a set of internally-consistent projections.

The Reference Case in the OPEC WOO 2012 is defined similarly to the previous version of the WOO. It retains the assumption that only policies that are already in place influence future supply and demand patterns. In addition to the Reference Case, the WOO presents three other scenarios addressing future demand for OPEC crude oil:

- **Lower Economic Growth** (LEG) looks at the impact of lower economic growth, both in the medium-term (largely as a result of the on-going Eurozone debt crisis and Chinese growth slowdown) and in the longer term;
- **Higher Economic Growth** (HEG) acknowledges that there is indeed upside potential for economic growth, and explores what this might imply for OPEC oil;
- **Liquids Supply Surge** (LSS) estimates possible impacts on OPEC crude if the overall supply of liquids is higher than estimated in the Reference Case.

4.1.1 Population Growth

The IEA and OPEC outlooks use consistent demographic assumptions based on data from the Population Division of the United Nations Department of Economic and Social Affairs. Both the IEA and OPEC expect that most of the population growth through 2035 will occur in developing countries, although the rate of expansion will gradually decline in some regions and accelerate in others. They also both point to the higher proportions of populations in urban areas, with the notable exception of Africa. This urbanisation trend will have significant implications on demand for energy services. OPEC's WOO also emphasises the importance of the changing age structure of populations, and the impact this phenomenon will have on the growth of working age populations. In all IEA and OPEC scenarios, world populations are expected to grow from an estimated 6.9 billion in 2010 to around 8.6 billion in 2035, an average growth rate of 0.9% per year.

4.1.2 Oil Price Assumptions

In projecting supply and demand, an important assumption is the expected price of crude oil over the forecasting period. It is important to note that price assumptions differ from price forecasts in that price assumptions are determined by a bottom-up approach designed to identify prices needed to generate sufficient investment in supply to meet projected demand.

OPEC Reference Basket: a weighted average of oil prices collected from the 12 Member Countries. This average is determined according to the production and exports of each country and is used as a reference point by OPEC to monitor worldwide oil market conditions.

The price assumptions in the IEA WEO are based on the average IEA crude oil import price[9] as a proxy for international oil price. In the OPEC WOO, assumptions are based on the OPEC Reference Basket (ORB) crude oil price.

In the IEA WEO New Policies Scenario, oil prices are assumed to rise steadily to $146/barrel in 2020 and $215/barrel in 2035 (both figures in nominal terms), reflecting higher production costs. In the Current Policies Scenario, the IEA assumes that the price rises more rapidly to $250/barrel (nominal terms) in 2035, reflecting increasing marginal costs – as more supply is needed to balance higher demand. Prices would rise more slowly in the 450 ppm Scenario to $172/barrel (nominal terms) in 2035 on lower demand. The IEA reaches these price assumptions by a process of iteration guided by expert opinion to balance the demand and supply models. Price is in effect an input to both the demand and supply model.

[9] Crude oil import prices come from the Crude Oil Import Register. Information is collected according to type of crude and average prices are obtained by dividing value by volume as recorded by customs administrations for each tariff position. Values are recorded at the time of import and include cost, insurance and freight (CIF) but exclude import duties.

The OPEC WOO Reference Case assumes a nominal price that remains at $100/barrel over the medium-term, before rising with inflation to reach $120/barrel by 2025. In the longer term, real prices are set to rise slightly and nominal prices thereby reach $155/barrel by 2035. The key basis for making such assumptions for the Reference Case's medium- to long-term outlook remains the perception of how the costs of supplying the marginal barrel might evolve, as well as the effects of depletion, an increasing supply of oil from more remote and harsher environments, and the impacts of stricter environmental protection on costs. The extent to which these costs rise is mitigated by the impacts of continued technological developments.

The price assumptions in both the IEA WEO 2012 and OPEC WOO 2012 have risen in comparison to the prior year's outlooks. The IEA and OPEC outlooks form their oil price assumptions based on their expectations of the marginal cost of oil supply, among other factors. However, they have diverse views on the level of these marginal costs, which is one key factor that contributes to differences in long-term oil price assumptions.

4.1.3 Economic Growth & Comparing Projections

Assumptions about economic growth are important in determining oil supply and demand projections, and there are some challenges in comparing the GDP growth rates utilised by the IEA WEO and OPEC WOO. First and foremost, the outlooks define geographical regions differently. Second, there are differences in the base year period. These difficulties were also highlighted during the First and Second IEA-IEF-OPEC Symposia on Energy Outlooks, given the fact that they make conducting an "apples to apples" comparison difficult.

Figure 11 shows that the IEA's and OPEC's long-term expectations for world economic growth are broadly similar, although the IEA's are a little higher. The differences may to a large extent be attributed to the difference in the base year.

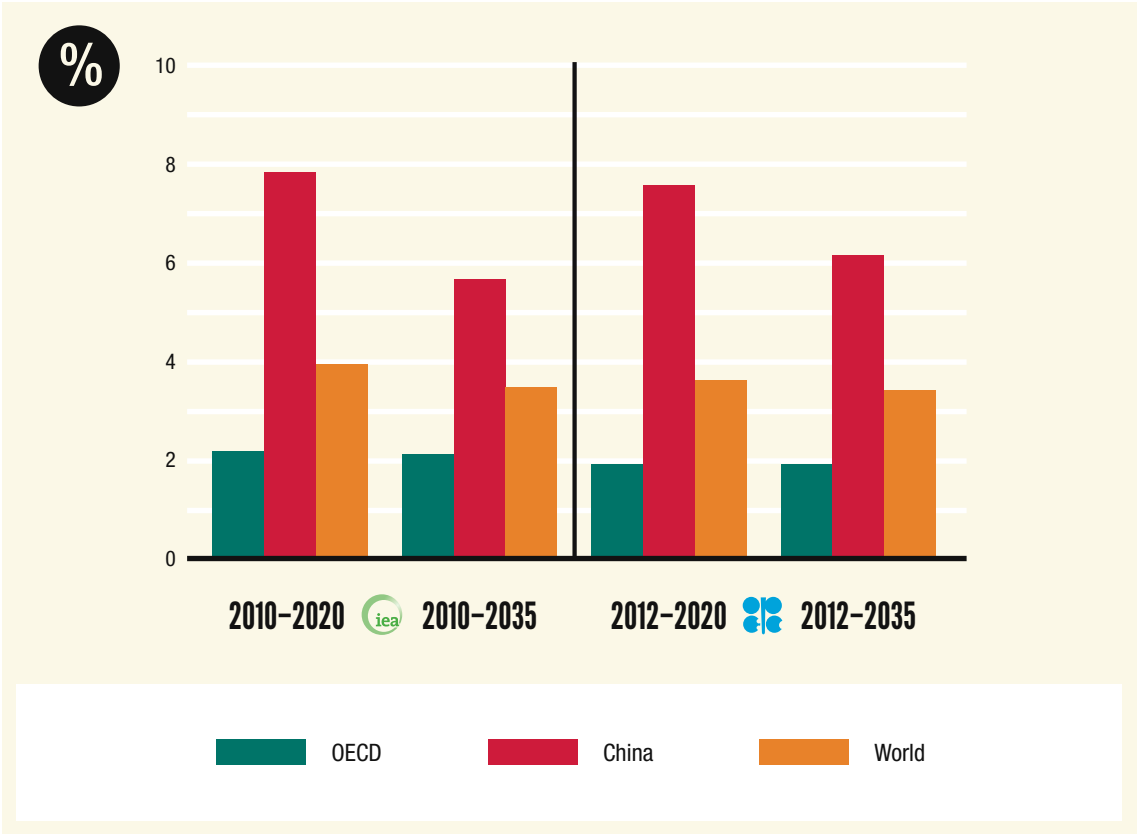
The IEA WEO assumes that the world global economy grows on average by 4.0% per year over the period 2010-2020. In the longer-term, the rate of growth is assumed to moderate, as emerging economies mature and their growth rates start to converge with those of the OECD economies. Global GDP growth is assumed to grow by an average of 3.5% per year over the period 2010-2035. Assumed growth is somewhat lower than in last year's WEO, in part due to lower medium-term growth.

