FOURTH IEA-IEF-OPEC SYMPOSIUM ON ENERGY OUTLOOKS

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INTRODUCTORY PAPER
A COMPARISON OF RECENT IEA AND OPEC OUTLOOKS

International Energy Forum in partnership with Duke University

Duke UNIVERSITY | ENERGY INITIATIVE

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

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This report was prepared by the IEF and the Duke University Energy Initiative, in consultation with the International Energy Agency and the Organization of the Petroleum Exporting Countries.

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Acronyms and Abbreviations

bbl	Barrel
CPS	Current Policies Scenario (IEA)
EOR	Enhanced Oil Recovery
FSU	Former Soviet Union
GDP	Gross Domestic Product
GHG	Greenhouse Gases
HEG	Higher Economic Growth Scenario (OPEC)
IEA	International Energy Agency
IEF	International Energy Forum
IMF	International Monetary Fund
kb/d	Thousand Barrels per Day
LEG	Lower Economic Growth Scenario (OPEC)
LSS	Liquid Supply Surge Scenario (OPEC)
LTO	Light Tight Oil
mb/d	Million Barrels per Day
mboe	Million Barrels of Oil Equivalent
mboe/d	Million Barrels of Oil Equivalent per Day
MOMR	Monthly Oil Market Report (OPEC)
mtoe	Million Tonnes of Oil Equivalent
MTOMR	Medium-term Oil Market Report (IEA)
NGLs	Natural Gas Liquids
OECD	Organisation for Economic Co-operation and Development
OMR	Oil Market Report (IEA)
OPEC	Organization of the Petroleum Exporting Countries
ORB	OPEC Reference Basket
ppm	Parts per Million
ROI	Return on Investment
R/P	Resources-to-Production
SPR	Strategic Petroleum Reserve
UN	United Nations
UPS	Upside Supply Scenario (OPEC)
URR	Ultimately Recoverable Resources
USGS	U.S. Geological Survey
WEO	World Energy Outlook (IEA)
WOO	World Oil Outlook (OPEC)

Key Observations

Data Harmonisation and Comparability of Outlooks

- **Comparing IEA and OPEC outlooks can be challenging because of the different ways in which the two organisations define, calculate, categorise or present data.** Examples include the non-uniform use of energy units, dissimilar regional country groupings, and distinct liquid fuels classifications systems in which biofuels, unconventional oil, and bunker fuels are treated differently.

The IEA and OPEC employ different methodologies that yield different sets of historical data, and divergences of past figures can contribute towards divergences in future outlooks.

- **The IEA and OPEC employ different methodologies that yield different sets of historical data, and divergences of past figures can contribute towards divergences in future outlooks.** Comparing November 2013 monthly reports from both the IEA and OPEC, the IEA's calculation of 2012 global liquids demand was 1.1 mb/d higher than that of OPEC (particularly stemming from differences over perceived 2012 demand from Africa and non-OECD Asia excluding China), and the IEA's 2012 figures for global liquids supply were 1.3 mb/d higher than OPEC's (linked to unconventionals and OPEC NGLs).

- **Differences in historical liquids demand data contribute towards a gap of over 1 mb/d** between the IEA and OPEC short-term world liquids demand outlooks for 2014.

- **Given the importance of supply and demand growth figures, this report seeks to distinguish baseline differences from growth differences.** In recent years, the IEA and OPEC have been fairly close in their historical estimates of liquids growth.

- **The IEA and OPEC utilise different country groupings, which makes comparing regions challenging.** OPEC's WOO2013 excludes OPEC member countries from their geographic neighbors and calculates OPEC member demand separately. For example, Latin America regional data in the WOO2013 excludes OPEC member countries Ecuador and Venezuela. This practice means that demand data for the Middle East, Africa and Latin America are not directly comparable with IEA data and must be considered as one large group for comparison purposes.

- **Different treatment of biofuels complicates any comparison of IEA and OPEC regional non-OPEC supply outlooks.** While OPEC includes biofuels in each region's total liquids supply, the IEA instead accounts for biofuels separately. While the IEA used to provide only a global biofuels estimate in its short-term Oil Market Report, since December 2013 it now also includes a separate regional biofuels production table. Nevertheless, care must still be taken when directly comparing liquids supply data from the IEA and OPEC, as OPEC includes biofuels in its main regional liquids estimates while the IEA does not.

- **The IEA and OPEC define bunker fuels differently, which makes it impossible to compare bunker and aviation fuels.** While the IEA reports international marine and aviation fuel as a distinct "bunker" group (not attributable to any country or region), OPEC includes bunker and aviation fuel in each region's oil demand, just as it does with biofuels. OPEC does not differentiate between international and domestic aviation fuels. Aggregating total marine bunker (international bunker) and aviation fuel demand from the OPEC WOO2013 yields a much larger number than that reported under the "Bunkers" category in the IEA's WEO2013 report.

- **The IEA uses different base year (2012) world oil demand and supply data in its monthly Oil Market Report (OMR) and its World Energy Outlook (WEO).** For example, world liquids demand for 2012 is 89.2 mb/d[1] in the WEO2013, while in the November 2013 OMR the level is 90.0 mb/d.

The manner in which the IEA and OPEC make oil price assumptions differs in two fundamental ways.

- **The manner in which the IEA and OPEC make oil price assumptions differs in two fundamental ways:**

  (1) The IEA and OPEC use different price proxies: In its WOO series, OPEC makes assumptions for an OPEC Reference Basket price, while the IEA uses an "IEA Average Import Price";
  (2) Oil price assumptions are derived differently: OPEC analyses how the full-cycle oil production cost of the marginal barrel is expected to evolve, while the IEA utilises a six-year forward curve of Brent futures prices and then applies a certain discount to reach its price assumptions.

Recent Progress on Data Harmonisation and Comparability of Outlooks

- Noteworthy progress on the outlooks harmonisation front includes the fact that **OPEC's WOO2013 encompasses for the first time non-commercial use of bioenergy in its total biomass demand calculation.** This change make's OPEC's world energy demand forecasts more comparable with those of the IEA.

- Another sign of improved outlook comparability is the fact that **the IEA has improved its estimation strategy for China's oil demand**, and as a result the gap in the IEA's and OPEC's "apparent demand" estimates for China is now quite small. The IEA's new "apparent demand" method adds changes in reported oil stock levels to the existing methodology that primarily summed refinery outputs with net product imports.

- **OPEC adjusted its medium-term outlook time horizon from four to five years**, and now both the IEA and OPEC project five years into the future, which helps to make the outlooks easier to compare.

- **As of December 2013, the IEA has started to provide country-by-country biofuels (ethanol and biodiesel) production in its OMR**. This effort has improved the comparability of the IEA and OPEC short-term liquids supply outlooks

The IEA, IEF and OPEC shall continue their on-going dialogue in 2014, with the objective of making more progress in enhancing outlook comparability.

- **Despite progress on the harmonisation front, there is still much work to be done**. The IEA, IEF and OPEC shall continue their on-going dialogue on these points in 2014, with the objective of making more progress in enhancing outlook comparability for the benefit of all involved stakeholders.

1 For world oil demand, the figure reported in the WEO2013 is 88.7 mb/d, which yields 89.2 mb/d after converting biofuels from an energy-equivalent basis to a volumetric basis.

IEA and OPEC Short-Term Outlooks

- The IEA and OPEC concur that 2014 global GDP growth will be around 3.5%, **yet OPEC is more bullish on projected GDP growth for China and India**, expecting 0.5% higher growth than IEA and IMF projections for both nations, while the IEA (IMF) has higher projections for the Euro-zone and the United States.

- **Monthly revisions to expected 2013 global liquids demand growth stayed within a narrow range of 0.2 mb/d last year, though short-term discrepancies may have emerged as a result of different time lags in responding to data updates**. For example, reported oil demand in some OECD economies was stronger than previously projected for July and August. While the IEA obtained those data and made a 90kb/d upward revision for 2013 in October, OPEC was not able to make that adjustment until November. Timely data sharing and responsiveness to updated information might help to reduce this type of projection gap.

- **The IEA and OPEC agree that Asia will continue to lead liquids demand growth in the short-term, yet the two organisations diverge on the outlook for Africa: the IEA expects a demand increase of 0.2 mb/d in 2014, while OPEC expects demand to remain flat**. As the IEA's 2012 baseline data for Africa is 0.3 mb/d higher than OPEC's, the total gap in Africa's projected 2014 liquids demand growth reaches 0.5 mb/d.

The supply side shows a greater divergence than the demand side regarding short-term projections.

- **The supply side shows a greater divergence than the demand side regarding short-term projections**. The IEA is more optimistic than OPEC regarding the outlook for OECD supply, and the gap in IEA and OPEC projections for total non-OPEC supply in 2014 has widened from 0.5 mb/d in 2013 to 1.1 mb/d in 2014.

- **The 0.2 mb/d difference in outlooks for 2014 total OPEC supply merits closer analysis, as it masks larger differences in projections for OPEC crude and OPEC NGLs and unconventionals**. While the IEA's estimate for the call on OPEC crude in 2014 is 0.5 mb/d lower than OPEC's, its estimate for OPEC NGLs and unconventionals is 0.7 mb/d higher.

- **During 2013, the IEA and OPEC both made upward revisions of 300kb/d to their outlooks for 2013 non-OPEC supply growth**. Production from the United States was the primary driver of these adjustments.

IEA and OPEC Medium-Term Outlooks

- **In 2013, a six-month gap in the publication of their respective medium-term outlooks raises questions regarding the congruence of the IEA and OPEC projections**. Both organisations use the IMF as a key source for GDP growth assumptions. As suggested by the IMF's repeated downards adjustments for world economic growth forecasts during 2013, the IEA's MTOMR may well have included more optimistic macroeconomic sentiment in light of its earlier publication. The different publication schedule may in part explain why the IEA's assumed GDP growth rate is 0.5% higher than OPEC's for the medium-term projection period.

Assumptions differ regarding the path of nominal oil prices over the medium-term, with the gap in prices expected to reach US$17/bbl by 2018.

- **Assumptions differ regarding the path of nominal oil prices over the medium-term, with the gap in prices expected to reach US$17/bbl by 2018**. The "IEA Average Import

Price" is projected to gradually decline from US$109/bbl in 2013 to US$93 in 2018, while OPEC's ORB is expected to average US$110/bbl throughout the period.

- **On the demand side, both the IEA and OPEC project robust medium-term growth in global liquids demand**, though the IEA's more bullish demand projection is based on higher 2012 baseline data and a more optimistic economic outlook over the time horizon. These factors contribute to a 2.3mb/d difference in expected total liquids demand by 2018.

Regarding regional demand growth, the IEA and OPEC have almost identical projections for medium-term OECD liquids demand, but diverge with respect to non- OECD demand growth.

- **Regarding regional demand growth, the IEA and OPEC have almost identical projections for medium-term OECD liquids demand, but diverge with respect to non-OECD demand growth**, again as a function of different baseline data and growth rate assumptions.

- **For their supply outlooks over the medium-term, the IEA and OPEC both expect non-OPEC countries to dominate supply growth**. The IEA foresees OECD Americas leading supply growth throughout the forecast horizon, while OPEC expects OECD Americas supply will give way to non-OECD, non-OPEC countries during the later years of the period.

IEA and OPEC Long-Term Outlooks

- **There are substantial differences between IEA and OPEC long-term price assumptions**. The difference in approaches of assessing the costs of developing oil resources by region and oil type may in part explain the gap of US$45/bbl (in real 2012 US$) in 2035 price assumptions made in OPEC's Reference Case and the IEA's Current Policies Scenario.

- **Overall, the fundamental trends of global energy consumption set forth in the 2013 WEO and WOO are similar to those presented in 2012**: global energy demand is expected to remain robust through 2035 (led by developing economies), and total fossil fuels are projected to retain their dominant share in energy consumed, albeit experiencing gradual declines.

- **OPEC expects stronger long-term primary energy demand growth than the IEA**: 52% in OPEC's Reference Case versus 45% in the IEA's Current Policies Scenario.

Comparing all scenarios presented in the WEO2013 and the WOO2013 yields a wide range of possible liquids demand levels in 2035, ranging from 90-115 mb/d.

- **Comparing all scenarios presented in the WEO2013 and the WOO2013 yields a wide range of possible liquids demand levels in 2035, ranging from 90-115 mb/d**. The range narrows to around 100-115 mb/d if one excludes the IEA's 450 ppm Scenario.

- **OPEC's Higher Economic Growth Scenario and the IEA's Current Policies Scenarios produce the higher end of demand projections (both around 115 mb/d by 2035)**, though these scenarios embody quite different sets of assumptions.

- **Comparing long-term liquids supply between the WOO2013 Reference Case and the WEO2013 Current Policies Scenario, the most significant divergence lies in the outlooks for OECD Americas**, with the IEA's projection 2.7 mb/d or 14.4% higher than OPEC's, excluding biofuels.

The IEA and OPEC have different definitions and perspectives regarding the prospects for light tight oil.

- **The IEA and OPEC have different definitions and perspectives regarding the prospects for light tight oil**:

  While the IEA's light tight oil (LTO) category only includes crude, OPEC's "tight oil" category also includes tight NGLs.

  OPEC projects that LTO supply in the US and Canada will peak around 2017-19, and will then gradually decline over the remainder of the long-term projection period. OPEC believes that by 2035 LTO production in the US and Canada will just slightly exceed current production levels, though in its Upside Supply Scenario OPEC considers a more optimistic LTO path wherein North American production in 2035 would be 2.5mb/d higher than in OPEC's Reference Case level.

  The IEA expects that by 2015 the United States will surpass Saudi Arabia as the world's largest oil producer, but acknowledges that there are downside risks to this scenario, including the possibility that new plays may be less productive and more expensive.

  The sharp contrast in LTO projections may result from different perspectives on the impact of rapid decline rates in field production or assumptions regarding the resource base and sustainability of investment activity.

- Beyond the different outlooks for LTO, **the IEA and OPEC also diverge regarding the prospects for Brazil's deep water pre-salt deposits**, with the former organisation quite optimistic for the South American nation's potential contributions to global supply.

- **The IEA's Current Policies Scenario and OPEC's Reference Case share a number of similar views regarding long-term supply outlooks**. Both expect OPEC crude production over the next ten years to remain around 30 mb/d, and both expect production levels to rise after 2020. Both expect OPEC NGLs production to increase steadily throughout the forecast period.

The major difference in total expected primary energy supply by energy source lies in the outlooks for fossil fuels.

- **The major difference in total expected primary energy supply by energy source lies in the outlooks for fossil fuels**. The IEA's projection for total natural gas supply by 2035 is 12 mboe/d or 14% lower than OPEC's, while its outlook for oil and coal supply are respectively 3 mboe/d and 6 mboe/d higher than OPEC's.

1. Background and Introduction

The IEA and OPEC support and inform energy market actors by collecting and analysing a wide variety of energy data, and by making projections about future trends in energy production and consumption. Both organisations track global energy market dynamics to produce short-, medium- and long-term energy outlooks.

In light of the importance of these outlooks and their influence on decisions taken by policymakers, corporate executives, investors, and a diverse selection of other stakeholders, the Joint Statement of the 22 June 2008 Jeddah Energy Meeting called for shared analyses of oil market trends and outlooks. Attachment II of the Cancún Ministerial Declaration (March 2010), which identifies specific areas for IEA-IEF-OPEC cooperation on numerous fronts, outlined the terms for trilateral collaboration with regard to energy outlooks and other areas. Attachment II recognised the IEF's role as a platform for sharing insights and exchanging views about energy market trends, and called for the three organisations to organise an Annual Symposium on Energy Outlooks at the IEF Secretariat.

The First, Second and Third IEA-IEF-OPEC Symposia on Energy Outlooks were held at the IEF Secretariat in 2010, 2011 and 2013, respectively, and discussions therein focussed on the outlooks and key themes—including the potential for data harmonisation efforts to help make the IEA and OPEC outlooks more directly comparable. The Third joint Symposium, held in 2013, involved more extensive participation from both the IEA and OPEC than prior Symposia. The presence of top leadership from all three organisations at the Third Symposium underscored the shared commitment to the dialogue. Technical experts from the IEA, IEF and OPEC were also present, and convened the day after the Third Symposium with the goal of identifying points where work could be done to harmonise data definitions, in a common effort to make the IEA and OPEC outlooks more comparable. Notable progress was made at that meeting and in the months that followed.

The Fourth IEA-IEF-OPEC Annual Symposium on Energy Outlooks will be held on 22 January 2014, wherein discussions among key market actors, policymakers and stakeholders from both the public- and private-sectors will focus on establishing better understanding of where there is consensus concerning energy outlooks, and where more dialogue is required. As with prior gatherings, the Fourth Symposium will also highlight where progress has been made in harmonising data definitions, and where additional enhancements may be made.

Attachment II of the Cancún Declaration calls for the IEF, in consultation with the IEA and OPEC, to produce an introductory paper to help frame discussions at the Symposia. In an effort to advance the goal of promoting understanding of energy market trends and outlooks, this paper--prepared for the Fourth Symposium on Outlooks--compares the IEA's and OPEC's short-, medium- and long-term energy outlooks published in 2013. This paper has the following three objectives:

- To identify key similarities and divergences between IEA and OPEC outlooks;
- To better understand the IEA's and OPEC's assumptions, definitions, and methodologies;
- To highlight efforts that have been made to improve the comparability of the outlooks, taking note of areas that would benefit from further progress on harmonisation.

On the topic of harmonisation, the introductory paper produced for the Third IEA-IEF-OPEC Symposium, published in January 2013, identified opportunities to enhance the comparability of the outlooks by facilitating a dialogue between the IEA and OPEC concerning the following points:

- Differences in historical data;
- Variations in geographical definitions;
- Non-OECD demand forecast methodologies, particularly for China, India and the Middle East;
- Energy intensity assumptions;
- Demand and supply elasticity assumptions;
- Cost estimation and long-term price assumptions;
- Categorisation of liquids supply;
- Unit conversion factors;
- Methods in which energy data and information are presented.

Progress has been made on several of the above-mentioned points, reflecting the cooperation and flexibility of both the IEA and OPEC to discuss and review their methods. Two examples of this progress include the IEA's improved demand estimation strategies for China and other non-OECD countries, and OPEC's inclusion of non-commercial biomass in its figures, which makes its energy demand outlook more comparable with that of the IEA (now both the IEA and OPEC include both traditional/non-commercial and modern biomass in their figures).

2. Baseline 2012 Data

Numerous issues on the energy outlooks harmonisation agenda remain, notably regarding baseline historical data—upon which the various outlooks base their projections.

Notwithstanding the progress made to date, numerous issues on the harmonsation agenda remain, notably regarding baseline historical data—upon which the various outlooks build their projections. **Table 1, Table 2,** and **Table 3** respectively provide comparisons of the IEA's and OPEC's base year (2012) demand, supply and stock change data. Comparing 2012 data using IEA's OMR, the differences with OPEC in both world oil demand and supply surpass the 1 million barrels per day (mb/d) mark, underscoring the fact that the IEA and OPEC make their calculations with different methodologies. It is worth noting that the IEA uses different 2012 base year data in its OMR and WEO. For example, world liquids demand for 2012 is 89.2 mb/d in the WEO2013, while in the November 2013 OMR the level is 90.0 mb/d.

Regarding global liquids demand, **Table 1** demonstrates that the historical difference is almost completely derived from non-OECD countries--particularly from non-OECD Asia excluding China, as well as Africa. The IEA has improved its estimation strategy for China's oil demand, and the IEA's revised method appears to have had the effect of reducing the gap between its estimate of China's oil demand relative to OPEC's calculation . The IEA's new "apparent demand" method adds changes in reported oil stock levels to the existing methodology that primarily summed refinery outputs with net product imports[2]. The IEA's rationale for this change is to more accurately reflect China's oil demand by accounting for its significantly increased oil stocks, as the country rapidly expands refinery capacity. As a result, the gap in the IEA's and OPEC's "apparent demand" estimates for China is now quite small.

2 The new methodology is explained in detail in the IEA's February 2013 OMR.

Table 1. Liquids Demand in 2012 (mb/d)

	IEA	OPEC	DIFFERENCE (IEA - OPEC)
Total OECD	45.9	46.0	-0.1
OECD Americas	23.6	23.6	0.0
OECD Europe	13.7	13.7	0.0
Asia Oceania	8.6	8.6	0.0
Total Non-OECD	44.1	43.0	1.2
Asia	21.1	20.6	0.5
China	9.8	9.7	0.1
Other non-OECD Asia	11.3	10.9	0.4
Middle East	7.7	7.6	0.1
Latin America	6.4	6.3	0.1
FSU	4.5	4.4	0.1
Europe	0.7	0.6	0.1
Africa	3.7	3.4	0.3
World	90.0	88.9	1.1

***Table 1 data sources**: IEA OMR Nov 2013, Table 1; OPEC MOMR Nov 2013, Table 4.1.*

As for world oil supply, **Table 2** shows that the IEA-OPEC difference in 2012 data primarily lies in non-OECD countries and in OPEC supply. The largest difference from the non-OECD region stems from the Former Soviet Union (FSU) nations. Regarding OPEC supply, there is a notable gap between the IEA and OPEC estimates of OPEC NGLs and unconventional oil supply data, and a more modest gap in OPEC crude.

The IEA and OPEC have different definitions for NGLs. For example, OPEC includes tight NGLs in the LTO (a crude category) rather than in the NGLs category, while IEA includes all NGLs in the NGLs category. The sizeable divergence in their historical OPEC NGLs figures may partly result from their different NGLs categorisation.

Table 2 shows that the IEA-OPEC difference in 2012 data primarily lies in non-OECD countries and in OPEC supply.

Table 2. Liquids Supply in 2012 (mb/d)

	IEA[a]	OPEC	DIFFERENCE (IEA - OPEC)
Total OECD	21.1	21.1	0.0
OECD Americas	16.9	16.8	0.1
OECD Europe	3.7	3.8	0.0
Asia Oceania	0.6	0.6	0.1
Total Non-OECD	30.2	29.7	0.4
Asia	7.9	7.8	0.1
China	4.2	4.2	0.1
Other non-OECD Asia	3.7	3.6	0.0
Middle East	1.5	1.5	0.0
Latin America	4.7	4.7	0.0
FSU	13.6	13.3	0.3
Europe	0.1	0.1	0.0
Africa	2.3	2.3	0.0
Processing gains	2.1	2.1	0.0
Total Non-OPEC	53.4	52.9	0.4
Total OPEC	37.6	36.7	0.9
OPEC crude	31.3	31.1	0.2
OPEC NGLs + unconventionals	6.3	5.6	0.7
World	90.9	89.6	1.3

Table 2 data sources: *IEA OMR Nov 2013, Table 1; IEA MTOMR 2013, Table on p.77 for biofuels; OPEC MOMR Nov 2013, Table 5.1,10.3.*

Table 2 notes: *IEA[a] Biofuels from IEA MTOMR 2013 are added to IEA regional oil supply data for comparability with OPEC estimates.*

Table 3 presents stock changes and other items that account for the difference between supply and demand data in the IEA and OPEC reports. Both the IEA and OPEC record data on commercial oil stock changes and strategic petroleum reserve (SPR) changes from reporting OECD countries. “Oil-on-water” is oil used in floating storage and water transit. The remainder of the gap between total supply and total demand is allocated to a “miscellaneous to balance” item, which covers both stock changes in non-OECD countries and other items.

Table 3. Stock Change and Miscellaneous Items (2012-2011) (mb/d)

	IEA	OPEC	DIFFERENCE (IEA - OPEC)
Reported OECD	0.2	0.2	0.0
Industry/commercial	0.2	0.2	0.0
Government/SPR	0.0	0.0	0.0
Oil-on-water	0.0	-0.1	0.1
Miscellaneous to balance [a]	0.8	0.6	0.2
Total stock change & misc.	0.9	0.7	0.2

Table 3 data sources: *IEA OMR Nov 2013, Table 1; OPEC MOMR Nov 2013, Table 10.3.*

Table 3 notes: *Miscellaneous to balance[a]: OPEC miscellaneous to balance is computed as the difference between total OPEC stock change/misc. and other reported stock changes.*

In addition to differences in historical data that generate divergences in their outlooks, the IEA and OPEC have various differences with regard to definitions, assumptions and forecast methodologies.

In addition to differences in historical data that generate divergences in their outlooks, the IEA and OPEC have various differences with regard to definitions, assumptions and forecast methodologies. For example, there is a gap of US$45 per barrel (in real 2012 dollars) in their assumptions for the price of oil in 2035. Another case in point is the sharp contrast regarding projections for expected North American LTO production levels. Both points will be explored further later in this paper.

Sections Three, Four and Five of this introductory paper compare the short-, medium-, and long-term outlooks issued by the IEA and OPEC, respectively. **Diagram 1** lists the publications used for comparison herein. November 2013 monthly oil market reports were used due to the short timeframe for completing the paper. The IEA has moved forward the publication date for its Medium-Term Oil Market Report (MTOMR) 2013, which yields a six-month gap versus the release of its counterpart: OPEC's World Oil Outlook (WOO) 2013.

Diagram 1. List of IEA and OPEC Outlooks Analysed in this Introductory Paper

	IEA	OPEC
Short-term	Oil Market Report (OMR), published November 2013	Monthly Oil Market Report (MOMR), published November 2013
Medium-term	Medium-Term Oil Market Report (MTOMR), **published May 2013**	World Oil Outlook (WOO 2013), published November 2013
Long-term	World Energy Outlook (WEO), published November 2013	World Oil Outlook (WOO), published November 2013

3. Short-term Energy Outlooks

Short-term oil market reports from the IEA and OPEC present outlooks about energy demand and supply for up to an 18 month time horizon, based on regular monitoring of economic growth and market conditions. Monthly oil market reports also include data and analysis of

fluctuations in benchmark oil prices, changes in economic indicators in major economies, and observations regarding product market and refinery operations as well as oil stock and trade movements. Both the IEA and OPEC capture market-moving events and offer in-depth analysis in the articles featured in their respective reports. Section Three summarises their perspectives on short-term macroeconomics and oil demand and supply outlooks[3].

3.1 Economic Growth Assumptions

The IEA and OPEC take different approaches to GDP forecasts. The IEA does not typically make its own GDP forecasts for the OMR, but instead refers primarily to the IMF's projections in World Economic Outlooks and World Economic Outlook Updates; on occasion the IEA OMR makes adjustment to IMF forecasts. OPEC incorporates projections from the IMF and other publications into its own GDP growth forecast model and delivers the forecast results for the world and major economies in its monthly reports.

Despite the general downward trend in growth forecasts, both the IMF (used by the IEA) and OPEC project higher global GDP growth rates in 2014 than in 2013, underpinned mainly by an expected further strengthening in advanced economies **(Diagram 2)**.

Diagram 2. Short-term Global GDP Growth Assumptions

	2013	2014
IEA (IMF)	2.9%	3.6%
OPEC	2.9%	3.5%

Diagram 2 data sources: *OPEC MOMR Nov 2013, Table 3.1; IMF World Economic Outlook Oct 2013, Table 1.1.*

However, the similarities in global projected growth rates between the IMF and OPEC mask important regional variations. For example, the IMF's 2014 projections for GDP growth in China and India (7.3% and 5.1%) are notably lower than OPEC's estimates (7.8% and 5.6%).

3.2 Short-term Liquids Demand

Although projections for GDP growth in 2013 have been steadily adjusted downward, projections for oil demand growth in 2013 have remained in the 0.8 to 1.0 mb/d range.

Although projections for GDP growth in 2013 have been steadily adjusted downward, projections for oil demand growth in 2013 have remained in the 0.8 to 1.0 mb/d range **(Figure 1)**. Differences in monthly projections for 2013 global liquids demand growth between the IEA and OPEC have been fairly small, staying within a range of 0.2 mb/d.

3 Though this introductory paper compares data from the November oil market reports, all 2013 monthly reports from both organisations were reviewed to assess how their views evolved throughout the year.

Figure 1. Forecast Revisions of 2013 World Liquids Demand Growth

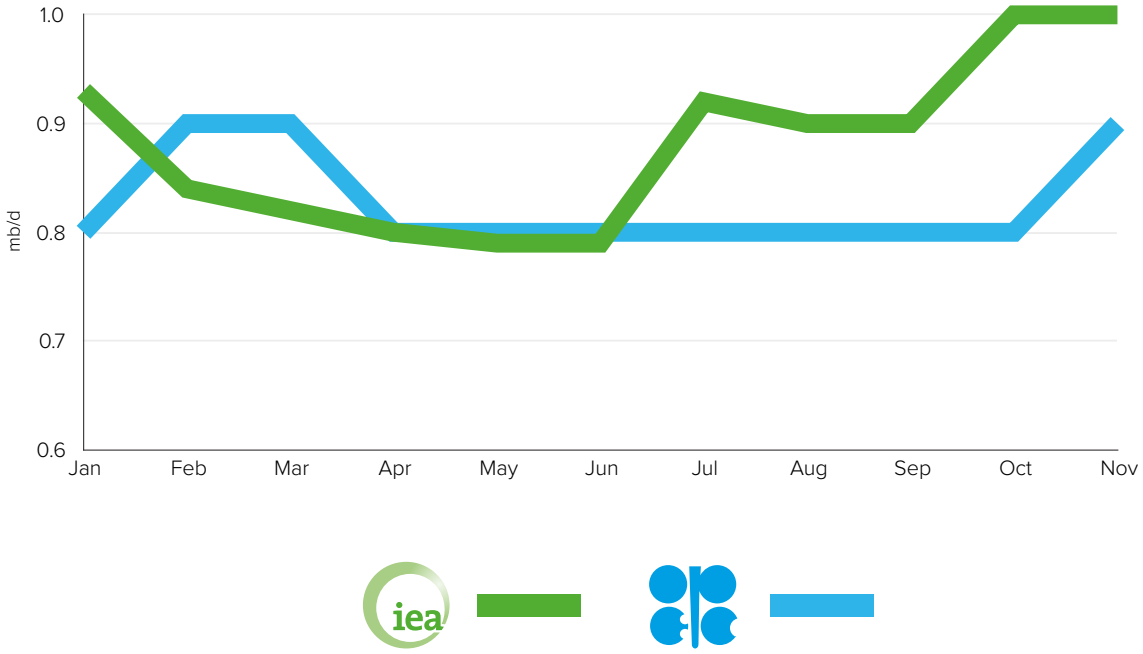


Figure 1 data sources: *IEA OMR Jan–Nov 2013, Table 1; OPEC MOMR Jan–Nov 2013, Table 10.3.*

Both the IEA and OPEC revise their demand forecasts based on actual demand data and changing macroeconomic conditions. However, discrepancies can emerge as a result of different time lags in responding to updated information. For example, reported oil demand in some OECD economies was stronger than previously projected for July and August 2013. While the IEA obtained those data and made a 90 kb/d upward revision in October, OPEC was not able to make that adjustment until November. Timely data sharing and responsiveness to updated information might help to reduce this type of projection gap, though practical considerations in the timing of data releases may preclude the complete elimination of this challenge. Macroeconomic uncertainties are the other main causes of projection differences, since the IEA and OPEC may revise their demand forecasts based on different market events and indicators.

Compared to 2013, both the IEA and OPEC are slightly more bullish about the prospects for liquids demand growth in 2014, in part supported by higher GDP growth projections. **Figure 2** presents the IEA and OPEC world liquids demand estimates for 2012, and projections for 2013 and 2014.

Figure 2 illustrates the impact of the difference in the 2012 historical liquids demand data. This difference yields a sizeable gap (over 1 mb/d) between the IEA and OPEC short-term world liquids demand outlooks for 2013 and 2014.

Figure 2. Short-term World Liquids Demand: 2012-2014

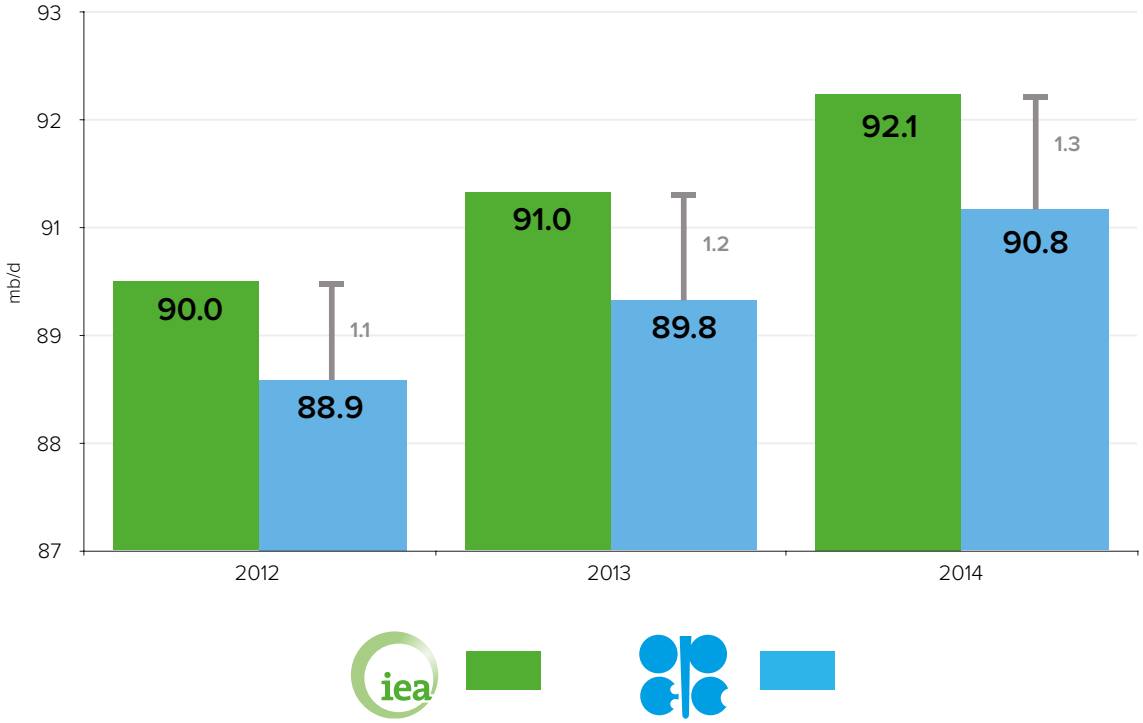


Figure 2 data sources: *IEA OMR Nov 2013, Table 1; OPEC MOMR Nov 2013, Table 10.3.*
Figure 2 notes: *2012 is historical data and 2013 and 2014 are projections.*

Table 1 and **Figure 2** illustrate the impact of the difference in the 2012 historical liquids demand data. This difference yields a sizeable gap (over 1 mb/d) between the IEA and OPEC short-term world liquids demand outlooks for 2013 and 2014.

Table 4 summarises the IEA's and OPEC's total liquids demand outlooks for 2013 and 2014, as well as the projection differences between them. **Table 1** again illustrates that those differences are mainly rooted in historical data. As of their November outlooks, the IEA projected 1.0 mb/d of growth in world liquids demand for 2013, while OPEC's forecast was for marginally lower 0.9 mb/d growth. For 2014, the IEA's projected growth was 1.1 mb/d and OPEC's was 1.0 mb/d (as of November 2013).

Table 4 summarises the IEA's and OPEC's total liquids demand outlooks for 2013 and 2014, as well as the projection differences between them.