OPEC's WOO 2012 projections are broadly similar, though the WOO 2012 expects higher long-term growth in China (6.2%). It assumes that the global economy will grow by 3.6% per year from 2012-2020 and 3.4% per year from 2012-2035.

In both outlooks, developing countries as a group are assumed to continue to grow much more rapidly than the OECD countries, driving up their share of world GDP. However, the OECD countries will retain their position as the wealthiest nations in terms of per capita income. In the short- and medium-term, both outlooks remain cautious about the sustainability of global economic recovery and warn that risks have recently increased.

Figure 11: Long-term Economic Growth Rates

The IEA's and OPEC's long-term expectations for world economic growth are roughly similar.



4.1.4 Energy and Environmental Policies

As noted earlier, the IEA's 2012 WEO maintained the New Policies Scenario as its central scenario. This outlook takes into account broad policy commitments and plans that have already been announced (but not necessarily implemented yet) by countries worldwide, aimed at tackling energy security issues, climate change and local pollution, and other pressing energy-related challenges. Those policy pledges include renewable energy and energy-efficiency targets, programmes relating to nuclear phase-out or additions, national pledges to reduce greenhouse-gas emissions communicated officially under the Cancun Agreements, and the initiatives taken by G-20 and Asia Pacific Economic Cooperation (APEC) to phase out inefficient fossil-fuel subsides that encourage wasteful consumption. The New Policies Scenario assumes that these pledges will be implemented in a relatively cautious manner, reflecting their non-binding character and – in many cases – the uncertainty concerning how they might be put into effect. According to the IEA, the scenario intends to provide a benchmark to assess the achievements and limitations of recent developments in climate and energy policy.

The WEO's Current Policies Scenario (called the Reference Scenario prior to WEO 2010) assumes no new policies are added to those in place as of mid-2012. A number of the policy commitments and plans that were included in the New Policies Scenario in WEO 2011 have since been enacted, and are now included in the Current Policies Scenario. These include China's 12th Five Year Plan for the period 2011–2015, a new energy scheme in India, and new feed-in-tariffs for renewable energy technologies in Japan.

The WEO's 450 ppm Scenario is different. Rather than representing a projection based on past trends and modified by known policy actions, it deliberately selects a plausible future energy pathway. The pathway chosen is composed of actions deemed to have a roughly 50% probability of meeting the goal of limiting the global increase in average temperature to two degrees Celsius (2°C) in the longer term (compared with pre-industrial levels). Through 2020, the 450 ppm Scenario assumes policy action to implement fully the commitments under the United Nations Framework Convention on Climate Change Cancun Agreements. After 2020, it assumes (i) the implementation of the high-end of national pledges and stronger policies by OECD countries, and (ii) that other major economies will set emissions targets for 2035 – and beyond that, they will collectively limit the concentration of greenhouse gases in the atmosphere to 450 ppm of CO_2 equivalent.

The WOO 2012 Reference Case is defined similarly as in the previous WOO. It embraces the principle that only policies that are already in place influence supply and demand patterns. The two key policies that are already factored in are the EU package of measures for climate change and renewable objectives, and the US Energy Independence and Security Act (EISA). No change is anticipated for these two sets of policies in terms of how they might impact the Reference Case, as they were in the previous WOO. This year's Reference Case, however, also introduces implications for the new measures that were reported in the WOO 2011 concerning international marine bunker fuel, whose standards are administered by the International Maritime Organization (IMO), a UN agency, under the International Convention for the Prevention of Pollution from Ships (MARPOL). It also reflects measures contained in China's current Five Year Plan, though the WOO does not foresee these measures greatly affecting the Reference Case.

In addition to the Reference Case, the WOO developed the Liquids Supply Surge (LSS) scenario. The LSS Scenario estimates the possible impact upon OPEC crude if the overall supply of liquid fuels is higher than estimated in the Reference Case. The LSS scenario focuses specifically on supply uncertainties.

Energy and environmental policies are key drivers of future energy demand and supply; however they are also one of the most uncertain areas of the outlooks. The policy assumptions incorporated in the New Policies Scenario of the IEA WEO-2012 are not exactly the same as those considered by OPEC's Reference Case. This difference in energy and environmental policy assumptions creates some ambiguity in the comparison between the outlooks, and drives differences in the supply and demand projections. However, for the purpose of this report, the IEA Current Policies Scenario and OPEC's Reference Case are compared.

4.2 Long-term Energy Demand

The IEA WEO expects global primary energy demand to continue to grow through the long-term. In the Current Policies Scenario, global energy demand reaches 18,676 million tonnes of oil equivalent (Mtoe) in 2035, 47% higher than in 2010, representing average growth of 1.5% per year. Non-OECD countries account for nearly 90% of the increase over the outlook period. Fossil fuels maintain a central role in the primary energy mix in the Current Policies Scenario, although their share declines slightly, from 81% in 2010 to 80% in 2035 (Figure 12). In the Current Policies Scenario, coal demand is expected to grow the most in absolute terms and overtake oil to capture the largest single share of energy mix

before 2035, at nearly 30%. Oil demand[11] should increase by around 23% over the forecast period, though oil's share in the total energy mix declines by 5 points from around 32% in 2010 to just over 27% in 2035 (Figure 12). Gas demand will rise by 60% in 2035 compared to 2010, though it is not expected to surpass coal's share of total energy demand. The share of nuclear power stays more or less flat over the projection period, at around 6%. The use of modern renewable energy, including wind, solar, geothermal, marine, modern biomass and hydro, is expected to rise over the outlook period – its share in total primary energy demand is expected to reach 14% in 2035 (Figure 12).

Figure 12: World Primary Energy Fuel Share

Though their share in the energy mix is expected to fall, fossil fuels represent over 82% to 2035 – with oil remaining dominant for most of the projection period.

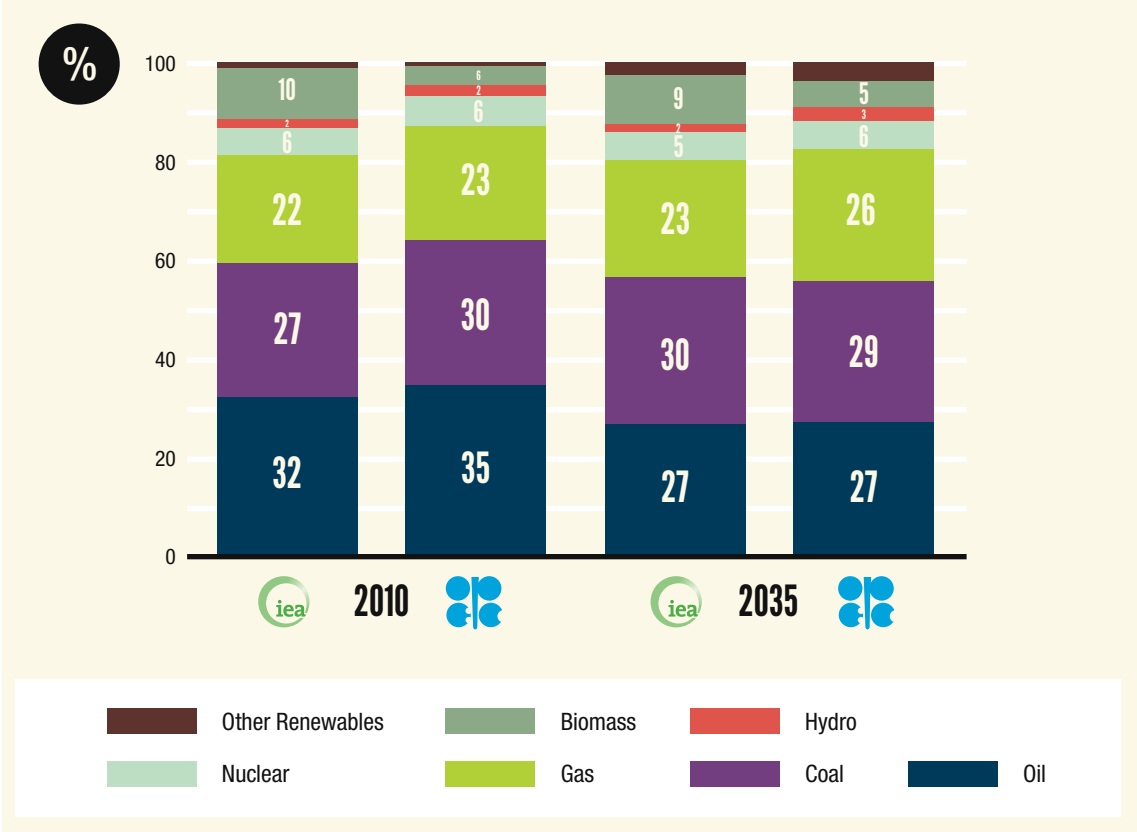


***Figure 12 Notes**:*
a. IEA Current Policies Scenario and OPEC Reference Case are shown above.
b. IEA biomass includes traditional and modern uses.