Table 4. Short-term World Liquids Demand (mb/d)

	2013			2014		
	IEA	OPEC	DIFFERENCE (IEA-OPEC)	IEA	OPEC	DIFFERENCE (IEA-OPEC)
Total OECD	45.7	45.7	0.0	45.5	45.5	0.0
OECD Americas	23.7	23.8	-0.1	23.7	23.9	-0.1
OECD Europe	13.6	13.5	0.1	13.5	13.3	0.2
Asia Oceania	8.4	8.5	-0.1	8.2	8.3	-0.1
Total Non-OECD	45.3	44.1	1.2	46.7	45.3	1.4
Asia	21.8	21.1	0.7	22.5	21.7	0.8
China	10.2	10.1	0.1	10.6	10.4	0.2
Other non-OECD Asia	11.6	11.1	0.6	11.9	11.3	0.6
Middle East	7.9	7.9	0.0	8.1	8.2	-0.1
Latin America	6.6	6.5	0.1	6.8	6.7	0.1
FSU	4.6	4.5	0.1	4.7	4.6	0.2
Europe	0.7	0.6	0.0	0.7	0.6	0.1
Africa	3.8	3.5	0.4	4.0	3.5	0.5
World	91.0	89.8	1.2	92.1	90.8	1.3

Table 4 data sources: *IEA OMR Nov 2013, Table 1; OPEC MOMR Nov 2013, Table 4.1 & Table 4.2*

Regarding regional demand growth, the IEA and OPEC also share similar views (**Figure 3, Table 4**). The IEA has slightly more bullish forecasts in almost all areas, with the exception of the 2014 forecast for OECD Americas. While OPEC expects OECD Americas' demand to increase by 0.1 mb/d in 2014, the IEA projects that it will remain nearly flat.

Both the IEA and OPEC believe that Asian countries will continue to lead liquids demand growth, though the IEA is noticeably more bullish regarding non-OECD Asia excluding China.

On the non-OECD side, both the IEA and OPEC believe that Asian countries will continue to lead liquids demand growth, though the IEA is noticeably more bullish regarding non-OECD Asia excluding China. A noteworthy difference in 2014 demand growth projections stems from African nations: the IEA anticipates a 0.2 mb/d growth for Africa, while OPEC expects the demand to be flat. Since the 2012 baseline data for Africa vary by 0.3 mb/d (**Table 1**), the discrepancy in projected total liquids demand for Africa in 2014 reaches 0.5 mb/d, the second largest divergence in projections among all regions (**Table 4**).

Regarding 2014 regional demand growth, the IEA has slightly more bullish forecasts, with the exception of the 2014 forecast for OECD Americas.

Figure 3. Short-term World Liquids Demand Annual Growth

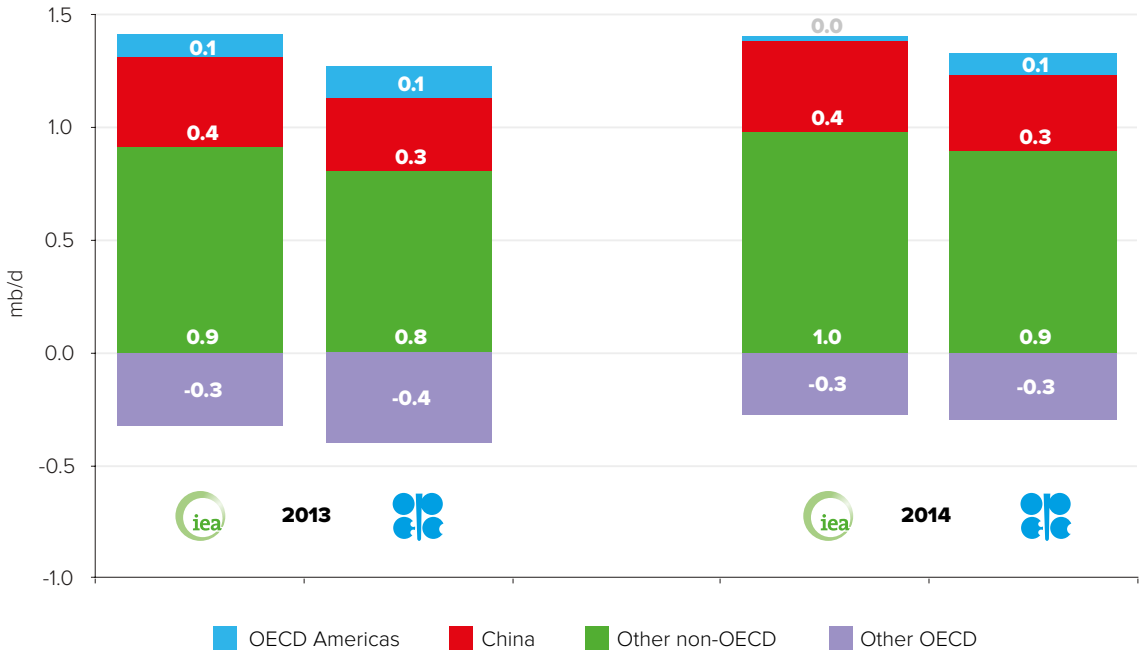


Figure 3 data sources: *IEA OMR Nov 2013, Table 1; OPEC MOMR Nov 2013, Tables 4.1, 4.2.*

Figure 3 data notes: *Due to rounding, numbers presented may not add up precisely to the totals provided and percentages may not precisely reflect the absolute figures.*

3.3 Short-term Liquids Supply

Table 5 displays a detailed comparison of short-term liquids supply outlooks by region. Compared with the historical supply data in **Table 2**, a substantial divergence emerges between the IEA's and OPEC's estimates of OECD supply, with the IEA projecting stronger production growth from OECD nations. The discrepancy between the two projections for total non-OPEC supply has increased from 0.5 mb/d in 2013 to 1.1 mb/d in 2014.

Regarding 2014 OPEC supply, the 0.2 mb/d difference between IEA and OPEC merits further discussion, as this small gap masks larger differences in projections for related subcategories.

Regarding 2014 OPEC supply, the 0.2 mb/d difference between IEA and OPEC merits further discussion, as this small gap masks larger differences in projections for related sub-categories. While the IEA's estimate for call on OPEC crude is 0.5 mb/d lower than OPEC's projection, its estimate for OPEC NGLs and unconventionals is 0.7 mb/d higher than OPEC's projection.

Table 5. Short-term World Liquids Supply Forecasts (mb/d)

	2013			2014		
	IEA[a]	OPEC	DIFFERENCE (IEA-OPEC)	IEA	OPEC	DIFFERENCE (IEA-OPEC)
Total OECD	22.2	21.9	0.3	23.3	22.7	0.6
OECD Americas	18.2	17.8	0.4	19.2	18.8	0.4
OECD Europe	3.5	3.6	-0.1	3.5	3.4	0.1
Asia Oceania	0.5	0.5	0.0	0.5	0.5	0.0
Total Non-OECD	30.2	29.9	0.3	30.9	30.4	0.5
Asia	7.8	7.8	0.0	8.0	7.8	0.2
China	4.3	4.2	0.1	4.4	4.2	0.2
Other non-OECD Asia	3.6	3.6	0.0	3.6	3.6	0.0
Middle East	1.4	1.4	0.0	1.3	1.4	-0.1
Latin America	4.8	4.8	0.0	5.0	5.0	0.0
FSU	13.8	13.4	0.4	14.0	13.6	0.4
Europe	0.1	0.1	0.0	0.1	0.1	0.0
Africa	2.3	2.4	-0.1	2.5	2.5	0.0
Processing gains	2.2	2.2	0.0	2.2	2.2	0.0
Total Non-OPEC	54.6	54.1	0.5	56.4	55.3	1.1
Total OPEC	36.4[c]	35.7[c]	0.7	35.7[c]	35.5[c]	0.2
Call on OPEC crude + stock ch. & misc.[b]	30.0	29.9	0.1	29.1	29.6	-0.5
OPEC NGLs + unconventionals	6.4	5.8	0.6	6.6	5.9	0.7
World Supply	91.0[c]	89.8[c]	1.2	92.1[c]	90.8[c]	1.3

Table 5 data sources: *IEA OMR Nov 2013, Table 1; IEA MTOMR 2013, Table on p.77 for biofuels; OPEC MOMR Nov 2013, Table 5.1, 5.2, 10.3.*

Table 5 notes: *IEA[a]: Biofuels from IEA MTOMR 2013 are added to IEA regional oil supply data for comparability with OPEC estimates; Call on OPEC crude + stock ch. & misc[b]: Equals total liquids demand minus non-OPEC supply minus OPEC NGLs/unconventionals. Estimates for total OPEC supply and world supply are constructed from other components because IEA and OPEC do not directly provide these forecasts in their reports. Total OPEC and World Supply[c]: Estimates for total OPEC supply and world supply are constructed from other components because IEA and OPEC do not directly provide these forecasts in their reports.*

Figure 4 shows that the IEA and OPEC have had similar estimates of non-OPEC annual supply growth over the past three years based on historical data and revisions over 2013. During 2013, both the IEA and OPEC made upward revisions of 300 kb/d for 2013 non-OPEC supply growth (**Figure 5**). The United States has been the primary driver of these upward revisions, as real production data have repeatedly surpassed expectations.

Looking forward, the IEA and OPEC differ greatly on the growth projections for 2014. The IEA

makes a bullish prediction of a 1.8 mb/d increase in total non-OPEC supply, 0.6 mb/d higher than OPEC's estimate. To assess if this degree of divergence in 2014 growth forecasts is unusual, November issues of monthly oil market reports from both the IEA and OPEC for the past five years were reviewed, with a focus on differences in their projections for annual non-OPEC supply growth for the following year. The 0.6 mb/d divergence for 2014 is indeed significant relative to past outlooks, as over the last five years divergences in IEA and OPEC projections for the following year's non-OPEC supply growth typically ranged from 0.1 to 0.2 mb/d.

The IEA makes a bullish prediction of a 1.8 mb/d increase in 2014 total non-OPEC supply, 0.6 mb/d higher than OPEC's estimate. This gap is significant relative to past outlooks, as over the last five years divergences in IEA and OPEC projections for the following year's non-OPEC supply growth typically ranged from 0.1 to 0.2 mb/d.

Figure 4. Short-term Non-OPEC Liquids Supply Annual Growth

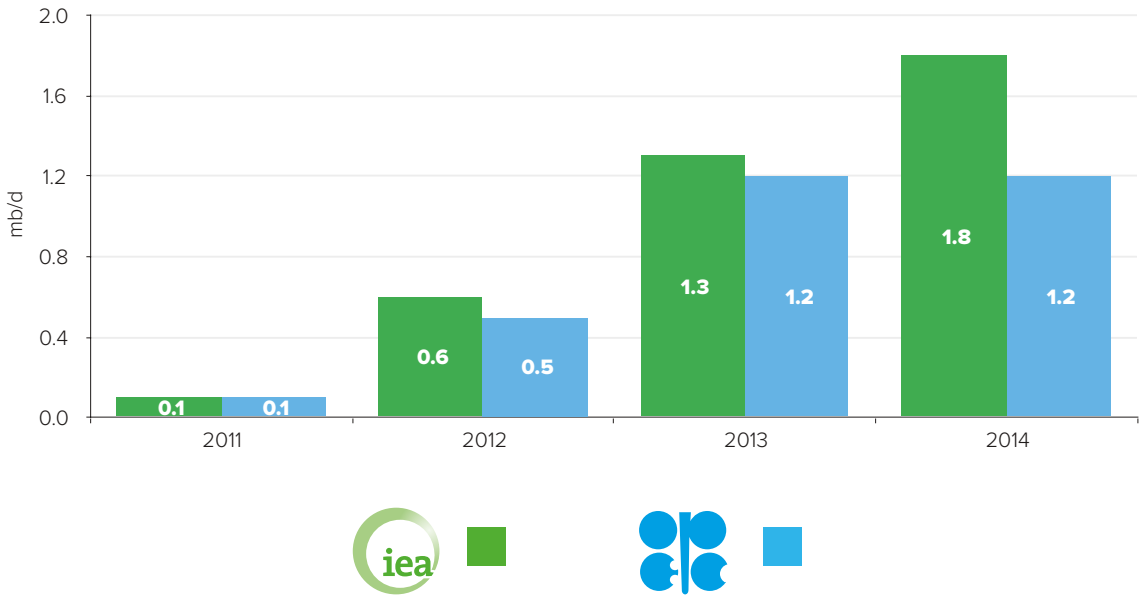


Figure 4 data sources: *IEA OMR Nov 2013, Table 1; OPEC MOMR Nov 2013, Table 10.3.*

During 2013, both the IEA and OPEC made upward revisions of 300 kb/d for 2013 non-OPEC supply growth.

Figure 5. Forecast Revisions of 2013 Non-OPEC Liquids Supply Growth

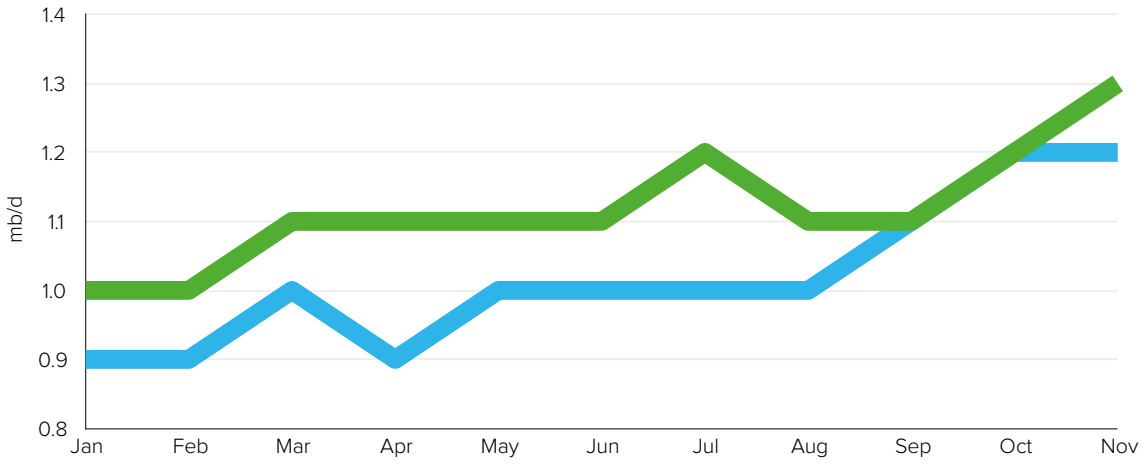


Figure 5 data sources: *IEA OMR Jan–Nov 2013, Table 1; OPEC MOMR Jan–Nov 2013, Table 10.3.*

Comparing regional non-OPEC supply forecasts between the IEA and OPEC presents a challenge because of the organisations' different treatment of biofuels. While OPEC includes biofuels in each region's total liquids supply, the IEA does not. Comparison is more feasible than in the past because as of December 2013 the IEA now provides a separate regional biofuels production table in its OMR. A direct comparison between IEA and OPEC liquids supply outlooks is still difficult, however, for two reasons: (1) biofuels supply data have to be added to other liquids supply in IEA reports to be comparable with OPEC's liquids supply data; and (2) country or regional breakdowns for biofuels production are inconsistent with the breakdowns for other liquids in the IEA reports as well as those for OPEC's liquids supply. Because this introductory paper was prepared before the new reporting in the December 2013 OMR, it refers to the IEA's Medium-term Oil Market Report for regional biofuels supply data, and adds those data to each region's oil supply data as featured in the IEA OMR. **Figure 6** illustrates how the IEA's and OPEC's views on regional supply growth differ in 2013 and 2014.

Figure 6 illustrates how the IEA's and OPEC's views on regional supply growth differ in 2013 and 2014. The IEA's higher growth forecast for non-OPEC supply in 2014 is based on more optimistic views on supplies from both OECD and non-OECD regions.

Figure 6. Short-term Liquids Supply Net Annual Growth

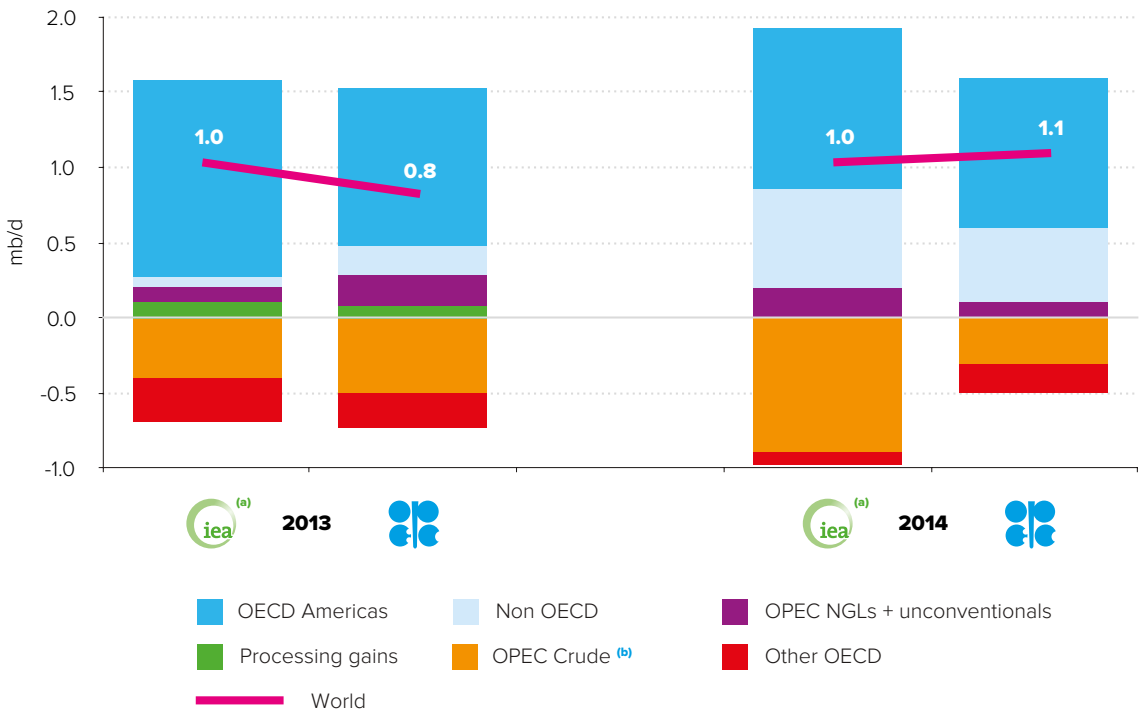


Figure 6 data sources: *IEA OMR Nov 2013, Table 1; IEA MTOMR 2013, Table on p.77 for biofuels; OPEC MOMR Nov 2013, Table 5.1, 5.2, 10.3.*

Figure 6 notes: *IEA[(a)]: Biofuels from IEA MTOMR 2013 are added to IEA regional oil supply data for comparability with OPEC estimates. OPEC crude[(b)]: IEA and OPEC do not forecast OPEC crude; this estimate is constructed as the "call on OPEC crude" including "stock change and miscellaneous".*

The IEA has made significant upward adjustments to its 2014 non-OPEC supply growth forecasts during the past year. Most of the adjustments can be attributed to a reassessment of supply from North America, the FSU and Africa.

The IEA's higher growth forecast for non-OPEC supply in 2014 is based on more optimistic views on supplies from both OECD and non-OECD regions. The IEA has made significant upward adjustments to its 2014 non-OPEC supply growth forecasts during the past year. Most of the IEA's adjustments can be attributed to a reassessment of three supply sources:

North America, the FSU and Africa. According to the IEA's October OMR, production in North America has consistently exceeded expectations, especially from LTO production at the Eagle Ford and Bakken plays, as well as NGLs production from the Marcellus and Utica plays. The IEA also expects several oil sands projects in Canada to ramp up before the end of 2014.

Outside North America, increases in growth projections are largely driven by Russia and Kazakhstan in the FSU region, and by South Sudan in Africa. Kazakhstan has gained attention since the announcement of start-up production at the giant Kashagan field. Upward revisions made to South Sudan were mainly due to an improved political outlook. Though OPEC has also revised its 2014 outlooks upward for these suppliers, its revisions are not as large as those of the IEA.

The IEA's and OPEC's outlooks for world liquids demand growth in 2014 are similar, yet their different perspectives on non-OPEC supply growth lead to a significant disparity in projections for the "call on OPEC crude". In late 2013, OPEC crude supply slipped below the 30 mb/d level, largely due to pipeline outages in Iraq and political unrest in Libya. Although Saudi Arabia increased its production level to over 10mb/d, this did not fully offset these losses. Both the IEA and OPEC have a lower "call on OPEC crude" number for 2014, suggesting a potential further reduction of OPEC supply. The IEA's estimate of "call on OPEC crude" is 0.5 mb/d below OPEC's estimate.

4. Medium-term Energy Outlooks

The comparison of medium-term outlooks in this introductory paper analyses the IEA's Medium-term Oil Market Report (MTOMR) published in May 2013, and OPEC's World Oil Outlook (WOO) published in November 2013 (**Diagram 1**). Both organisations make their medium-term projections through 2018, using 2012 as a base year. However, there is a six-month gap between the publication dates of the two reports. Given the dynamic nature of market conditions, this time gap may have may have affected the congruence of the two medium-term projections.

4.1 Oil Price and Economic Growth Assumptions

4.1.1 Oil Price

The manner in which the IEA and OPEC make oil price assumptions differs in two fundamental ways: they use different price proxies and oil price assumptions are derived through different approaches. These differences understandably lead the two organisations to distinct medium-term price assumptions.

The manner in which the IEA and OPEC make oil price assumptions differs in two fundamental ways.

First, the IEA and OPEC use different price proxies. In the WOO series, OPEC makes assumptions for an OPEC Reference Basket (ORB) price, which is a production-weighted average price of a number of OPEC crude products. In contrast, the IEA uses an "IEA Average Import Price", which reflects the IEA's perspective on its member countries' future crude import prices.

Second, oil price assumptions are derived through different approaches. OPEC's ORB price assumption mainly reveals its perceptions regarding how the full-cycle oil production cost of the marginal barrel will evolve. This marginal cost estimate is based on an assessment of those fields where production costs are highest, such as oil sands, tight oil plays, deepwater

and Arctic fields. Differing from this cost-based approach, the IEA utilises market information to derive its medium-term price assumptions. The IEA uses a six-year forward curve of Brent futures prices, and then applies a certain discount to reach its price assumptions.

These differences understandably lead the two organisations to distinct medium-term price assumptions. In the MTOMR report, the nominal "IEA Average Import Price" is projected to gradually decline from US$109/bbl in 2013 to US$93/bbl in 2018. In contrast, the nominal ORB price in OPEC's WOO report is expected to average US$110/bbl over the period to 2020. As a result, there is a growing discrepancy between the two price assumptions throughout the medium-term projection period, with the gap reaching US$17/bbl by 2018 (**Figure 7**). The extent to which the disparity in price assumptions influences the IEA and OPEC medium-term supply and demand outlooks is not clear. The IEA's higher medium-term demand projection might be driven in part by its lower price assumption, and perhaps also by its higher economic growth assumption (if one assumes a somewhat more optimistic IEA supply outlook). Price divergences of this magnitude may eventually lead to lower investment in production, but the main impacts would be felt over the longer term.

The extent to which the disparity in price assumptions influences the IEA and OPEC medium-term supply and demand outlooks is not clear: The IEA's higher medium-term demand projection might be driven by its lower price assumption, and/or by its higher economic growth assumption.

Figure 7. Medium-term Oil Price Assumptions (nominal US$)

***Figure 7 data sources**: Annual average ORB price from OPEC WOO 2013 and history from www.opec.org/opec_web/en/data_graphs/40.htm?selectedTab=annually;*
Annual average IEA import price from IEA MTOMR 2013 and Brent history from www.quandl.com/IMF-International-Monetary-Fund/POILBRE_USD-Crude-Oil-petroleum-Price-Dated-Brent.

***Figure 7 notes**: IEA Average Import Price assumption is based on the Brent futures strip, adjusted slightly downward.*

4.1.2 Economic Growth

Both the IEA and OPEC refer to the IMF's World Economic Outlooks for medium-term economic growth assumptions, and they both expect a stronger global economic performance in the near future. However, OPEC's WOO was published later than the IEA's MTOMR this year. This difference is relevant because during 2013 the IMF regularly revised GDP growth forecasts downward for most world regions over the medium-term projection period. The IEA's MTOMR was probably completed under more optimistic macroeconomic expectations than OPEC's WOO2013. As a result, GDP growth assumptions for the entire medium-term projection period are lower in OPEC's WOO2013 report than in the IEA's MTOMR2013 report

(**Table 6**). On average, OPEC estimates the global economy will grow at 3.8% per year during 2014-2018, 0.5% below the IEA's assumed growth rate of 4.3% per year.

OPEC's WOO was published later than the IEA's MTOMR this year. As in 2013 the IMF regularly revised GDP growth forecasts downward for most world regions over the medium-term projection period, the IEA's MTOMR likely incorporated more optimistic macroeconomic expectations.

Table 6. Medium-term Annual GDP Growth Assumptions

	2014	2015	2016	2017	2018
OPEC	3.5%	3.8%	3.9%	3.9%	3.9%
IEA	4.0%	4.3%	4.4%	4.5%	4.4%

***Table 6 data sources**: IEA MTOMR 2013, Table on p.8; OPEC WOO 2013, Table 1.2. Both IEA and OPEC rely on IMF GDP forecasts; the difference arises from OPEC's use of a more recent IMF forecast.*

On a regional level, both the IEA and OPEC project that non-OECD nations will continue to grow faster than OECD nations, though OPEC is more optimistic about the OECD region's growth prospects. While the IEA cites the IMF's concerns about fiscal challenges in advanced economies in its MTOMR report, OPEC sees the growth momentum gradually shifting back from developing to developed regions, citing the arguments that fiscal drags in the United States have eased, economies continue to recover in the Euro-zone, and more fiscal and monetary stimulus has been introduced in Japan.

4.2 Medium-term Liquids Demand

4.2.1 Global and Regional Demand Growth

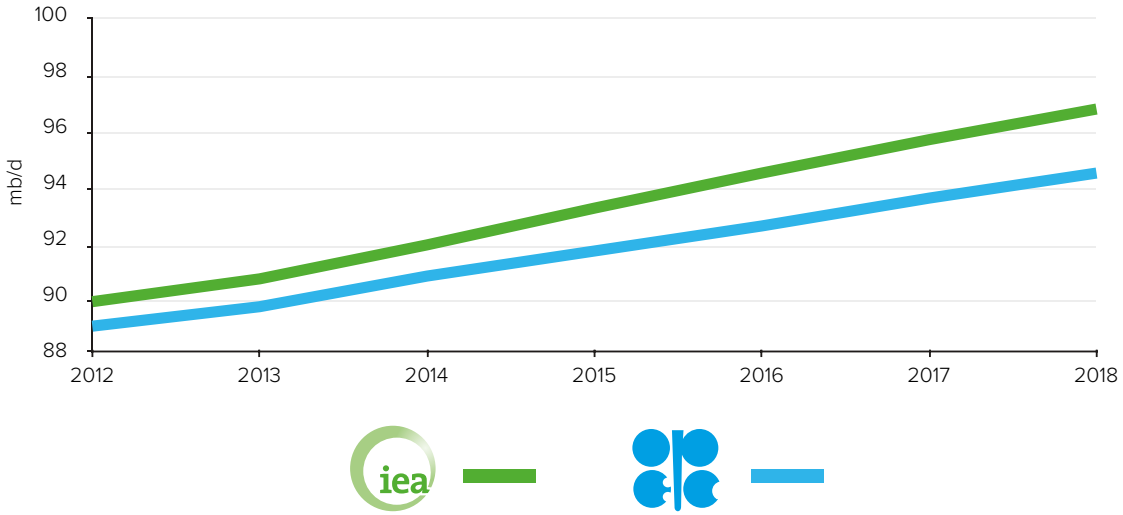
Both the IEA and OPEC project robust medium-term growth in global liquids demand, though the IEA's demand projection is based on higher baseline 2012 historical demand data than that of OPEC.

Both the IEA and OPEC project robust medium-term growth in global liquids demand, though the IEA's demand projection is based on higher baseline 2012 historical demand data than that of OPEC. In addition, the IEA projects higher liquids demand growth in part due to its more optimistic economic outlook over the period. These factors contribute to a 2.3 mb/d difference in total liquids demand projections by 2018 between the IEA and OPEC, as shown in **Figure 8(a)** and **Table 7**.

As for regional demand growth, OECD and non-OECD regions are projected to see starkly different trajectories, as illustrated in **Figure 8(b)**. In both IEA and OPEC projections, non-OECD countries are expected to grow rapidly, while OECD countries see declining liquids demand. Further, **Figure 8(b)** shows that the IEA and OPEC have almost identical projections for OECD liquids demand during 2012-2018, but diverge with respect to non-OECD demand growth. This divergence is due to differences in both baseline data and growth rate assumptions. With these differences, the IEA estimates in its May 2013 MTOMR that demand from non-OECD countries surpassed that of OECD nations in 2013.

The IEA's higher 2012 historical baseline demand data and a more optimistic economic outlook contribute to a 2.3 mb/d difference in total liquids demand projections by 2018 between the IEA and OPEC.

Figure 8 (a): World Medium-term Liquids Demand



The IEA and OPEC have almost identical projections for OECD liquids demand during 2012-2018, but diverge with respect to expected non-OECD demand growth.

Figure 8 (b): OECD and Non-OECD Medium-term Liquids Demand

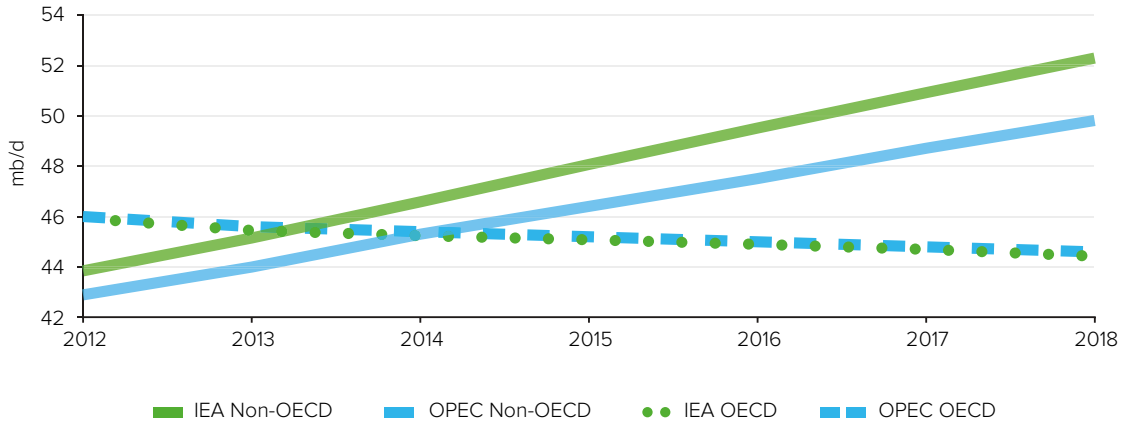


***Figure 8 data sources**: IEA MTOMR 2013, Table 2; OPEC WOO 2013, Table 1.8.*

Table 7. Medium-term Liquids Demand (mb/d)

	2018		Avg. annual growth (2012-2018)		
	IEA	OPEC	IEA	OPEC	DIFFERENCE (IEA-OPEC)
Total OECD	44.4	44.6	-0.3	-0.2	0.0
OECD Americas	23.3	23.8	-0.1	0.0	-0.1
OECD Europe	13.0	12.7	-0.1	-0.2	0.1
Asia Oceania	8.2	8.1	0.0	-0.1	0.0
Total Non-OECD	52.3	49.8	1.4	1.2	0.3
Asia	25.1	24.7	0.7	0.7	0.0
China	12.0	11.9	0.4	0.4	0.0
India	4.4	4.6	0.1	0.2	0.0
Other non-OECD Asia	8.8	8.2	0.2	0.2	0.0
Middle East, Africa & Latin America	21.1	19.7	0.6	0.4	0.2
Europe & Eurasia	6.1	5.4	0.1	0.1	0.1
World	96.7	94.4	1.2	0.9	0.2

***Table 7 data sources**: IEA MTOMR 2013, Table 2; OPEC WOO 2013, Table 1.8.*

***Table 7 notes**: OPEC calculates demand from OPEC member countries as a whole by excluding them from their corresponding geographical regions, which makes demand figures for Middle East, Africa, and Latin America not comparable with IEA estimates. Therefore, in this report, Middle East, Africa and Latin America are grouped together for regional demand comparisons.*

4.2.2 Sectoral Demand

Though the WOO2013 does not address medium-term sectoral demand growth, the IEA's perspective on this topic is worth highlighting. In the transportation sector, the IEA projects that oil will – unsurprisingly – remain the dominant transportation fuel. Natural gas is expected to "make significant inroads" in transportation, but is not likely to detract considerably from oil's dominance, largely due to infrastructure constraints in the near term. The IEA also projects continued improvement in fuel efficiency in OECD countries, which is expected to offset demand gains in the projection period. Gasoline demand from non-OECD countries is expected to approach but not surpass the OECD level. In the power generation, residential and petrochemical sectors, the IEA expects other sources of energy to continue to displace oil.

4.3 Medium-term Liquids Supply

4.3.1 Liquid Fuels Classification

For their medium-term liquids supply outlooks, both the IEA and OPEC take bottom-up approaches by assessing field-level supply capabilities in each country. However, they may hold different perspectives on which projects should be included and how productive each field will be. These production estimates in turn hinge on oil price levels, which vary between

the two projections, and help determine the extent to which high-cost oil is produced. As a result, regional supply projections may differ despite similarities in their respective bottom-up approaches.

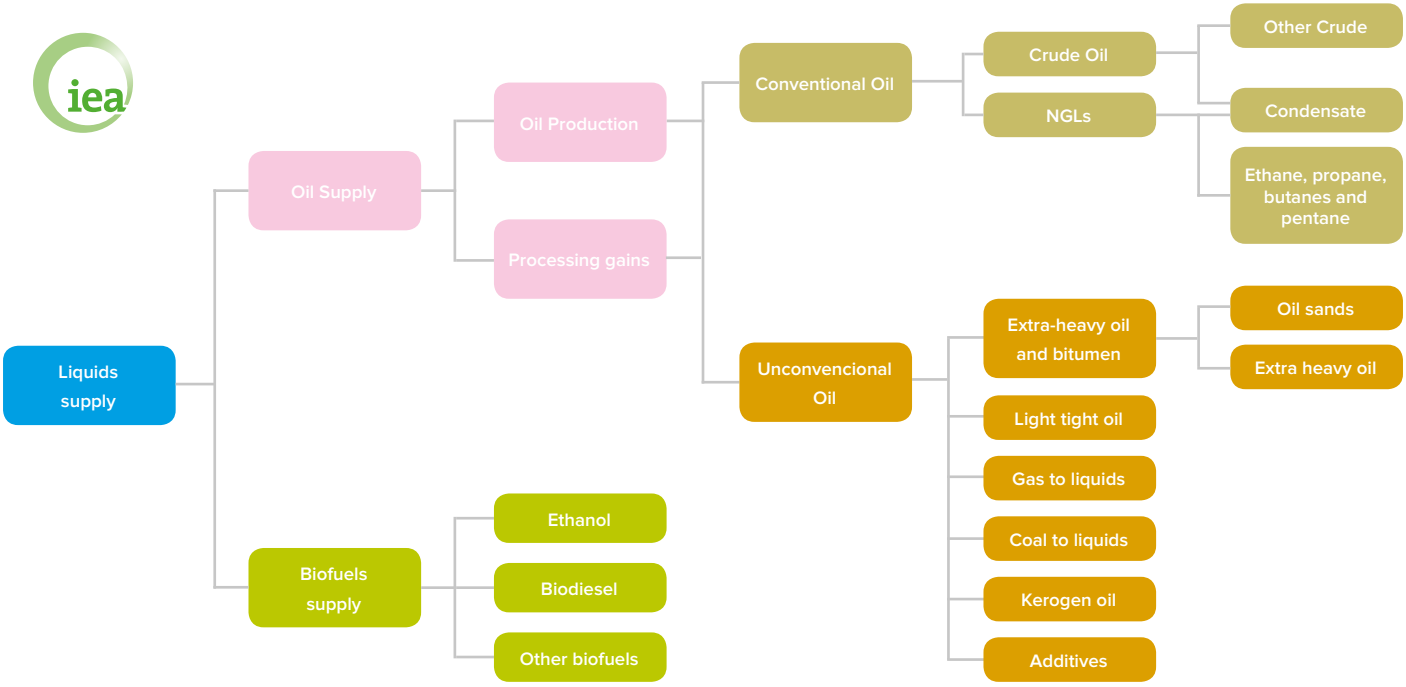
Key differences in the IEA's and OPEC's liquid fuels categorisations are worth highlighting, and include differences in how some types of unconventional oil are treated.