OPEC's Reference Case expects global energy demand to continue to increase, as economies expand, the global population grows and living conditions across the world improve. By 2035, world energy demand will be 54% higher than in 2010 (Figure 13). In the future, developing countries will account for most of the demand increase, though per capita energy use in developing countries will remain well below that of the OECD countries in 2035.

[11] Excludes biofuels demand, which is projected to rise from 1.3 mb/d (in energy-equivalent volumes of gasoline and diesel) in 2011 to 3.7 mb/d in 2035.

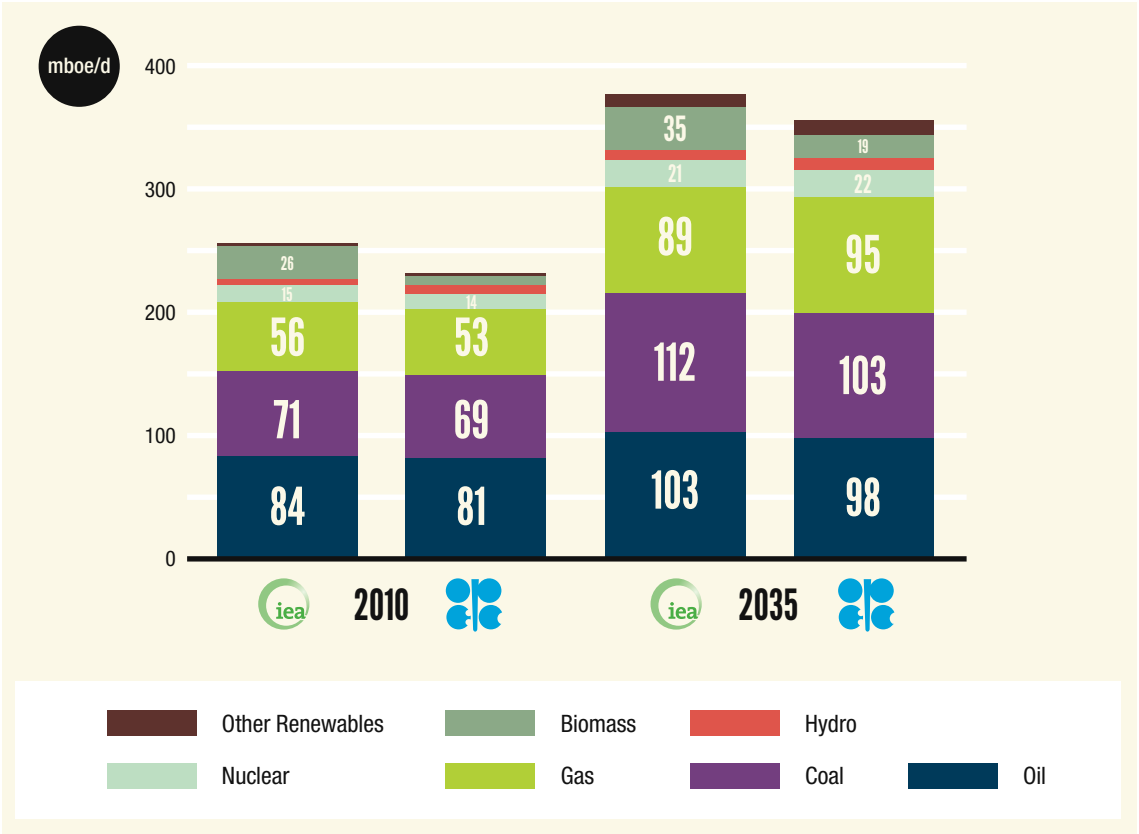
Fossil fuels maintain a prominent role. Though their share in the energy mix is expected to fall, it remains over 82% throughout the period to 2035. For most of the projection period, oil will remain the energy type with the largest share. However, towards the end of the projection period, coal use in the Reference Case reaches similar levels as that of oil, with oil's share expected to drop from 35% in 2010 to 27% by 2035. The rate of expansion in natural gas use is expected to rise by 86% in 2035 versus 2010, especially in light of technological developments that facilitate the exploitation of unconventional resources. There is clear potential for shale gas on the world energy scene. Gas use will rise at faster rates than either coal or oil, both in percentage terms and volumes, with its share rising from 23% to 26%.

According to the WOO 2012, the prospects for nuclear energy have been affected by events at Japan's Fukushima nuclear power plant in March last year, which prompted the closing of many other nuclear plants. In the Reference Case, nuclear energy still expands at an average annual rate of 1.7% in total, with a share in the energy mix of 6% in 2035, similar to today.

Biomass use expands rapidly, and its contribution to total supply will approach near that of nuclear by 2035, at around 5.4%. Renewable energy, other than hydro, rises the fastest of all energy forms, though as it starts from a low base its share will be just 3.5% by 2035.

Figure 13: World Primary Energy Demand

Global energy demand levels in the IEA Current Policies Scenario through 2035 are slightly higher than OPEC's Reference Case projections.



The IEA WEO Current Policies Scenario and OPEC WOO Reference Case expect global primary energy demand for all energy sources to continue to grow (Figure 13). By 2035, IEA Current Policies Scenario expects world primary energy demand to be 47% higher than today, while OPEC's Reference Case sees world primary energy demand 54% higher than today. Fossil fuels continue to be the most widely used. Their resources are expected to be more than sufficient to meet the anticipated growth in demand, and will represent over 80% of total energy consumption in 2035.

OPEC's WOO sees slightly higher growth in the world primary energy use than the IEA WEO does (1.8% versus 1.5%). However, global energy demand levels in the IEA Current Policies Scenario through 2035 are slightly higher than OPEC's reference case projections (Figure 13). This is mainly due to the higher base data, as the IEA WEO includes traditional biomass uses. In addition, the IEA WEO and OPEC WOO's growth rates by fuel type are relatively comparable, although the OPEC Reference Case projects faster growth in hydro, biomass and other renewable demand, while the IEA Current Policies Scenario projects faster growth in coal.

4.2.1 Long-term Oil Demand Outlooks

Both the IEA and OPEC expect oil to continue to be the single largest component of primary energy demand for most of the projection period, although OPEC expects its share as a proportion of total fuels to fall from 35% in 2010 to 27% in 2035, and the IEA sees a drop from 32% in 2012 to 27% in 2035.

Similar to last year's assessment, the IEF was unable to make direct comparisons on regional/country levels between IEA and OPEC figures for oil demand for several reasons:

– **Different treatment of biofuels and marine bunker fuels.** The IEA does not include biofuels in its WEO definition of oil, and consequently, reports biofuels separately. Bunker fuels are only included as an aggregate, not at the regional level;

– **Differences in the regional breakdown.** The WOO has an OPEC grouping while the IEA WEO does not routinely publish its demand projection for OPEC – as the OPEC Member countries are split across different WEO regions.

A comparison at the global level between the IEA Current Policies Scenario and OPEC Reference Case is presented in Figure 14. Over the long-term forecast period, the IEA Current Policies Scenario sees higher growth in world oil demand than the OPEC Reference Case does (0.9% versus 0.8%). Both outlooks point out that the key to future demand growth is the transportation sector of non-OECD countries, notably China and India.

Figure 14: Global Liquids Demand

The transportation sector in non-OECD countries, notably China and India, is the key to future demand growth.

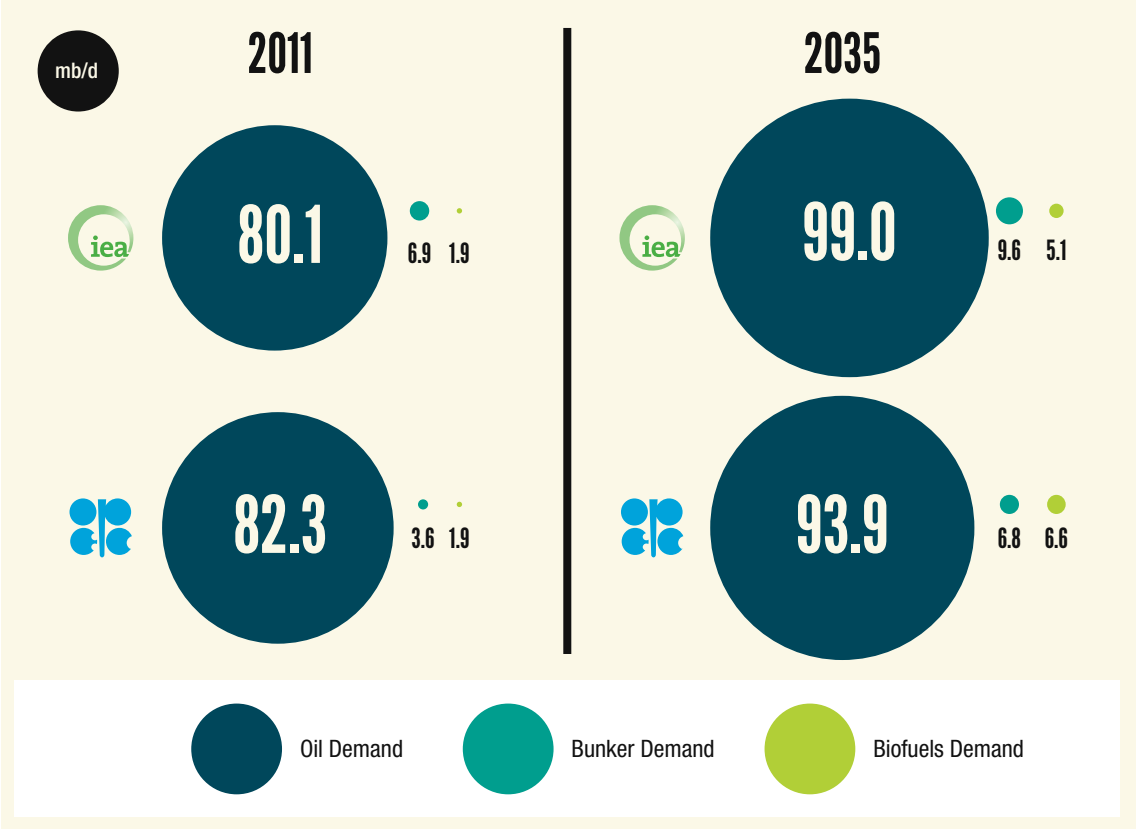


***Figure 14 Notes**:*
1. IEA Current Policies Scenario and OPEC Reference Case are shown above.
2. IEA bunker figures also include international marine and aviation fuels.
3. Biofuels figures are calculated on a volumetric basis.

The IEA Current Policies Scenario long-term projection for world liquids demand (defined as world oil and NGLs production plus processing gains plus biofuels) in 2035 is 113.7 mb/d, whereas OPEC's Reference Case projection is 107.3 mb/d, a difference of more than 6.0 mb/d. This is partly explained by the IEA's higher base data, which is around 1.0 mb/d higher than OPEC for the year 2011. The main difference can be explained in terms of expectations regarding economic growth and energy and environmental policies. The IEA report sees higher world economic growth over the forecast period than the OPEC report does, especially for the period through 2020, as illustrated above, which translates to higher demand growth. In addition, this year OPEC's Reference Case introduces the implications of the new measures of international marine bunker fuel and the implications of technological developments and implementation, especially in the transportation sector, which are expected to reduce demand growth.

Both outlooks envision a decline in OECD oil demand over the projection period, with a demand increase coming from developing countries. However, the outlooks have different views on biofuels and bunker demand levels. For example, the IEA Current Policies Scenario sees biofuels demand reaching 5.1 mb/d (on a volumetric basis) by 2035, while OPEC's Reference Case sees biofuels demand reaching 6.6 mb/d by 2035 – a difference of around 1.5 mb/d.

Regarding bunker demand, the IEA Current Policies Scenario expects international marine and aviation fuels demand to reach 9.6 mb/d by 2035 versus marine bunker demand of 6.8 mb/d in OPEC's Reference Case – a difference of around 2.8 mb/d. However, by adding OPEC's aviation oil demand to its marine bunker demand (marine and aviation fuels), OPEC's figure then reaches 13.4 mb/d by 2035. The main reason behind this difference lies in the fact that total aviation demand includes domestic flights. As such, this aggregate figure is therefore not comparable. This issue concerning methodology and definitions warrants further consideration.

In addition to oil demand in the Current Policies Scenario, the IEA projected oil demand under its three other scenarios – differentiated by the underlying assumptions about government policies as highlighted earlier (see Figure 15).

Figure 15: Global Liquids Demand by Scenario

Expectations regarding future energy and environmental policy pathways are a key cause of differences in oil demand projections.

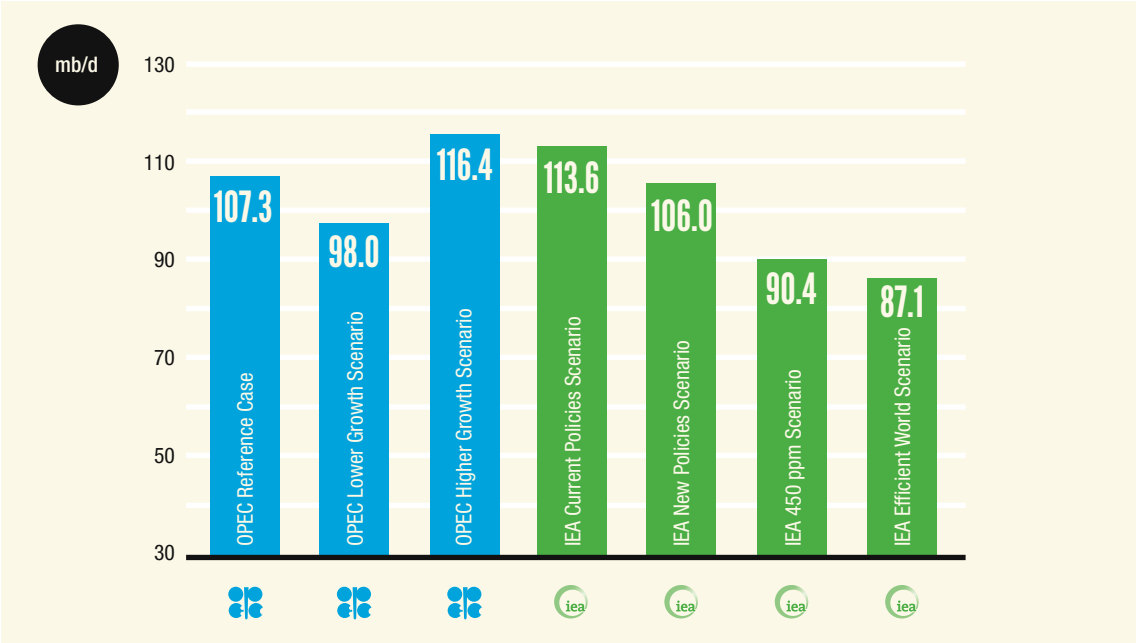


***Figure 15 Notes**:*
1. Biofuels figures are included in all scenarios except the IEA Efficient World Scenario, and are calculated on a volumetric basis.
2. IEA bunker figures also include international marine and aviation fuels.

OPEC's WOO also presents two other scenarios for oil demand (Low Growth and High Growth), reflecting the uncertainties over technological developments, economic growth, energy and environmental policies, and the implications these will have on the oil market in the future (Figure 15). The Low Growth scenario reflects the downside risks to demand stemming from uncertainties over economic growth. The High Growth scenario considers the upside potential for economic growth, with an even swifter recovery from the recent downturn than that assumed in the Reference Case. This scenario also involves a more optimistic view of long-term GDP growth rates. By 2035, these scenarios see the call on OPEC crude 10 mb/d lower or higher than the Reference Case.