On a related note, key differences in the IEA's and OPEC's liquid fuels categorisation are worth highlighting. **Figures 9(a)** and **9(b)** provide a comparison of the IEA's and OPEC's distinct liquids classification systems.

The institutions first differ in their categorisation of some types of unconventional oil. **Figure 9(a)** shows that in its "oil" branch, the IEA basically classifies everything except crude oil and NGLs into unconventional oil. For OPEC, the equivalent to the IEA's "unconventional oil" group is "other liquids". However, OPEC excludes light tight oil and Venezuela heavy oil from that category, and treats them as crude oil. Moreover, while the IEA's LTO category only includes crude, OPEC's includes tight NGLs in the "tight oil" category rather than in the NGL category. Additionally, OPEC and the IEA use different terms in their reports, implying that their definitions for some types of fuels might be different. As seen in **Figure 9(b)**, OPEC categorises biofuels together with other unconventional non-crude supply sources, whereas the IEA treats biofuels distinctly from all other oil supply sources.

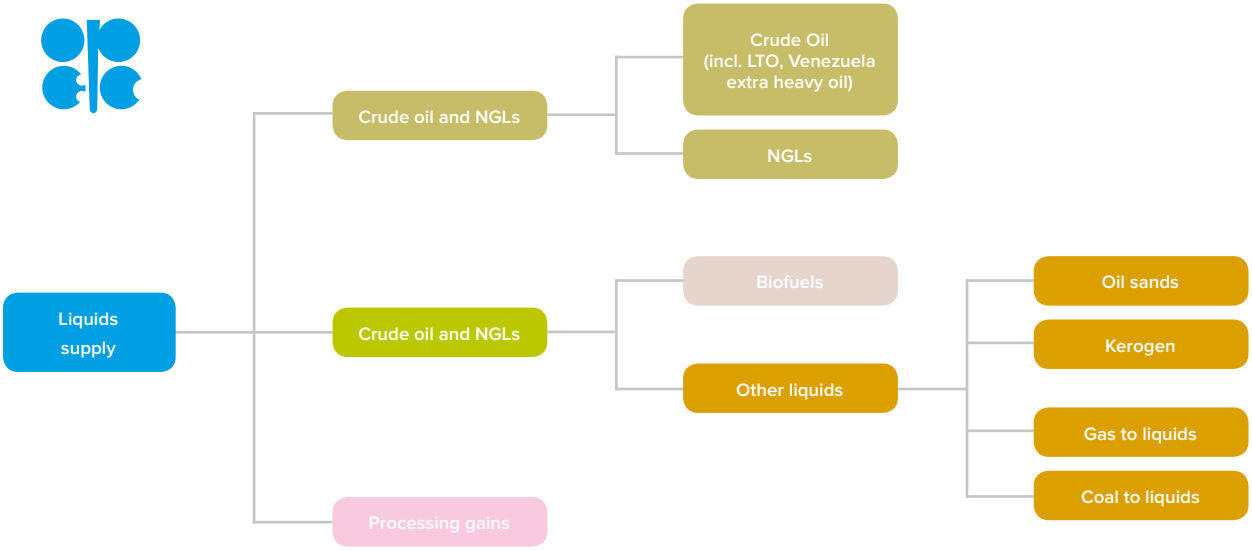
Figure 9. Liquid Fuels Categorisation by the IEA and OPEC

(a) IEA Liquid Fuel Schematic



Source: IEA WEO2013, Figure 13.2

(b) OPEC Liquid Fuels Schemeatic



Source: Duke and IEF based on WOO2013.

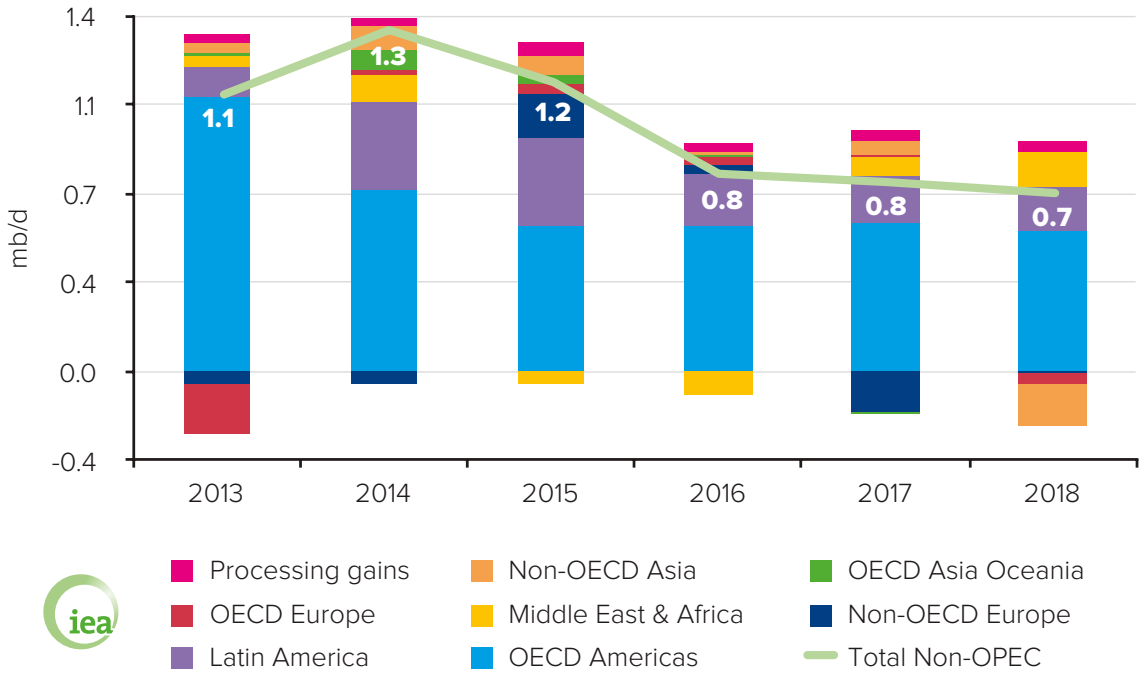
4.3.2 Global and Regional Liquids Supply

In both the IEA and OPEC medium-term projections, non-OPEC countries are expected to dominate supply growth, yet views on OECD Americas differ.

In both the IEA and OPEC medium-term projections, non-OPEC countries are expected to dominate supply growth. In addition, both projections expect non-OPEC liquids supply growth to peak before 2016. However, they diverge on the relative contributions from each region. While the IEA foresees OECD Americas leading supply growth throughout the projection period, OPEC expects OECD Americas growth to dominate only during the first two years of the time horizon. In OPEC's projections, supply growth from OECD Americas will taper off, and by the end of the projection period almost no growth will come from that region. OPEC expects non-OECD, non-OPEC countries to become the major contributors of liquids supply growth in later years of the period. These trends are illustrated in **Figures 10(a)** and **(b)**.

Figure 10. Medium-term Non-OPEC Liquids Supply Annual Growth

(a) IEA Outlook



(b) OPEC Outlook

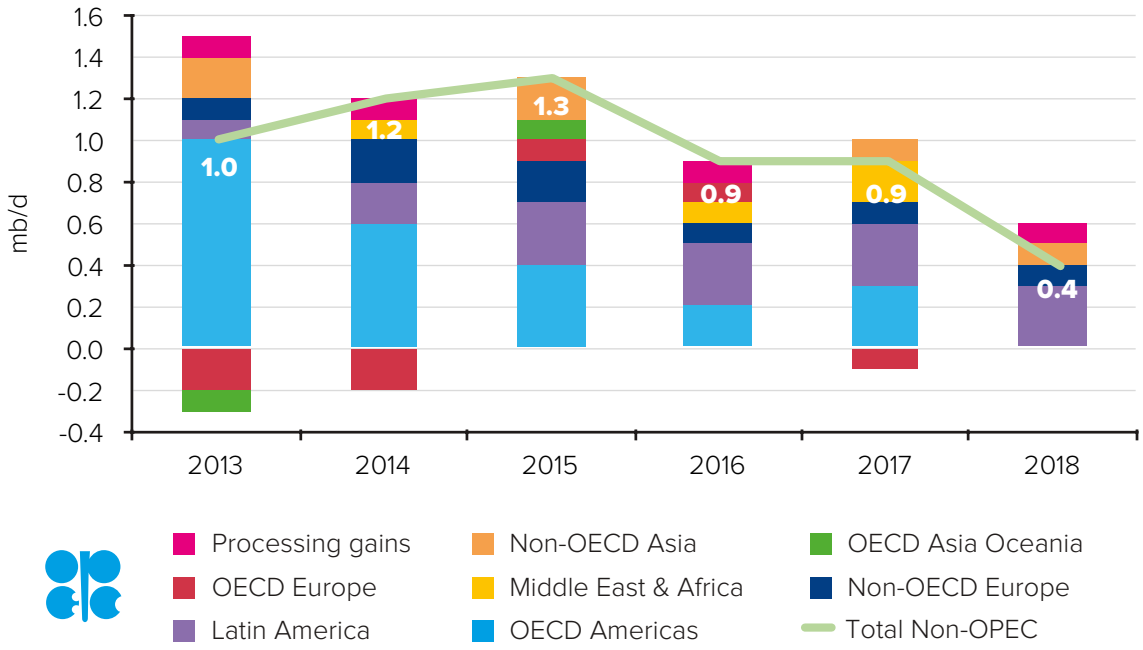


Figure 10 data sources: *IEA MTOMR 2013, Table 3 and Table on p.77 for biofuels; OPEC WOO 2013, Table 1.10.*
Figure 10 notes: *Biofuels are added to IEA regional oil supply data for comparability with OPEC estimates.*

Table 8 features a detailed regional comparison of the IEA and OPEC medium-term liquids supply outlooks. While total non-OPEC supply growth forecasts are similar between the IEA and OPEC, the two organisations hold different viewpoints regarding expected growth contributions from non-OECD and OECD regions.

Table 8. Medium-term World Liquids Supply (mb/d)

	2018		Avg. annual growth (2012-2018)		
	IEA[b]	OPEC	IEA	OPEC	DIFFERENCE (IEA-OPEC)
Total OECD	25.1	23.3	0.7	0.4	0.3
OECD Americas	20.9	19.2	0.7	0.4	0.3
OECD Europe	3.6	3.5	0.0	-0.1	0.0
Asia Oceania	0.6	0.6	0.0	0.0	0.0
Total Non-OECD	31.8	33	0.3	0.5	-0.3
Asia	8.0	8.4	0.0	0.1	-0.1
China	4.5	4.3	0.0	0.0	0.0
Other non-OECD Asia	3.6	4.1	0.0	0.1	-0.1
Middle East & Africa	4.0	4.2	0.0	0.1	0.0
Latin America	6.1	6.2	0.2	0.3	0.0
Europe & Eurasia	13.8	14.2	0.0	0.1	-0.1
Processing Gains	2.4	2.5	0.0	0.1	0.0
Total Non-OPEC	59.3	58.6	1.0	0.9	0.0
Total OPEC	37.4[c]	36	0.2	-0.1	0.3
OPEC crude[a]	30.4	29.2	-0.1	-0.5	0.4
OPEC NGLs + unconventionals	7.0	6.8	0.1	0.1	0.0
World	96.7[c]	94.6	1.2	0.8	0.3

Table 8 data sources: *IEA MTOMR 2013, Table 1, Table on p.77 for biofuels and p.8 for global balance; OPEC WOO 2013, Table 1.10.*

Table 8 notes: *OPEC crude[a]: For IEA is the "call on OPEC crude" including "stock change and miscellaneous". IEA[b]: regional supply estimates include biofuels, based on IEA MTOMR 2013 p. 77. [c]: Estimates for total OPEC supply and world supply are constructed from other components because IEA does not directly provide these forecasts in their reports.*

For OECD nations, the IEA expects their supply to increase 0.7 mb/d per year, 0.3 mb/d higher than OPEC's outlook. This projection difference in the OECD region primarily stems from two key factors related to OECD Americas:

First, the IEA is more optimistic about expected supply growth in the United States and Canada, projecting their total oil supply (excluding biofuels) growth during 2012-2018 to reach 4.0 mb/d versus OPEC's growth forecast of 3.1 mb/d. As shown in **Figure 11**, the IEA's and OPEC's projections for the US and Canada oil supply diverge after 2015, as OPEC's growth forecast decelerates.

The IEA's and OPEC's projections for the US and Canada oil supply diverge after 2015, when OPEC's growth forecast decelerates.

Figure 11. Medium-term US and Canadian Oil Supply (excluding biofuels)

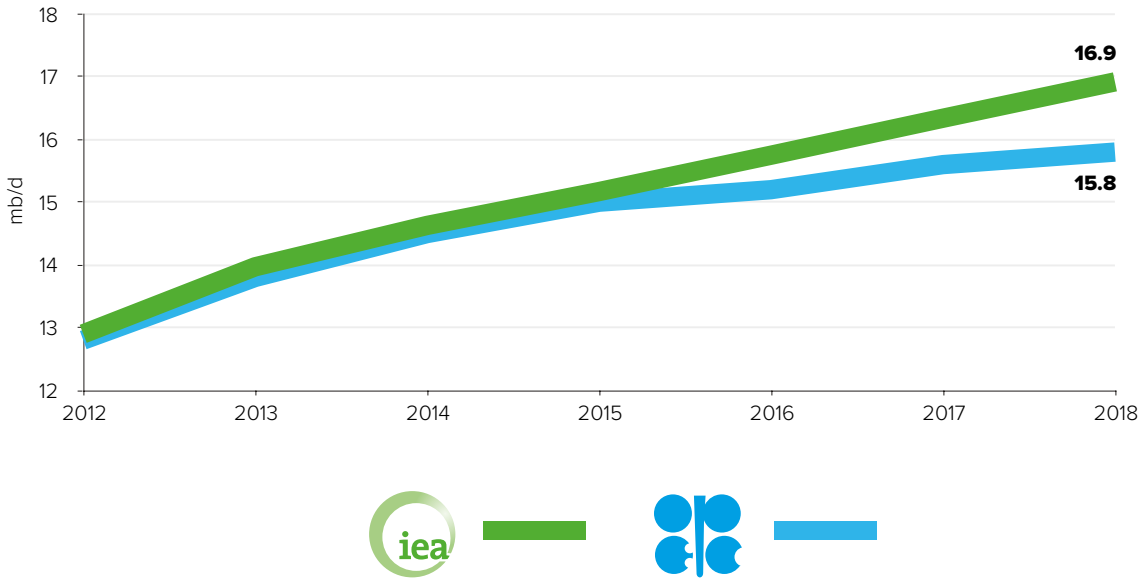


***Figure 11 data sources**: IEA MTOMR 2013, Table 3 & Table on p.77 for biofuels; OPEC WOO 2013, Table 1.10 & Table 3.4.*
***Figure 11 notes**: Biofuels are excluded from OPEC's total liquids supply estimates for US & Canada*

Second, the IEA projects that Mexican production will remain steady, while OPEC expects it to fall from 2.9 mb/d in 2012 to 2.3 mb/d in 2018. OPEC bases this outlook on the fact that production from Mexico's two largest complexes, Cantarell and Ku-Maloob-Zaap, has steadily declined in recent years. Unlike OPEC, the IEA projects that proposed legal and fiscal changes will reinvigorate the Mexican oil and gas sector.

On the non-OECD side, the IEA anticipates annual supply growth at roughly 0.3 mb/d, almost 0.3 mb/d lower than OPEC's estimate. OPEC anticipates higher growth from the FSU region (especially Azerbaijan and Kazakhstan) and Asian countries excluding China. The higher growth projection for Europe and Eurasia in OPEC's WOO2013 report probably results from the recently announced start-up production in the giant Kashagan field in the Caspian region. The Kashagan field is considered the fourth-largest offshore oil field in the world, but projects to develop the field were postponed until September 2013. The IEA was not able to take this development into consideration in its MTOMR, as it was published in May.

Though projections for overall non-OPEC supplies are similar, the IEA's higher demand forecast has resulted in a greater estimate for OPEC crude production.

Though projections for overall non-OPEC supplies are similar, the IEA's higher demand forecast has resulted in a greater estimate for OPEC crude production. This is because both organisations structure their OPEC crude supply forecasts by subtracting non-OPEC supply and OPEC NGLs supply from total world liquids demand.

Finally, despite a large difference in historical data, the IEA's and OPEC's projections for total OPEC NGLs and other unconventional oils are fairly close by the end of the projection period.

5. Long-term Energy Outlooks

The long-term outlooks comparison in this paper evaluates the IEA's World Energy Outlook 2013 (WEO2013) and OPEC's World Oil Outlook 2013 (WOO2013), both released in November 2013 (**Diagram 1**).

The IEA and OPEC make long-term projections through 2035. However, long-term projections for fuels other than oil are based on different baseline years (2010 for OPEC and 2011 for IEA), which may account for a small part of projection differences and certainly influences growth rates contemplated in the two reports. To enhance comparability, this introductory paper uses 2010 as the baseline year for IEA long-term projections, in contrast with the WEO2013, which uses a 2011 base year.

Another comparability challenge is related to units for primary energy demand: OPEC uses million barrels of oil equivalent per day (mboe/d) and the IEA uses million tons of oil equivalent (mtoe) per year. IEA primary energy is therefore converted from mtoe per year to mboe/d by multiplying by 7.37 mboe/mtoe and dividing by 365 days per year.

5.1 Key Assumptions

5.1.1 Scenarios

Both the IEA and OPEC engage in scenario analysis to address a wide range of uncertainties over the long-term. **Table 9** lists key assumptions for each scenario included in the WEO2013 and WOO2013. A more detailed comparison is provided in **Annex 1**, and a comparison of outlooks results for each scenario is featured in **Annex 2**.

Table 9. Long-term Scenario Key Assumptions

IEA WEO Scenarios	OPEC WOO Scenarios
Current Policies Scenario Only considers policies that have been enacted as of mid-2013	**Reference Case** Only considers policies that have been enacted
New Policies Scenario Considers both policies in place and commitments announced	**Higher Economic Growth Scenario (HEG)** Assumes higher economic growth rate than the Reference Case
450 Scenario Assumes policies to be taken to limit the concentration of GHG in the atmosphere to 450 ppm of CO2 equivalent	**Lower Economic Growth Scenario (LEG)** Assumes lower economic growth rate than the Reference Case
	Upside Supply Scenario (UPS) Looks at possibility of higher non-OPEC supply than the Reference Case

In its WEO2013, the IEA presents three key scenarios--the New Policies Scenario, the Current Policies Scenario and the 450 Scenario-- each of which involves different assumptions about policy, which in turn influence technological development and energy markets. The New Policies Scenario is the central scenario in the IEA's World Energy Outlook. In its WEO2012, the IEA also developed an Efficient World Scenario, highlighting the energy-saving and greenhouse gas emissions reduction potential of the widespread adoption of energy efficiency. The IEA did not present this scenario in its WEO2013.

OPEC's WOO2013 uses the Reference Case as the main scenario, with the assumption that only existing policies affect future energy demand and supply. Three alternative scenarios are considered in WOO2013: the Lower Economic Growth Scenario (LEG), the Higher Economic Growth Scenario (HEG), and the Upside Supply Scenario (UPS). The LEG and HEG scenarios differ from the Reference Case primarily in their assumptions regarding economic growth. Unlike previous reports, in its WOO2013 OPEC adopted a new methodology to derive alternative growth rates for its LEG and HEG scenarios. Instead of applying a simple +/- 0.5% in all regions, OPEC allows for variations in the range of economic growth across regions in the WOO2013 report. Additionally, the LEG scenario assumes a larger downside than the upside potential under the HEG scenario.

As for the UPS scenario, OPEC looks at alternative supply patterns in which liquids supplied from non-OPEC countries surpass the expectations in the Reference Case. In the WOO2012 report, a Liquid Supply Surge Scenario (LSS)--based on the assumption that some elements of non-OPEC supply exceed estimates in the Reference Case--was provided alongside the LEG and HEG scenarios for intuitive comparisons with the Reference Case. In 2013, rather than providing the full range of results associated with the 2012 LSS scenario, the OPEC UPS analyses alternative supply paths on a regional basis to better understand how non-OPEC supply might impact OPEC production and global oil prices.

The most comparable of these scenarios—at least conceptually—are the Current Policies Scenario in the IEA WEO and the Reference Case in the OPEC WOO, because both only take existing policies into account. Unless otherwise noted, the figures and tables in this section refer to these two scenarios.

5.1.2 Population

Among the numerous drivers that impact energy demand, population growth tends to be the most stable. As in previous outlooks, both the IEA and OPEC base their demographic assumptions primarily upon the United Nations (UN) database, in which world population is projected to grow from around 7 billion in 2010 to 8.7 billion by 2035 in its medium-fertility scenario. The UN projections also include low- and high-fertility projections, which range from 8.1 to 9.4 billion global population levels in 2035. Aside from population growth, both organisations identify changing age structure and urbanisation rates as crucial factors affecting energy consumption.

5.1.3 Economic growth

The IEA and OPEC take similar approaches in deriving their GDP assumptions. They both use the IMF's World Economic Outlook as an important input for medium-term assumptions, and estimate long-term growth rates by assessing labor supply and productivity enhancement. Both project that changing demographics and productivity trends will put downward pressure on economic growth through 2035. Consequently, economic growth is projected to slow after 2020.

Overall, the IEA and OPEC share similar medium- (2013-2020) and long-term (2021-2035) views about GDP growth for the OECD nations and the world.

Overall, the IEA and OPEC share similar medium- (2013-2020) and long-term (2021-2035) views about GDP growth for the OECD nations and the world. For non-OECD nations, the comparison is more challenging because, as mentioned previously, the two projections differ in their regional definitions.

Regarding China's economic growth trajectory, the IEA and OPEC diverge, as shown in **Figure 12**. The IEA expects a slightly higher growth rate for China than OPEC in the medium-term, yet its long-term GDP growth forecast falls significantly below OPEC's. The IEA and OPEC agree in that they both expect China's GDP growth to decelerate after 2020.

Figure 12. Long-term GDP Growth Assumptions for Selected Regions

Regarding China's economic growth trajectory, the IEA and OPEC diverge: the IEA expects a slightly higher growth rate for China than OPEC in the medium-term, yet its long-term GDP growth forecast falls significantly below OPEC's.

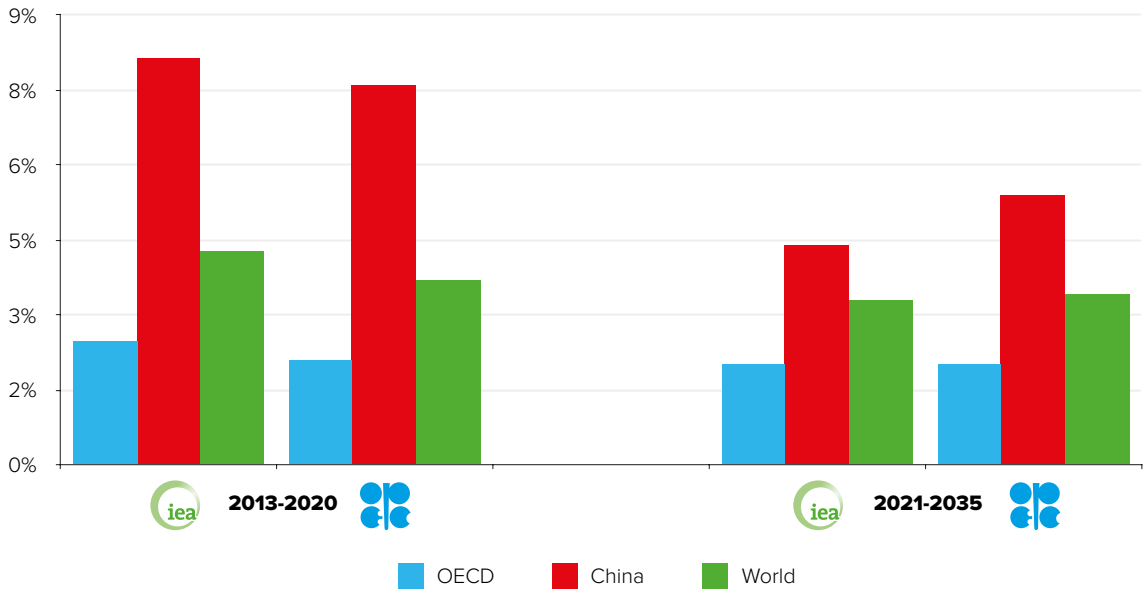


***Figure 12 data sources**: IEA WEO 2013, Table 1.2; Communication from IEA; OPEC WOO 2013, Table 1.6.*

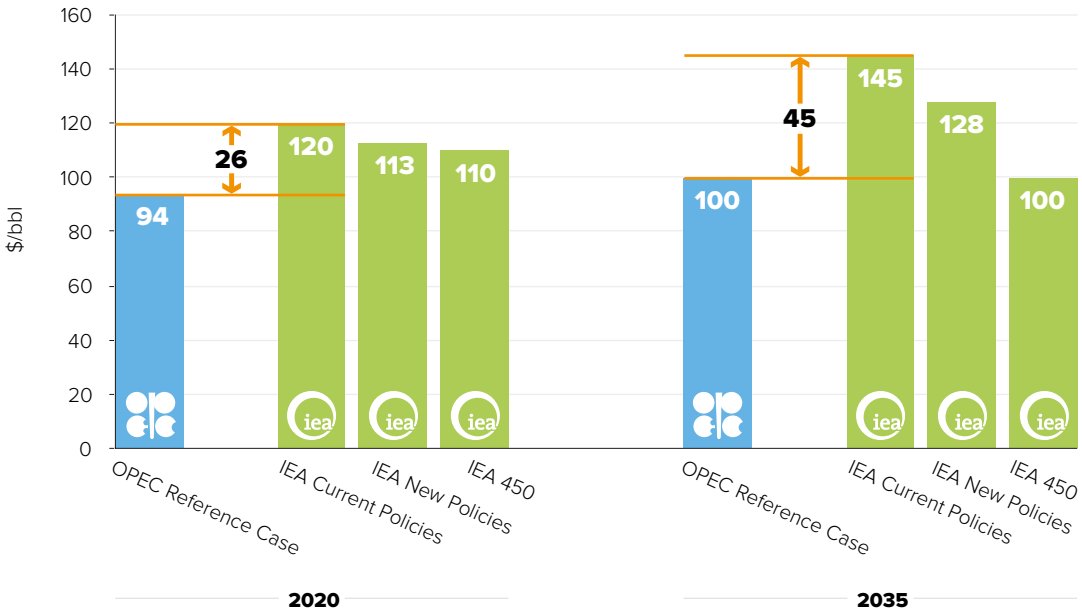
5.1.4 Oil Price Assumptions

There are substantial differences between the IEA and OPEC long-term oil price assumptions.[4] As shown in **Figure 13**, OPEC's real oil price assumptions in the Reference Case are significantly lower than all but the 450 Scenario in WEO2013, both through 2020 and 2035. In addition, OPEC expects real oil prices to fall below the current level of US$110/bbl, whereas the IEA believes the price will steadily increase over the long-term, as noted in its Current Policies and New Policies scenarios.

4 See Section 4 for an explanation of the different proxies for oil price assumptions used by the IEA and OPEC.

Figure 13. Long-Term Oil Price Assumptions (real 2012 US$)

OPEC's price assumption reflects the full-cycle oil production cost for supplying the marginal barrel of oil. The IEA argues that the oil price should be around 12% higher than the marginal cost to factor in sufficient ROI. This difference in approaches may partially explain the gaps in long-term price assumptions.



Both the IEA and OPEC conduct bottom-up approaches to assess the costs of developing oil resources by region and by oil type. OPEC's price assumption reflects the full-cycle oil production cost for supplying the marginal barrel of oil. However, the IEA argues that the oil price should be around 12% higher than the marginal cost to factor in sufficient return on investment. This difference in approaches may partly, but not completely, explain the gap of US$45/bbl (in real 2012 US$) in 2035 oil price assumptions between the OPEC's Reference Case and IEA's Current Policies Scenario.

5.1.5 Energy and Environmental Policies

A comparison of policy updates highlighted in the WOO2013 and WEO2013 suggests that OPEC and the IEA may have integrated different policies into their energy projection models and assigned them varying levels of importance.

As mentioned earlier, OPEC's Reference Case and the IEA's Current Policies Scenario are comparable because both only consider policies already in place. Each year new policies are enacted, affecting energy projections. A comparison of policy updates between WOO2013 and WEO2013 is provided below. The comparison shows that OPEC and the IEA highlight different policies introduced in the past year, which suggests that they may have integrated different policies into their energy projection models and assigned them varying levels of importance.

5.2 Long-term Energy Demand

5.2.1 Primary Energy Demand

The fundamental trends of global energy consumption identified in this year's WEO and WOO are similar to those presented last year. Global energy demand is expected to sustain robust growth through 2035, primarily driven by economic and population growth, with the majority of demand growth coming from developing economies. Fossil fuels are projected to remain a central player in energy consumption, though their combined shares gradually decline. As always, significant uncertainties remain regarding policy and technological development, which will play important roles in shaping the pace of demand growth as well as fuel mix composition.

Overall, OPEC expects stronger primary energy demand growth than the IEA during the projection period of 2010-2035: 52% in OPEC's Reference Case versus 45% in IEA's Current Policies Scenario.

Figure 14 provides a comparison of total expected primary energy supply by energy source. **Figure 15** compares shares of each fuel in the global energy supply mix in 2010, along with the outlooks for 2035. As illustrated by these two charts, the major difference lies in forecasts for fossil fuels. The IEA's projection for total natural gas supply by 2035 is 12 mboe/d lower than OPEC's, while its outlook for oil and coal supply are respectively 3 mboe/d and 6 mboe/d higher than OPEC's.

Figure 14. World Primary Energy in 2010 and Outlook for 2035

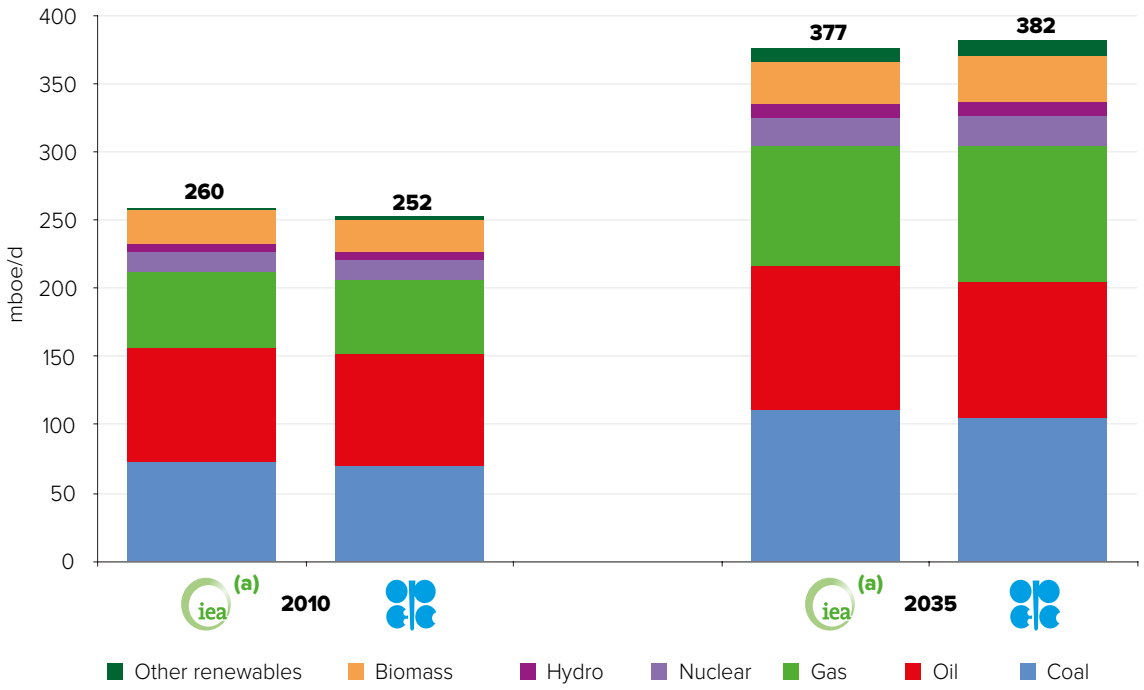


***Figure 14 data sources**: IEA WEO 2013, Table 2.1; Communication from IEA; OPEC WOO 2013, Table 1.7.*

***Figure 14 notes**: IEA[(a)]: primary energy is converted from mtoe per year to mboe/d by multiplying by 7.37 mboe/mtoe and dividing by 365 days per year.*

Figure 15. World Primary Energy Fuel Shares in 2010 and Outlook for 2035

The IEA projects the share of oil will decline from 32% in 2010 to 27% in 2035, while OPEC sees a slightly larger drop from 32% to 26%. The forecast that coal and natural gas consumption will gain ground on oil is based on the expectation that electricity demand will grow faster than any other sector.

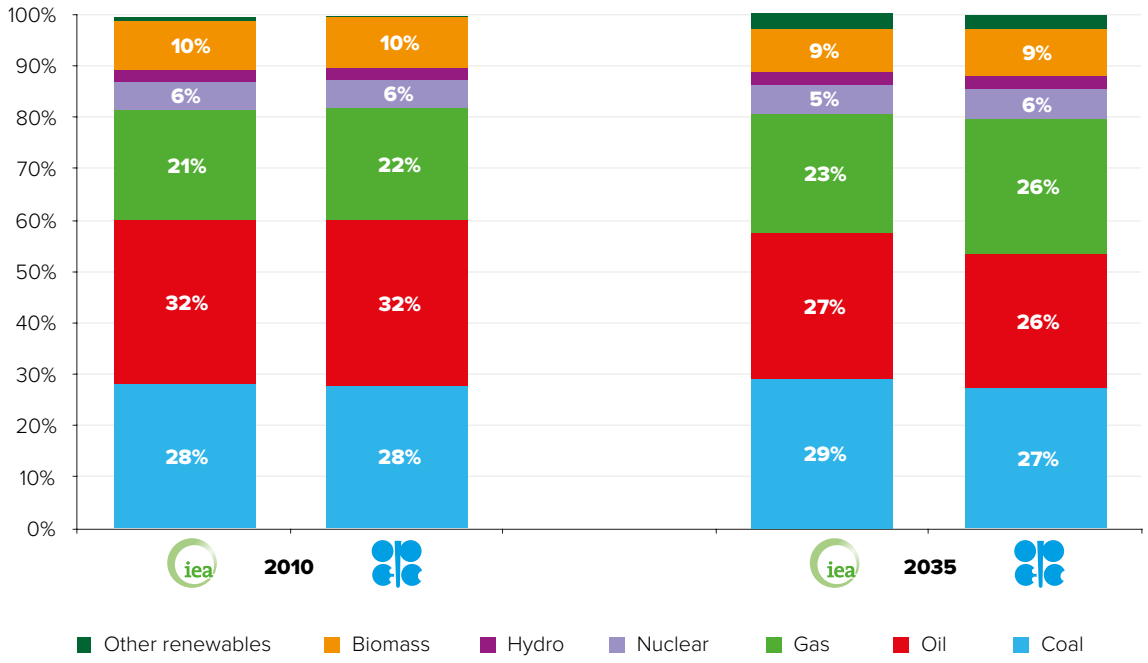


***Figure 15 data sources**: same as Figure 14.*

An important change OPEC made to this year's WOO report is a re-definition of biomass. The WOO2013 for the first time includes non-commercial uses of biofuels in total world primary energy demand. This revision slightly lowers the forecast for energy demand growth to 52% over the projection period 2010-2035, compared to a forecast 54% growth in the WOO2012, as the switch from non-commercial to commercial biomass consumption no longer appears under new net energy demand growth. This improvement brings OPEC's primary energy demand projection more in line with that of the IEA, as the "biomass" category in OPEC's WOO is now similarly defined as the IEA's "bioenergy" category, as both include biomass and biofuel.