Indeed, oil demand projections are based on various assumptions (economic growth, oil intensity, oil prices, energy policies, and technology developments). For example, under

the IEA's Efficient World Scenario, the long-term projection for world oil demand in 2035 is 87.1 mb/d, whereas its Current Policy Scenario projection is 113.7 mb/d – a difference of more than 26.0 mb/d. The divergent views in the underlining assumptions between the IEA New Policies Scenario and Efficient World Scenario, especially those related to energy and environmental policies, contribute to the differences in their projections.

4.3 Long-term Supply Outlooks

Assumptions in the IEA and OPEC outlooks regarding the availability of resources and the size of the resource base are quite similar – in part because both organisations use to varying extents the 2012 the US Geological Survey Assessment (USGS-2012) to estimate ultimately recoverable resources of conventional crude oil and NGLs.

According to the OPEC WOO, ultimately recoverable conventional resources – a category that includes initial proven and probable reserves from discovered fields, reserves growth, and economically recoverable oil that has yet to be found – amounts to 3.85 trillion barrels. The remaining resources as of the end of 2010 are around 2.7 trillion barrels.

IEA estimates now put remaining recoverable resources worldwide at nearly 5.9 trillion barrels – a 9% increase on last year's estimate, with proven reserves amounting to about one-quarter of the total.

Both outlooks posit that non-conventional oil resources are expected to make an increasingly important contribution to liquid supply. They indicate that significant non-conventional resources exist throughout the world. Major examples include light, tight oil and the oil sands of Alberta, Canada. However, the potential of future oil supplies from non-conventional sources faces many technical, environmental and commercial challenges.

The IEA WEO projections take account of current field production profiles and future decline rates based on field characteristics, including size and physiographical situation. The IEA WEO mentions that by 2035, aggregate output from fields producing as of 2011 will fall by close to two-thirds, to only 26 mb/d by 2035, decreasing output by around 3.9% per year. Current OPEC projections do not refer to any decline rate figures. However OPEC's WOO-2009 stated that the production-weighted average annual observed decline rate for non-OPEC production is around 4.6% per annum, and this is higher than that in OPEC Member Countries. In addition, the IEA WEO oil supply balances the modeled WEO oil demand. The OPEC WOO does the same, but with around 0.2 mb/d allowance for stock building.

A comparison between IEA's WEO supply projection in its Current Policies Scenarios and OPEC's WOO supply projection in its Reference Case appears in Diagram 9 and Figure 16. Both outlooks have been similarly adjusted by the IEF for the purposes of consistency. The IEA WEO projects higher OPEC NGLs and other liquids (excluding Venezuela extra heavy oil) than OPEC's WOO by around 1.5 mb/d for 2035. For the call on OPEC crude oil in 2035, the estimates differ by around 4 mb/d: 38.9 mb/d (including Venezuela extra-heavy) for IEA WEO versus 34.8 mb/d for OPEC WOO. The IEA report projects a greater increase in oil demand than OPEC over the long-term. Indeed, the IEA Current Policies Scenario expects global demand in 2035 to reach 113.7 mb/d, whereas OPEC's Reference Case sees it at 107.3 mb/d – a difference of more than 6.0 mb/d.

Diagram 9: WEO and WOO Supply Projection Highlights (mb/d)

	IEA WEO (Current Policies Scenario)	OPEC WOO (Reference Case)	DIFFERENCE
Call on OPEC crude by 2035	38.9 (including Venezuela extra-heavy)	34.8	4.1
Global Supply in 2035	113.7	107.5	6.2

Figure 16: Long-term World Oil Supply

The IEA WEO projects a higher call on both OPEC crude and OPEC NGLs through 2035 than OPEC's WOO expects, by around 4mb/d and 1.5 mb/d, respectively.

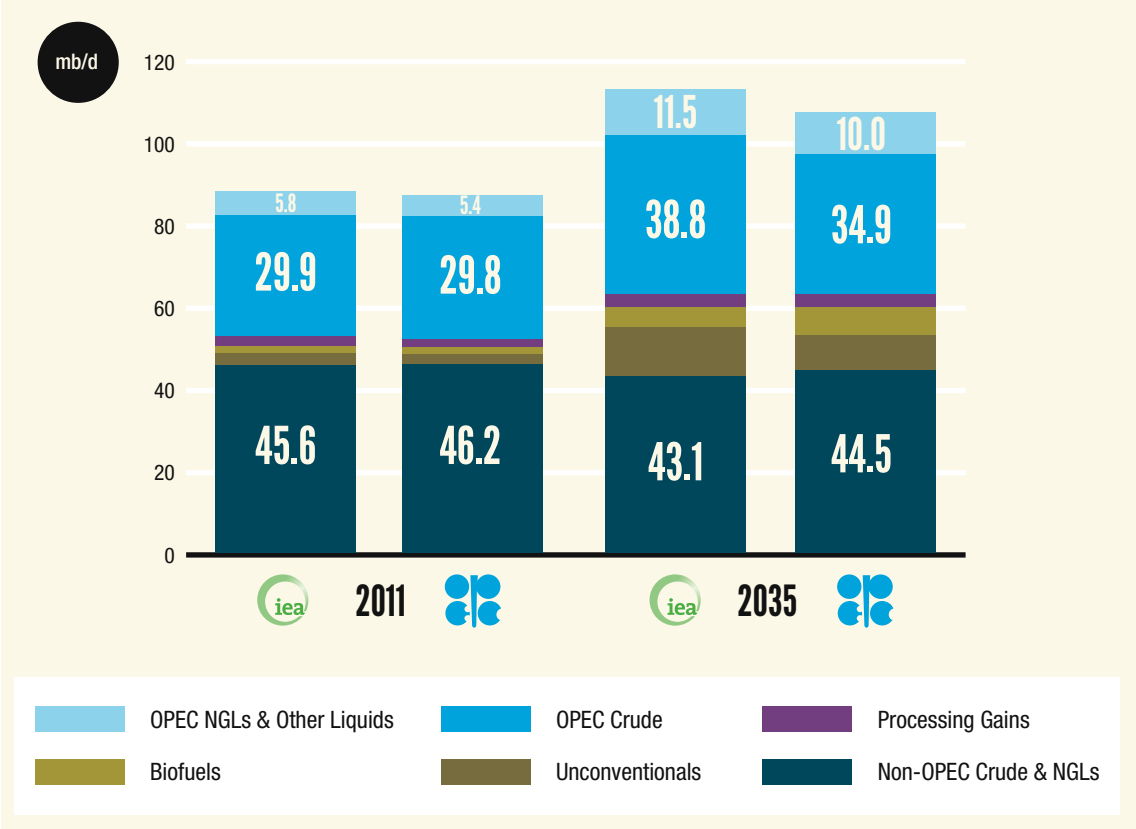


***Figure 16 Notes**:*
1. Biofuels figures are calculated on a volumetric basis.
2. IEA Current Policies Scenario and OPEC Reference Case are shown above.
3. OPEC crude includes Venezuela extra-heavy.

There are minor differences in expectations for total non-OPEC supply (defined as crude oil and NGLs production plus processing gains plus biofuels) between the two outlooks. The IEA WEO Current Policies Scenarios expects non-OPEC supply to increase slightly more than OPEC's WOO Reference Case does, reaching 63.2 mb/d by 2035 (only 0.5 mb/d higher than the OPEC WOO figure (Figure 16). However, there are large differences on regional and national levels.

Figure 17: Long-term Non-OPEC Supply

There is a difference of around 1.1 mb/d between OPEC's WOO and the IEA's WEO projections for supply from North America, and double that for Latin America -- compared to an overall difference in supply projections for non-OPEC regions of just 0.4 mb/d.