5.2.2 Liquids Demand

In both the IEA's Current Policies Scenario and OPEC's Reference Case, oil is expected to cede its top position in primary energy consumption to coal by 2035. In the IEA's New Policies Scenario, however, oil maintains its position as the leading fuel. As **Figure 15** shows, the IEA Current Policies Scenario projects the share of oil will decline from 32% in 2010 to 27% in 2035, while OPEC sees a slightly larger drop from 32% to 26%. The forecast that coal and natural gas consumption will increase is based on the expectation that electricity demand will grow faster than any other sector. Nonetheless, oil demand is expected to experience significant growth during the projection period.

Similar to last year's assessment, it remains a challenge to directly compare oil demand between the WEO and WOO reports. First, the IEA and OPEC maintain different regional definitions. As mentioned in Section 4, OPEC separates its member countries from their geographic regions and calculates OPEC oil demand as a distinct group. The IEA groups countries by geography and OECD membership status. Since OPEC member countries are found in the Middle East, Africa and Latin America, oil demand in these regions reported by

OPEC is not comparable with the IEA's figures. This paper aggregates the Middle East, Africa and Latin America into one group to more directly compare oil demand projections.

Second, the IEA and OPEC diverge on their classification of biofuels. To adjust for this difference, this paper aggregates the IEA's oil and biofuels demand for each region, making the numbers comparable with OPEC's forecasts.[5] Both the IEA's oil and biofuels regional demand forecasts under the Current Policies Scenarios are available in "IEA World Energy Outlook 2013 Annex A Tables for Scenario Projections"[6] but are not contained in the main body of the WEO2013 report.

Third, the IEA and OPEC define bunker fuels differently. While the IEA reports international marine bunker and aviation fuel as a distinct "bunker" group – not attributable to any country or region – OPEC includes bunker and aviation fuel in each region's oil demand, just as it does with biofuels. In addition, OPEC does not differentiate between international and domestic aviation fuels. Aggregating total marine bunker and aviation fuel demand from the OPEC WOO2013 report leads to a much larger number than what is reported under the "Bunkers" category in the IEA's WEO2013 report. For this reason, in this paper it is not possible to compare bunker and aviation fuels between the IEA and OPEC, yet "Bunkers" is shown as a category when presenting the IEA's world oil demand projections.

Finally, the IEA and OPEC use different units in energy demand projections. Oil demand in the OPEC WOO2013 is presented in volumetric units "million barrels per day (mb/d)". However, since the IEA's WEO includes fuels other than oil, the IEA standardises the reporting in energy-equivalent terms: "million tonnes oil equivalent (mtoe)". For biofuels in particular, this paper divides energy-equivalent ethanol and biodiesel estimates from the IEA by 0.7 and 0.9 respectively to make them volumetrically comparable to OPEC estimates in mb/d. The above conversion factors for biofuels were provided by the IEA to the authors of this report.

Table 10 presents a comparison of long-term world liquids demand projections using the IEA's Current Policies Scenario and OPEC's Reference Case. Overall, both reports have only slightly adjusted world liquids demand in 2035 compared to last year.

5 For the IEA's New Policies Scenario, biofuels projections are presented in Chapter 6. For the Current Policies Scenario, they are available in "IEA World Energy Outlook 2013 Annex A Tables for Scenario Projections" (see WEO 2013 p. 568).

6 Instructions regarding how to access the IEA World Energy Outlook 2013 Annex A Tables for Scenario Projections were provided on Page 568 of the WEO2013. Both regional oil demand data and biofuel demand data are available in this Annex table.

Table 10. Long-term Liquids Demand (mb/d)

Both the IEA and OPEC project that OECD countries will experience a decline in long-term oil demand, though this decrease is expected to be offset by more robust demand growth in non-OECD regions.

	2035		Avg. annual growth (2012-2035)		
	IEA Current Policies Scenario[a]	OPEC Reference Case	IEA Current Policies Scenario	OPEC Reference Case	Difference (IEA-OPEC)
Total OECD	39.7	40.4	-0.1	-0.2	0.1
OECD Americas	23.1	21.9	0.0	-0.1	0.1
OECD Europe	10.8	11.4	-0.1	-0.1	0.0
Asia Oceania	5.9	7.1	-0.1	-0.1	0.0
Total Non-OECD	66.3	68.2	1.1	1.1	0.0
Asia	36.4	37.8	0.7	0.7	0.0
China	18.2	17.5	0.4	0.3	0.0
India	8.7	9.3	0.2	0.2	0.0
Other non OECD	9.5	11.0	0.1	0.2	0.0
Middle East, Africa & Latin America	24.1	24.4	0.4	0.3	0.0
Europe & Eurasia	5.7	6.0	0.0	0.0	0.0
Bunkers[b]	9.7	n/a	0.1	n/a	n/a
World	115.4	108.6	1.1	0.9	0.3

***Table 10 data sources**: IEA WEO 2013, Annex A Tables, Table 15.2; Communication from IEA; OPEC WOO 2013, Table 1.9.*

***Table 10 notes**: IEA Current Policies Scenario[a]: Biofuels from IEA WEO 2013 Annex A are added to IEA regional oil demand data for comparability with OPEC estimates, after converting from mtoe to mb/d. Bunkers[b]: in the IEA WEO include international marine bunkers and aviation fuels. In the OPEC WOO, all bunkers are within regional demand. Some differences (IEA-OPEC) yield to 0.0 because of rounding.*

In total, the IEA projects a 26.2 mb/d higher liquids demand in 2035 relative to 2012, versus OPEC's projection of a 19.7 mb/d higher demand for liquids.

In addition, both projections for regional growth patterns have remained consistent. Both project that OECD countries will experience a decline in long-term oil demand, though this decrease is expected to be offset by more robust demand growth in non-OECD regions. The center of demand growth is expected to continue to shift to developing Asian economies, among which China exhibits the highest growth in absolute terms. As a result of the divergent liquids demand trends between developing and developed economies, OECD countries' share of total oil demand declines from above 50% to below 40% in both the IEA's and OPEC's outlooks, with OPEC expecting the OECD share loss to be slightly larger than the IEA's (**Figure 16**).

Figure 16. OECD and Non-OECD Shares of Liquids Demand in 2012 and Outlook for 2035

As a result of the divergent liquids demand trends between developing and developed economies, OECD countries' share of total oil demand declines from above 50% to below 40% in both the IEA's and OPEC's outlooks.

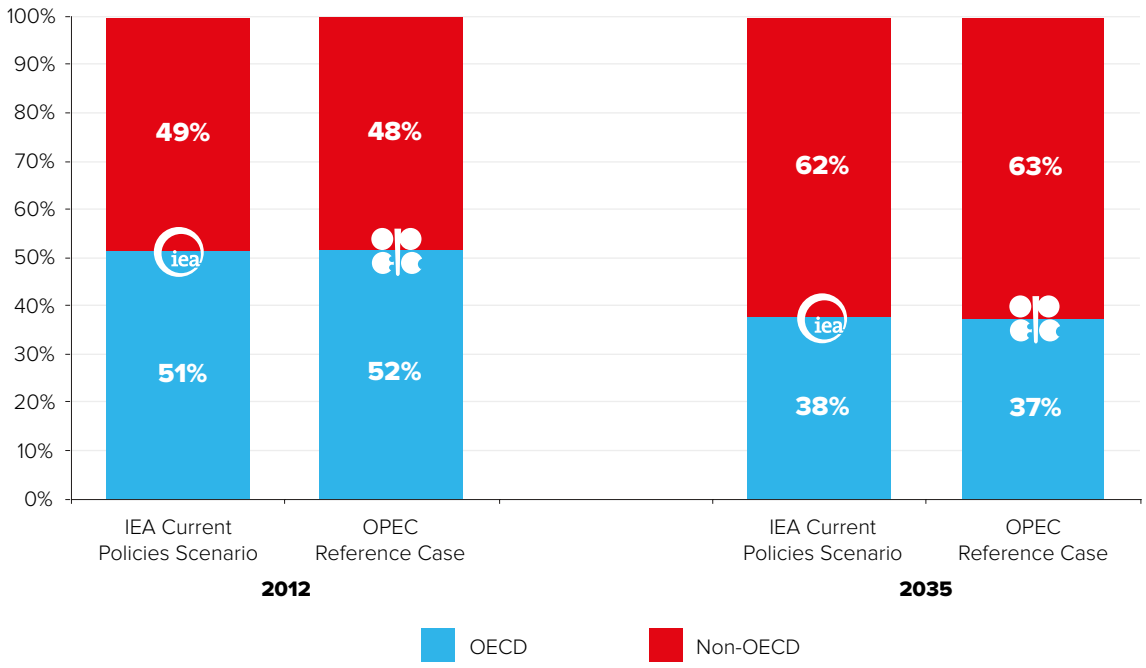


***Figure16 data sources**: IEA WEO 2013, Annex A Tables for Scenario Projections & Table 15.2; OPEC WOO 2013, Table 1.9.*

***Figure16 notes**: The "bunkers" group in the IEA's WEO report is excluded from calculation for OECD and non-OECD oil demand shares.*

Although overall conclusions are similar to those presented in last year's outlooks, some regional revisions have been made by both organisations. OPEC revisited China's vehicle ownership and road development patterns and arrived at a much more bullish projection of China's vehicle growth potential. Infrastructure constraints and road congestion problems previously cited by OPEC appear to be less of a restraint in their new assessment. Despite this revision, the overall oil demand forecast for China by 2035 remains almost unchanged from the WOO2012 report due to downward revisions in other sectors. However, the majority of other non-OECD regions are expected to experience a universal increase in oil demand. This increase in projected oil demand from non-OECD countries results in an upward revision for global oil demand versus the WOO 2012, which had seen only downward revisions since 2007.

Unlike OPEC, the IEA adjusted its expectations for non-OECD oil demand down, though the organisation emphasised growth potential in the Middle East, a new major oil demand centre, and the United States, due to more vigorous industrial activity and impacts from lowered biofuel quotas.

Regarding sectoral trends, the IEA and OPEC share similar views: transport and petrochemical industries are expected to remain the largest oil consumption sectors, contributing to the majority of demand growth.

Regarding sectoral trends, the IEA and OPEC share similar views. Transport and petrochemical industries are expected to remain the largest oil consumption sectors, contributing to the majority of demand growth. Their combined share of oil use is also expected to be higher in the future. Within the transport sector, both the IEA and OPEC revised biofuels growth downward due to the approach of the "blend wall" in the United States, along with other

signals showing that biofuel targets may not be met in advanced economies.

Aside from biofuels, the IEA mentions natural gas as likely the most promising alternative fuel to oil in the transportation sector, though its impact over the medium-term might be limited. Beyond transportation and petrochemical sectors, the IEA expects oil's share in the power generation and building sectors to decline, as it expects oil to lose competitiveness *vis à vis* more economical fuels.

Finally, a comparison of liquids demand projections in all WEO2013 and WOO2013 scenarios is provided in **Figure 17**. Variations in the IEA's and OPEC's policy and economic growth assumptions lead to divergent projections for liquids demand, ranging from about 90-115 mb/d in 2035, and about 100-115 mb/d in scenarios other than the IEA 450 scenario. Interestingly, the central scenarios for both organisations are very similar, with OPEC's Reference Case projection of 108.5 mb/d and IEA's New Policies Scenario projection of 107.3 in 2035.

Of all the scenarios, the higher end of demand projections comes from OPEC's HEG scenario and the IEA's Current Policies Scenario. Although these two scenarios have quite different assumptions, their demand projections are similar. The lower end of world liquids demand projection by 2035 is in the IEA's 450 Scenario, as proposed strict policies to curb climate change in this scenario would bring significant energy efficiency improvement and a wide adoption of clean energy technologies. In the 450 Scenario, liquids demand peaks around 2020, and after that world demand gradually declines to around the 2013 level by 2035. The forecast gap between the IEA's 450 scenario and OPEC's HEG scenario is as high as 26.8 mb/d.

Figure 17. World Liquids Demand Projections in Various Scenarios

Variations in the IEA's and OPEC's policy and economic growth assumptions lead to divergent projections for liquids demand, ranging from about 90-115 mb/d in 2035, and about 100-115 mb/d excluding the IEA 450 scenario.

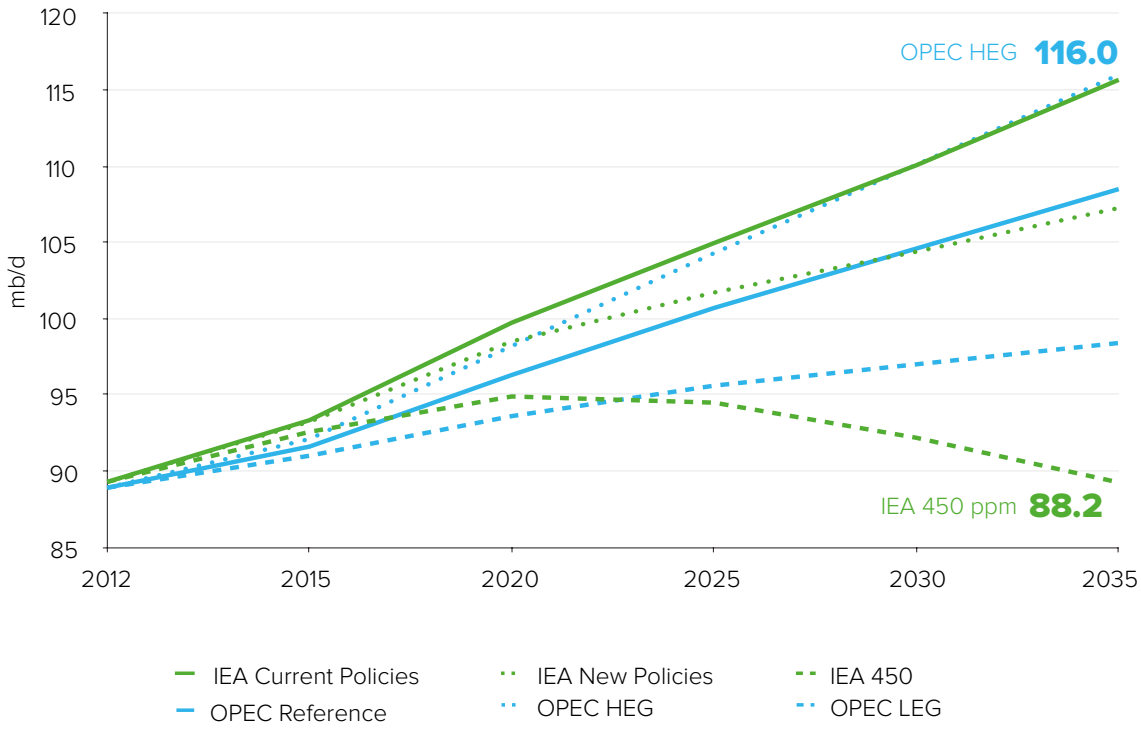


***Figure 17 data sources**: IEA WEO 2013, Annex A Tables for Scenario Projections and Table 15.2; Communication from IEA; OPEC WOO 2013, Table 1.9, Table 4.2, 4.4.*

***Figure 17 notes**: IEA ethanol and biodiesel converted from energy-equivalent basis by divining by 0.7 and 0.9 respectively.*

In addition, forecast results from the two central scenarios in WEO2013 and WOO2013 – the New Policies Scenario and the Reference Case – are also similar. **Figure 17** implies that further dialogue might be merited on the effects of policy assumptions on forecast results, given that the IEA's Current Policies Scenario has a much higher forecast than OPEC's Reference Case, even though their policies assumptions are reported to be similar.

5.3 Long-term Energy Supply

5.3.1 Mathematical Models

Section 4 mentioned that both the IEA and OPEC base their medium-term supply projections upon bottom-up approaches. However, their long-term supply projection methodologies differ greatly.

According to the WOO, OPEC uses a resources-to-production model to check future oil production feasibilities. In this model, oil gradually depletes as the remaining resources-to-production (R/P) ratio declines over time. To derive the R/P ratio, OPEC primarily relies on U.S. Geological Survey (USGS) data for Ultimately Recoverable Resources (URR) at the country level. The advantage of this model is its simplicity and ease of understanding, yet there are some limitations to this approach.

First, previous studies suggest that existing URR estimates are too low because both new discoveries and reserve growth could be underestimated[7]. OPEC takes this into consideration, and complements its analysis by providing an Upside Supply Scenario, in which a more optimistic view of URR is taken for major oil producers.

Second, the R/P mathematical model used for assessing conventional resources is not as applicable for unconventional resources. For this reason, OPEC's forecast for North America tight oil is conducted separately from conventional resources.

In contrast, the IEA again employs a bottom-up modeling approach for long-term oil supply projection. Unlike in the MTOMR, however, for the long-term the IEA conducts a country-by-country instead of field-by-field projection. In such an approach, production forecasts are based on observed historical decline rates for fields that have already entered post-plateau periods, and the data are then employed to simulate production trends for fields with similar characteristics. Notwithstanding the accuracy of using a bottom-up approach for short- and medium-term supply forecasts, its application in long-term projections presents challenges. One difficulty is defining the type of decline rate appropriate for new unconventional production fields. Another is the notion that the possibility of enhanced oil recovery (EOR) adds uncertainty to the supply forecasts. Based on the IEA's analysis, OPEC production has the lowest decline rate throughout the projection period. In contrast, output from North America LTO production fields and oil sands decline at a more rapid pace, meaning that to

7 Adam R. Brandt, Review of mathematical models of future oil supply: Historical overview and synthesizing critique, Energy, Volume 35, Issue 9, September 2010, Pages 3958-3974, ISSN 0360-5442, http://dx.doi.org/10.1016/j.energy.2010.04.045.

maintain a high share of world liquids supply constant investment in those unconventional fields is required.