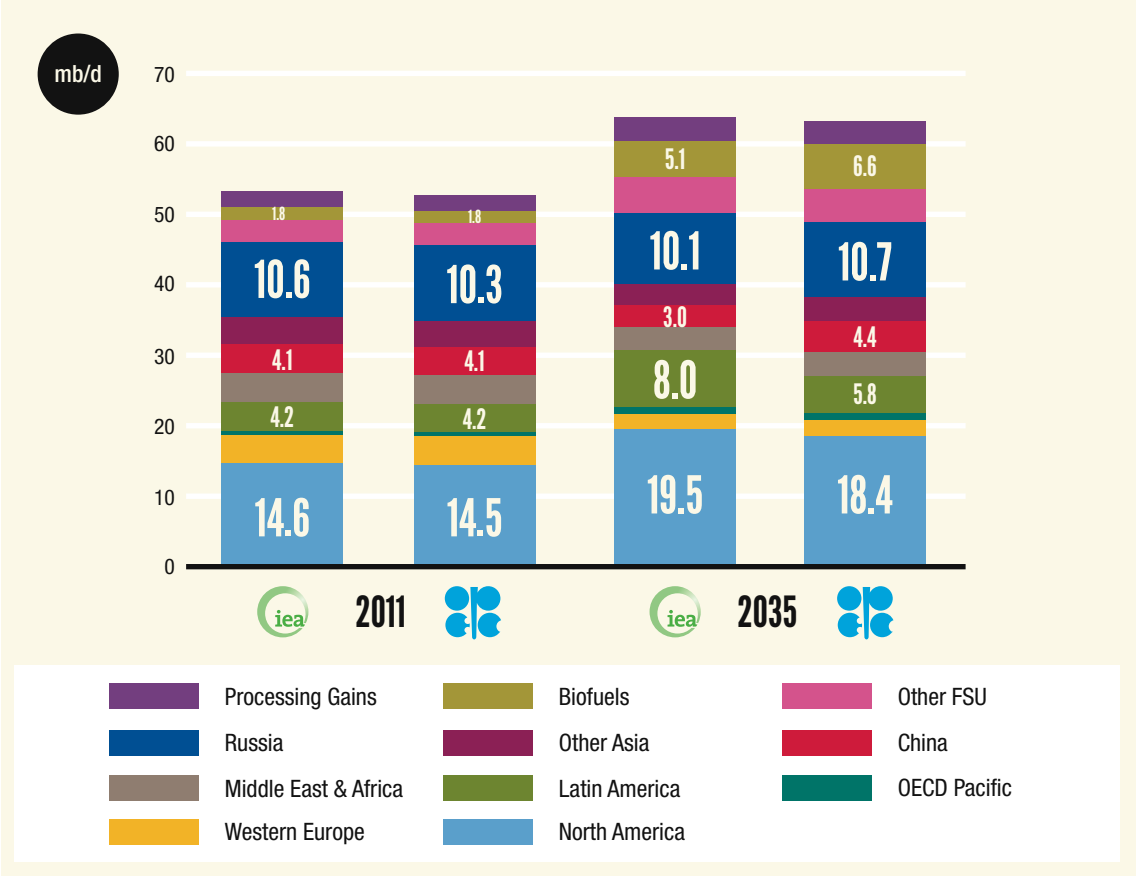


***Figure 17 Notes**:*
1. IEA Current Policies Scenario and OPEC Reference Case are shown above.
2. Region/country data include non-conventional and exclude biofuels.
3. Biofuels figures are calculated on a volumetric basis.

To identify the differences between the two outlooks within the non-OPEC regions, Figure 17 presents a more detailed breakdown of supply from non-OPEC regions/countries, including biofuels. As Figure 17 illustrates, there is a difference of around 1.1 mb/d between the OPEC's WOO and IEA's WEO projections for supply from North America – and double that (2.2 mb/d) for Latin America, compared to an overall difference in supply projections for non-OPEC regions of 0.4 mb/d. On the other hand, OPEC's WOO Reference Case projection for biofuels is around 1.4 mb/d (on a volume basis) higher than the IEA's WEO Current Policies Scenarios. There is also a difference of 1.5 mb/d (shown above as 1.4 due to rounding) in the two outlooks regarding projections for China. The big differences in non-OPEC supply on the regional/country levels merit closer analysis.

The regions where the IEA WEO supply projection is greater than OPEC's are North America, Latin America, OECD Pacific and other FSU. This region covers those areas (after accounting for Russia) defined by OPEC as "transition economies" and by the IEA as "Eastern Europe/Eurasia".

There are large differences in oil price assumptions: OPEC assumes $155/bbl (nominal) by 2035 versus $250/bbl (nominal) by the IEA.

All in all, the non-OPEC supply as projected by the IEA WEO is just 0.5 mb/d higher than the OPEC WOO figures. This is worth highlighting despite the fact that there are large differences in oil price assumptions. OPEC assumes $155/bbl (nominal) by 2035 versus $250/bbl (nominal) by the IEA.

Oil supply projections are also available by oil type, and this analysis attempts to further demonstrate where differences may exist. The IEA's and OPEC's projections by oil type are shown in Figure 18. OPEC's WOO and the IEA WEO show significant differences in their OPEC crude, non-OPEC Crude, OPEC NGLs and biofuels projections.

OPEC's WOO and the IEA's WEO show significant differences in their OPEC crude, non-OPEC Crude, OPEC NGLs and Biofuels projections.

Figure 18: Long-term World Oil Supply by Region and Type

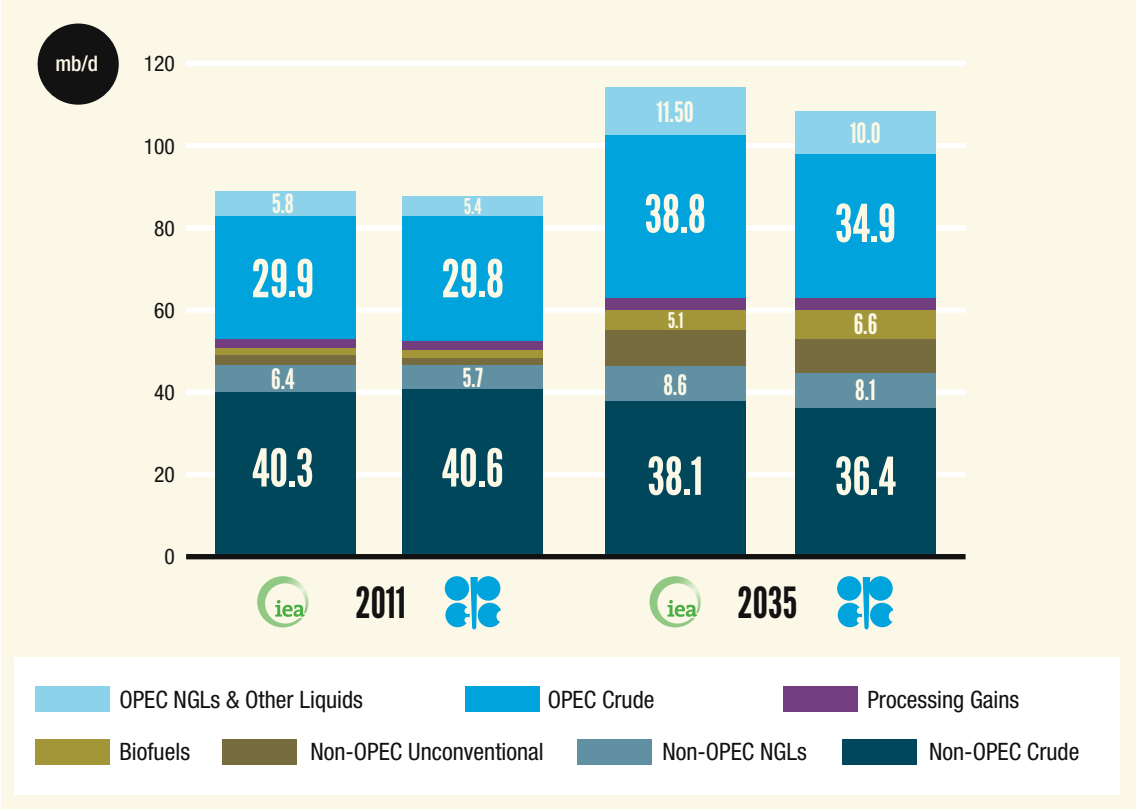


***Figure 18 Notes**:*
1. IEA Current Policies Scenario and OPEC Reference Case are shown above.
2. Non-OPEC crude includes light tight oil.
3. Non-OPEC non-conventional includes oil sands.
4. OPEC crude includes Venezuela extra heavy oil.

By 2035, OPEC projects that it will have to supply roughly 4 mb/d less than the IEA expects it will have to send to the market. The gap is mainly due to differences in long-term demand projections. The IEA also forecasts that more crude production will come from non-OPEC countries than OPEC expects these countries will produce. By 2035, the outlooks gap will be around 1.8 mb/d, to a large extent because of differing views on the level of shale/tight oil supply (as the IEA report is more optimistic on the future prospect of shale oil). The IEA Current Policies Scenario sees global production of crude oil and condensate from shale and tight formations reaching over 4.5 mb/d by 2025, declining after that to 3.7 mb/d by 2035. On other hand, the OPEC Reference Case expects US shale oil supply to increase rapidly during this decade to reach 2.0 mb/d by 2020, but its pace will slow down afterward – with shale oil supply expected to be at a level of 3.0 mb/d by 2035. Both reports acknowledge that the development of shale/tight oil resources are still facing technical, commercial, environmental, and regulatory challenges – as well as obstacles related to infrastructure bottlenecks and social acceptance.

Finally, the IEA sees more NGLs and other liquids (mainly gas to liquids) coming from OPEC member countries than OPEC does: the difference by 2035 is expected to be around 1.5 mb/d. On the other hand, the OPEC WOO projects more biofuels than the IEA WEO does: the difference by 2035 is around 1.4 mb/d (on a volume basis).

Both outlooks recognise that there will be a wide range of sources of oil to satisfy demand. In particular, they see non-crude liquids supply from both OPEC and non-OPEC sources (such as non-conventional oil, condensate and NGLs and biofuels) more than doubling by 2035. Consequently, global conventional crude supply in 2035 is expected to be less than 1.0 mb/d higher than its 2011 level (according to OPEC) and around 7.0 mb/d higher according to the IEA (Figure 19). On the other hand, global non-crude supply in 2035 is expected to increase by more than 18.0 mb/b versus its 2011 level. By 2035, OPEC's WOO expects demand for crude to reach 71.2 mb/d, while the IEA WEO sees the level at 77.0 mb/d (crude includes Venezuela extra-heavy and light tight oil) – a difference of 7.0 mb/d. As explained above, this gap is mainly due to differences in long-term demand projections.

Figure 19: Long-term World Oil Supply by Type

There will be a wide variety of oil sources to satisfy demand over the long-term.

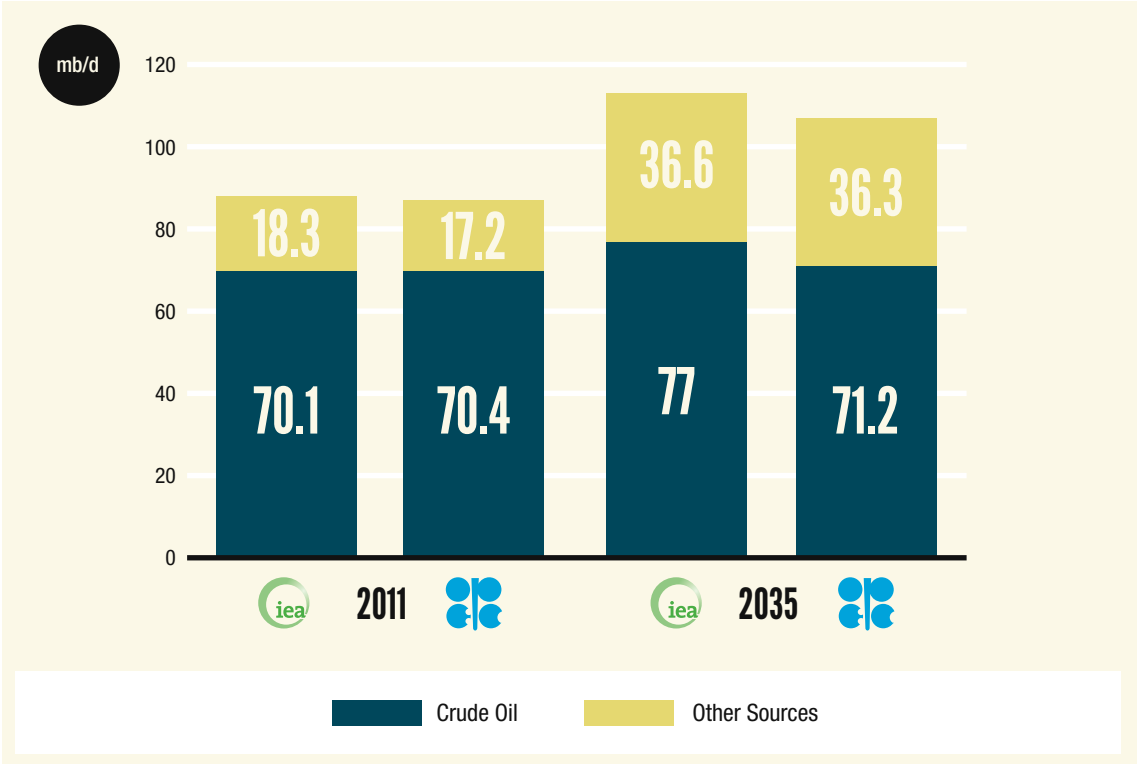


Figure 19 Notes:
1. Crude includes Venezuela extra heavy oil and light tight oil.

In addition to the oil supply in the Current Policies Scenario, the IEA projected oil supply under two other scenarios: New Policies Scenario and 450 ppm Scenario (Figure 20). Under these scenarios, the IEA WEO projects much lower global oil supply for both non-OPEC and OPEC regions. Under the 450 ppm Scenario, global oil demand peaks before 2020 at just below 95 mb/d, and declines to 90 mb/d by the end of the projection period – almost the same level of 2011. In the 450 ppm Scenario the demand for OPEC crude in 2035 is more than 2 mb/d below the 2011 level.

Figure 20: Long-term World Oil Supply by Scenario

The gap in expected long-term oil supply between OPEC's Higher Growth Scenario and the IEA's 450 Scenario is 26.2 mb/d.

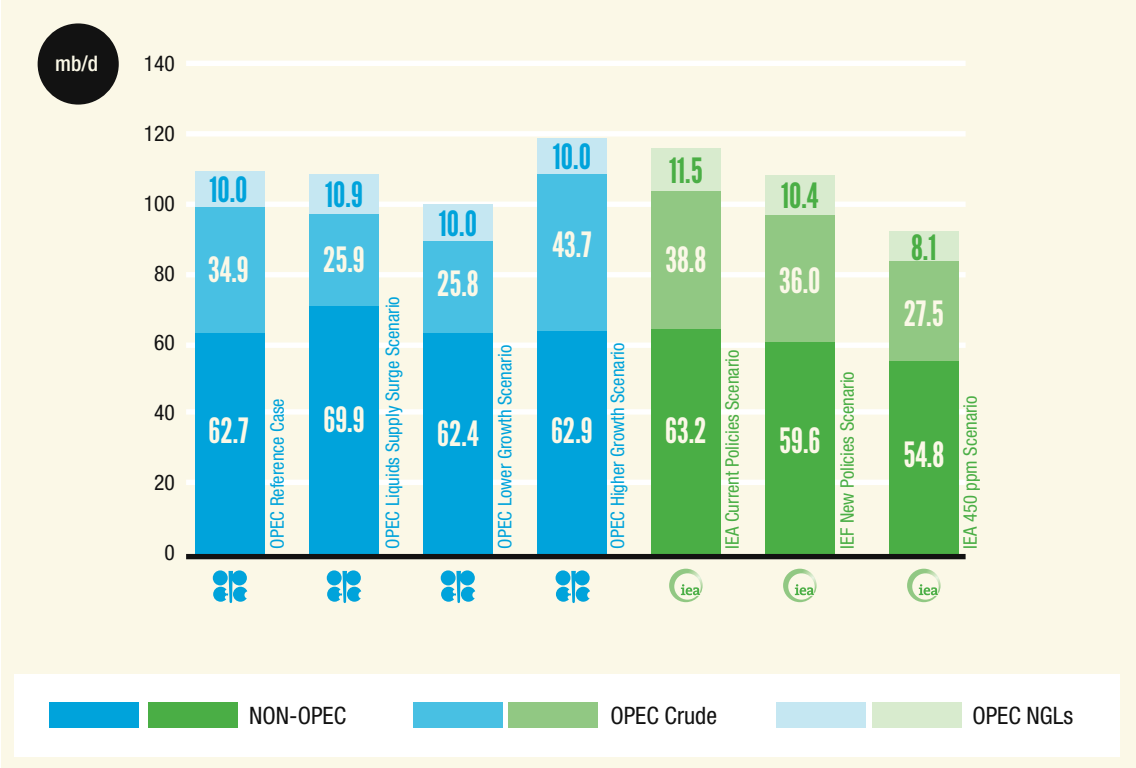


***Figure 20 Notes**:*
1. Non-OPEC includes non-conventional and biofuels (volumetric basis).
2. OPEC crude includes Venezuela extra heavy oil.

As per the three other scenarios in OPEC's WOO, the lower growth scenario is assumed to be accompanied by oil prices that are lower than in the Reference Case, which could mean lower non-OPEC supply (Figure 20). However, under this scenario OPEC carries most of the burden resulting from the weakness in demand. In the higher growth scenario, stronger growth in non-OPEC oil – both conventional and non-conventional – is projected, associated with higher oil prices. In addition, the key supply response comes from OPEC. Finally, OPEC's LSS Scenario, which focuses specifically on supply uncertainties, sees OPEC crude production 9.0 mb/d lower than the Reference Case by 2035.

The large differences in projected demand for crude among the various scenarios translate into huge uncertainties regarding necessary investment and supply.

Indeed, differences in scenarios, in methodologies, in the level and regional distribution of projected demand for crude – as well as in regional cost assumptions – translate into differences in the level of projected investments that may be needed in producing fields and for additional capacity to meet demand by 2035. Moreover, the large differences in projected demand for crude among the various scenarios translate into huge uncertainties regarding necessary investment and supply.

5. Final Remarks

This paper has identified the main differences between the IEA's and OPEC's outlooks and reasons behind these differences, including points related to definitions and the presentation of results.

The differences in the IEA and OPEC projections for future energy demand – especially those for oil demand – can be attributed mainly to respective assumptions regarding energy and environmental policies. These policies are key drivers for the energy outlooks and are arguably the greatest sources of uncertainty.

Regarding oil supply, the primary difference in the IEA's and OPEC's projections is over their views about non-OPEC regions. Significant differences are also seen in the oil price assumptions utilised by the IEA and OPEC.

The purpose of this exercise was not to reconcile the assumptions made and outlooks produced by the IEA and OPEC, but instead to improve clarity over how the assumptions differ – as a better understanding of the reasoning from both organisations should help boost overall transparency.

Uncertainty affecting the global economy in the short-term (associated with price volatility witnessed over the past years) makes energy forecasting difficult to say the least. In this respect, this paper points to a number of areas where there is room to discuss and analyse various related issues – not necessarily to come to a common view, but to ensure a better understanding of each outlook.

Examples include the following points:

- Assumptions regarding demand growth in some countries or regions, such as China, India and the Middle East.
- The expected impact of policy changes.
- The marginal cost of production and price assumptions.
- How spare capacity is defined.
- How bunker fuels, biofuels and natural gas liquids (NGLs) are defined and classified.
- Seasonality patterns in oil demand and supply.
- Thinking with regard to long-term non-OPEC supply.
- Assumptions regarding the outlook for shale and tight oil.
- Different viewpoints regarding processing gains.
- The links between GDP growth and oil demand.

The Third IEA-IEF-OPEC Symposium on Energy Outlooks offers a neutral platform for stakeholders to discuss energy market trends (energy supply, demand and prices) and associated factors that influence these trends (environmental policies, economic conditions, technological development).

Annex 1: Outlooks and Corresponding Assumptions

Variables	OPEC Reference Case	OPEC Liquid Supply Surge	OPEC Lower Growth	OPEC Higher Growth	IEA Current Policies	IEA New Policies	IEA 450 ppm	IEA Efficient World
Time Period	2011-2035	2011-2035	2011-2035	2011-2035	2011-2035	2011-2035	2011-2035	2011-2035
Global Economic Growth	3.4% for 2012-2035	3.4% for 2012-2035	0.5% lower than the Reference Case	0.5% higher than the Reference Case	3.5% for 2010-2035	3.5% for 2010-2035	3.5% for 2010-2035	0.4% higher than the NPS by 2035.
Population, billion	From 6.9 to 8.6	From 6.9 to 8.6	From 6.9 to 8.6	From 6.9 to 8.6	From 6.8 to 8.6	From 6.8 to 8.6	From 6.8 to 8.6	From 6.8 to 8.6
Oil Price Assumptions (nominal terms)	$100/bbl over the medium-term reaching $155/bbl by 2035	Not specified	Not specified	Alternative price paths to that of the Reference Case	$157/bbl in 2020 reaching $250/bbl by 2035	$146/bbl in 2020 reaching $215/bbl by 2035	$139/bbl in 2020 reaching $172/bbl by 2035	$187 in 2035
Investment	Oil upstream, mid-stream and downstream: $6-7 trillion (2011 dollars) between 2011-2035., excluding investment in additional infrastructure.	Not specified	Not specified	Not specified	Not specified	Cumulative investment over the period 2012-2035 in the oil sector (including biofuels) worldwide is $10.6 trillion, of which 90% for the upstream sector	Not specified	Not specified for oil and gas
Cost	Not specified, but it will increase.					Oil and gas cost increase by 6% in 2011, will be increased by 16% in real terms between 2012 and 2035.		
Energy and Environmental Policies	Only policies currently in place or widely anticipated are allowed to influence supply and demand	The scenario focuses specifically on supply uncertainties. It portrays an outlook that could be regarded as feasible.	This scenario reflects the downside risks to demand stemming from uncertainties over economic growth.	This scenario, considers the upside potential for economic growth, with an even swifter recovery from the recent economic downturn than that assumed in the Reference Case.	No policies are added to those in place as of mid-2012.	Considers broad policy commitments and plans that have already been announced by countries around the world, to tackle energy insecurity, climate change and local pollution, and other pressing energy-related challenges	Assumes implementation of the high-end of national pledges and stronger policies after 2020, to limit the concentration of greenhouse gases in the atmosphere to 450 ppm of CO_2 equivalent.	Assumes all energy investments that are economically viable are made and all necessary policies to eliminate market barriers to energy efficiency are adopted.
Carbon Price	Not specified	Not specified	Not specified	Not specified	By 2035 $45/tonne in 2011 dollars	By 2035 $45/tonne in 2011 dollars	By 2035 $95-$120/tonne in 2011 dollars	Not specified

Annex 2: Long-term Outlook Results

	OPEC Reference Case		OPEC Liquid Supply Surge		OPEC Lower Growth		OPEC Higher Growth		IEA Current Policies		IEA New Policies		IEA 450 ppm		IEA Efficient World	
	2011	2035	2011	2035	2011	2035	2011	2035	2011	2035	2011	2035	2011	2035	2011	2035
Global Energy Demand, mboe/d	233	359	-	-	-	-	-	-	259	380	259	350	259	301	259	302
Global Oil Demand, mb/d	87.8	107.3	87.8	107.3	87.8	98.0	87.8	116.4	88.86	113.6	88.86	106.0	88.86	90.4	88.86	87.1 *
Global Oil Supply, mb/d	87.5	107.6	87.5	107.3	87.5	98.2	87.5	116.6	88.4	113.5	88.4	106.0	88.4	90.4	88.4	-
Non-OPEC supply, mb/d	52.4	62.2	52.4	69.9	52.4	62.2	52.4	62.2	52.8	63.2	52.8	59.6	52.8	45.8	52.8	-
OPEC crude mb/d	29.8	34.9	29.8	25.9	29.8	25.8	29.8	43.7	29.9	38.8	29.9	36.0	29.9	27.5	29.9	-
OPEC NGLs and other liquids, mb/d	5.4	10.0	5.4	10.9	5.4	10.0	5.4	10.0	5.8	11.5	5.8	10.4	5.8	8.1	5.8	-

* Oil demand under the Efficient World Scenario (87.1) is lower than under the 450 ppm scenario (90.4) because figures for the Efficient World Scenario do not include biofuels.