Finally, both the IEA's and OPEC's oil supply projections are derived by balancing demand in their energy models, but OPEC accounts for a difference between the supply and demand figures through a "stock change and miscellaneous items" category.[8]

5.3.2 Liquids Supply Forecasts

As **Figure 9** in Section 4 illustrates, the IEA and OPEC have different classification systems for liquids supply, which present challenges in making long-term supply forecasts data comparable. **Table 11** summarises the IEA and OPEC long-term liquids supply outlooks (the long time horizon shown in **Table 11** tends to reduce the differences in supply growth projections). The most significant divergence lies in forecasts for OECD Americas in 2035. On a related note, more information regarding the IEA's and OPEC's perspectives on North American LTO is featured in the accompanying box.

8 The stock change and miscellaneous item considers development of Strategic Petroleum Reserve (SPR) as well as commercial stock building in some non-OECD countries.

Table 11. Long-term World Liquids Supply (mb/d)

Table 11 summarises the IEA and OPEC long-term liquids supply outlooks. The most significant divergence lies in forecasts for OECD Americas in 2035.

	2035		Avg. annual growth (2012-2035)		
	IEA Current Policies Scenarioa	OPEC Reference Case[a]	IEA Current Policies Scenario	OPEC Reference Case	Difference (IEA-OPEC)
OECD	24.6	21.7	0.2	0.1	0.1
Americas	21.5	18.8	0.2	0.1	0.1
Europe	2.2	2.5	-0.1	0.0	0.0
Asia Oceania	0.8	0.5	0.0	0.0	0.0
Non-OECD	33.5	31.9	0.2	0.1	0.1
Asia	6.4	7.1	-0.1	0.0	0.0
Middle East, Africa & Latin America	11.5	9.5	0.2	0.1	0.1
Europe & Eurasia	15.6	15.3	0.1	0.1	0.0
Processing Gains	3.6	3.0	0.1	0.0	0.0
World Biofuels supply	4.4	4.9	0.1	0.1	0.0
Total Non-OPEC	66.1	61.5	0.6	0.4	0.2
Total OPEC	49.3	47.1	0.5	0.4	0.1
OPEC crude[b]	38.6	37.5	0.3	0.3	0.0
OPEC NGLs + unconventionals	10.7	9.6	0.2	0.2	0.0
World Supply	115.4	108.6	1.1	0.8	0.2

***Table 11 data sources**: IEA WEO 2013, Annex A Tables, Table 14.1; Communication from IEA; OPEC WOO 2013, Table 1.11, 3.7.*

***Table 11 notes**: OPEC Reference Case[a]: The IEA WEO does not include regional biofuels supply. Regional biofuels supply (OPEC WOO 2013 Table 3.7) is therefore subtracted from each of OPEC's regional total liquids supply (OPEC WOO 2013, Table 1.11) and only world biofuels supply is provided. OPEC crude[b]: Venezuela extra heavy oil is included in OPEC crude, consistent with OPEC classification.*

The IEA and OPEC: Different Perspectives on LTO Growth

In its WOO2013 report, OPEC projects that LTO supply in the United States and Canada will peak around 2017-2019--with the largest annual production growth already seen in 2012--and then gradually decline over the remainder of the projection period. OPEC believes that by 2035, LTO production in the United States and Canada will just slightly exceed the current production level.

In contrast, the IEA projects that the LTO revolution will last longer. It expects LTO supply in North America to plateau around 2025 and not taper off until the beginning of the 2030s. According to the WEO2013, growth in LTO as well as NGLs from shale plays will propel the United States past Saudi Arabia as the world's largest oil producer by 2015, retaining that position until the beginning of 2030s. The sharp contrast in LTO projections may result from different perspectives on the impact of rapid decline rates on field production, or assumptions regarding the resource bases and sustainability of investment activity. It could also relate in part to the different definitions of LTO and NGLs discussed elsewhere. Although the IEA acknowledges the challenges of LTO's faster decline rates than conventional oil and the initial targeting of "sweet spots", it projects that continuous investment in new rigs and discoveries of new fields, as well as other technological advances, will maintain LTO production at a high level.

The sharp contrast in LTO projections may result from different perspectives on the impact of rapid decline rates on field production, or assumptions regarding the resource bases and sustainability of investment activity. It could also relate in part to the different definitions of LTO and NGLs discussed elsewhere.

Despite quite different views on LTO long-term prospects, both projections acknowledge large uncertainties about the future. In its WEO2013, the IEA pointed out that downside risks may include new LTO plays (beyond the Bakken/Three Forks, Eagle Ford and Permian) being less productive and more expensive to develop, with the possibility of a lower oil price inhibiting the development of LTO. In its WOO2013, OPEC considers a more optimistic LTO supply path in the Upside Supply Scenario, in which existing major LTO plays are productive and more plays are added to the production profile. In this scenario, LTO production from North America will be 2.5 mb/d higher than the Reference Case by 2035, though the production is still expected to peak around 2020, earlier than IEA's forecast.

As for LTO resources outside North America, both the IEA and OPEC adopt cautious estimates due to a lack of global commercial experience and thorough and detailed worldwide resource assessments. However, they both mention potential contributions from the Vaca Muerta shale in Argentina and the Upper Jurassic Bashenov shale in Russia (OPEC only considers these shale plays in its UPS). It is not predictable at this moment how much LTO production can be produced globally in the long-run.

In addition to the regional supply differences, it is also worthwhile to understand the IEA's and OPEC's views about the composition of world supply by fuel type, as shown in **Figure 18**.

Figure 18. Liquids Supply Sources in 2012 and Outlook for 2035

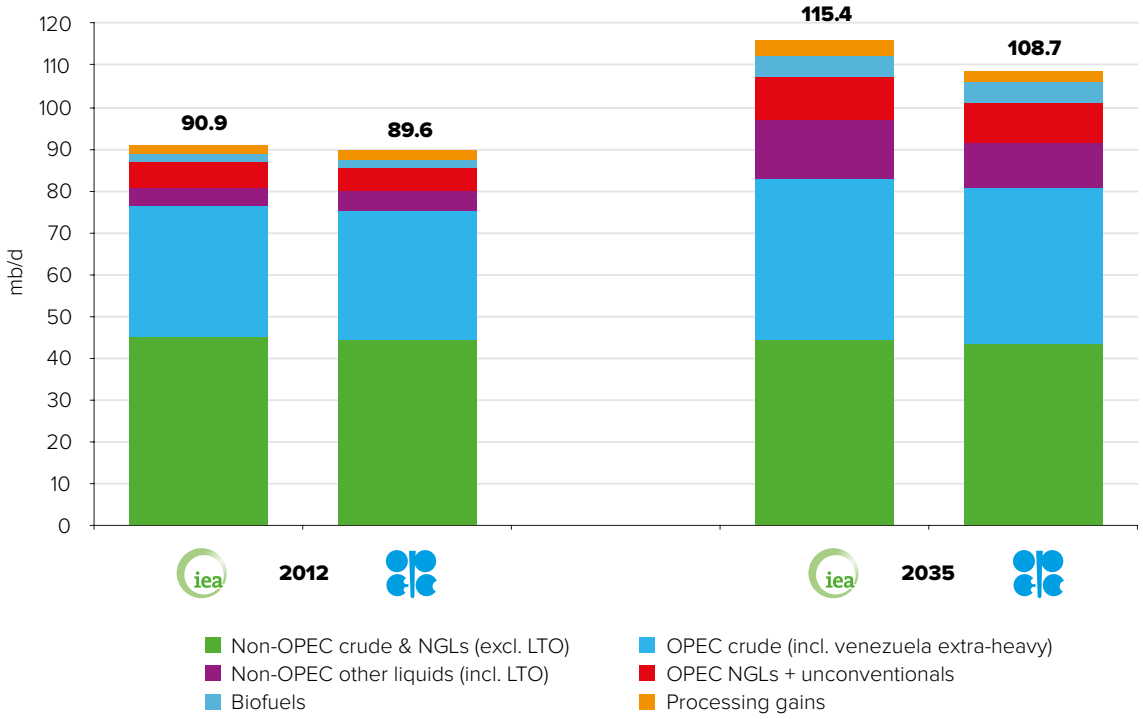


***Figure 18 data sources**: IEA WEO 2013, Table 14.1; Communication from IEA; OPEC WOO 2013, Table 1.11, 3.5, 3.6 & 3.7.*

***Figure 18 notes**: IEA biofuels from Table 14.1 in WEO 2013 converted from energy-equivalent basis by dividing by 0.7.*

A major divergence between the IEA and OPEC is over non-OPEC unconventional oil supply. Besides their different views on LTO, the IEA is more optimistic about Brazil's abundant deepwater pre-salt deposits. The IEA considers Brazil a country of great significance to the global energy outlook, and makes it the spotlight country in its 2013 WEO report.

Both the IEA and OPEC expect OPEC crude production over the next 10 years to hold steady around 30 mb/d, largely affected by the unconventional oil boom in the United States, oil sands from Canada and deepwater production in Brazil.

Aside from the aforementioned point, the IEA and OPEC share many similar views. Both projections expect OPEC crude production over the next 10 years to hold steady around 30 mb/d, largely affected by the unconventional oil boom in the United States, oil sands from Canada and deepwater production in Brazil. However, they both hold that OPEC crude will rise again after 2020, although the share of OPEC crude is unlikely to pass the 2012 level of 34% during the projection horizon.

Unlike OPEC crude, OPEC NGLs production is expected by both reports to increase steadily throughout the forecast period, accounting for more than 3 mb/d of the total OPEC production increase. The IEA's Current Policies Scenario and OPEC's Reference Case both project that OPEC supply will account for around 43% of total world liquids supply in 2035. Within the OPEC supply group, the WOO2013 does not give detailed supply forecasts country by country, or specify growth prospects for different types of oil sources. The IEA forecasts that Saudi Arabia will remain the world's biggest oil exporter, while Iraq will contribute most to OPEC (and global) oil production growth.

The IEA's and OPEC's views on "Non-OPEC Crude & NGLs" are also similar. Both expect this supply to fall slightly below the current level, and its share in total world supply to drop by around 10% over the projection period.

A comparison of world liquids supply forecasts in all WEO and WOO scenarios is featured in **Figure 19**, which highlights how world supply outlooks can be affected by different frameworks of scenario assumptions. The IEA primarily varies assumptions about policies across different scenarios. As a result, all types of liquids supply are affected. When more stringent environmental and energy policies are put forward in the 450 Scenario, biofuels gain, along with NGLs and other cleaner unconventional sources. In the WOO report, the key variable that drives differences in the scenarios is economic growth. OPEC assumes non-OPEC supplies and OPEC NGLs to be relatively fixed across scenarios, and OPEC supplies adapt to demand changes under different economic growth scenarios.

Figure 19. 2035 Liquids Supply Outlook in Different Scenarios

Figure 19 shows a comparison of world liquids supply forecasts in all WEO and WOO scenarios, and highlights how world supply outlooks can be affected by different frameworks of scenario assumptions.

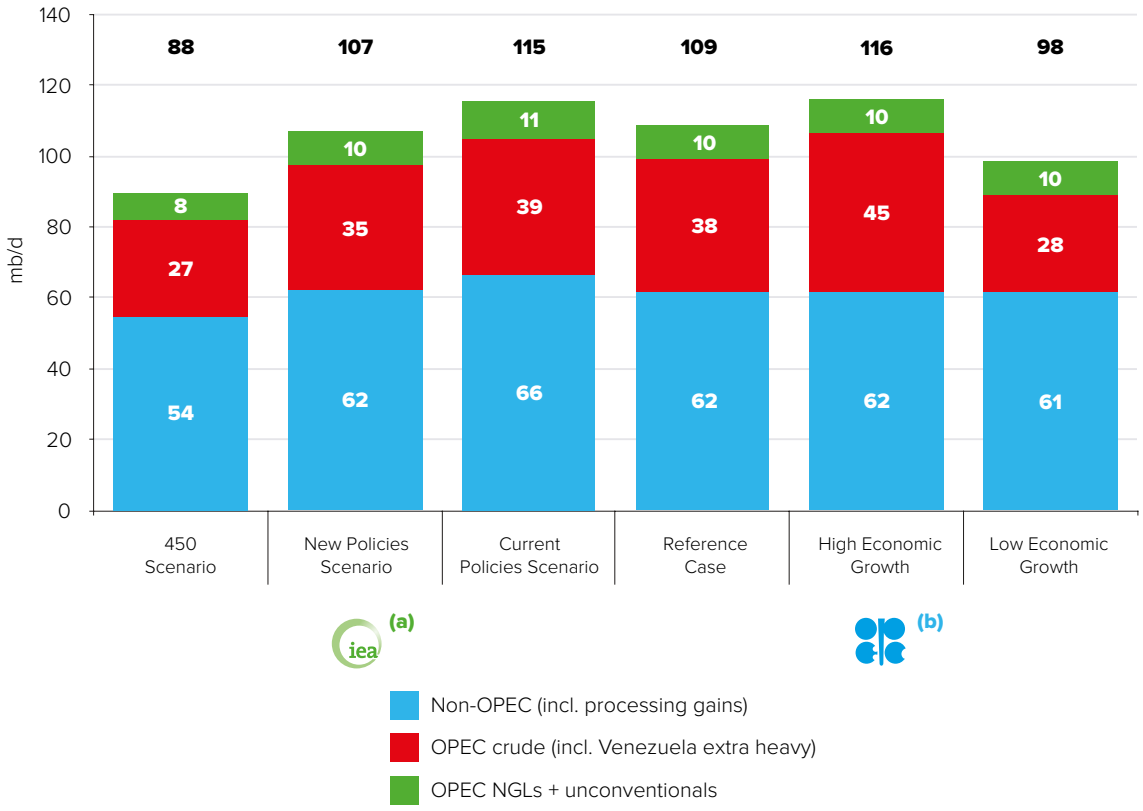


***Figure 19 data sources**: IEA WEO 2013, Table 14.1; Communication from IEA; OPEC WOO 2013, Table 1.11, 4.3, 4.5.*

***Figure 19 notes**: IEA[(a)]: biofuels from Table 14.1 in WEO 2013 converted from energy-equivalent basis by dividing by 0.7. OPEC[(b)]: WOO does not report projections for processing gains in the LEG and HEG scenarios; it is assumed that processing gains in these scenarios are the same as the OPEC Reference Case. Due to rounding, numbers presented throughout this document may not add up precisely to the totals provided and percentages may not precisely reflect the absolute figures.*

6. Final Remarks

The past few years have seen historic changes in the global oil market. On the demand side, expected growth in oil consumption has continued to shift eastward, and non-OECD oil demand may have already surpassed OECD demand. On the supply side, growth in non-OPEC production, especially from unconventional resources, has already reshaped the global oil market. Tectonic shifts are also occurring in the midstream and downstream industries. While those changes, including a rapidly expanding refinery sector in China and other non-OECD countries, were not explored in depth in this paper, they will surely influence global energy markets for years to come.

This introductory paper attempts to strengthen our collective understanding of the future of energy supply and demand by comparing outlooks over various horizons from two widely acknowledged information providers, the IEA and OPEC. The purpose is neither to harmonise all assumptions nor to eliminate all differences in perspectives. On the contrary, a diversity of opinions should be welcomed, as it improves market resilience and enriches the global energy dialogue. Along those lines, this comparison pursues an enhanced understanding of views and methodologies from both parties, and explores possibilities for data quality improvement to better inform decision-makers worldwide.

The Fourth IEA-IEF-OPEC Symposium on Energy Outlooks aims to provide an open platform to facilitate consumer-producer dialogue on global energy security. This paper has identified many similarities and differences between the IEA and OPEC's short-, medium- and long-term outlooks and posits the following issues for further discussion at the Symposium:

- Discussing differences of perception regarding LTO's potential;
- Sharing viewpoints regarding price forecasting methodologies;
- Bridging historical data differences, particularly in non-OECD demand and OPEC NGLs/ unconventionals;
- Advancing efforts to standardise liquids fuel supply categories;
- Understanding challenges related to a uniform classification of country groupings, as harmonised regional definitions would greatly enhance the comparability of the outlooks;
- Standardising unit conversion processes across mb/d, mboe/d, and mtoe;
- Adopting consistent approaches in classifying fuels at regional versus global levels (e.g., biofuels, bunkers);
- Analysing whether or not there is room for enhancement of long-term oil supply projection models, particularly with respect to unconventional resources;
- Improving long-term energy demand projection models, particularly for non-OECD regions.

Annex 1: Long-term Outlook Assumptions

	OPEC			IEA		
Variables	**Reference Case**	**LEG**	**HEC**	**New Policies**	**Current Policies**	**450**
Global Economic Growth Rate (2013-2035)	3.5%	3.0%	3.9%	3.6%	Same as New Policies	Same as New Policies
Population, Billion	From 7.0 to 8.6 (2012-2035)	Same as Reference Case	Same as Reference Case	From 7.0 to 8.7 (2011-2035)	Same as New Policies	Same as New Policies
Oil Price Assumptions (in 2012 $)	$94/bbl by 2020;	Same as Reference Case	Same as Reference Case	$113/bbl by 2020; $128/bbl by 2035	$120/bbl by 2020; $145/bbl by 2035	$110/bbl by 2020; $100/bbl by 2035
Investment	$5.2 trillion upstream investment, half made by OECD countries. $1.5 trillion refining investment; (2012-2035, all in 2012 $)	Not specified	Not specified	$9.4 trillion upstream investment, with the majority made by non-OECD region. (2013-2035, in 2012 $)	Not specified	Not specified
Cost	gradual rise expected, as reflected in the oil price assumption	Not specified	Not specified	marginal supply cost around $80-90/bbl, significantly lower than price assumption	Not specified	Not specified
Energy and Environmental Policies	Only considers policies that have been enacted	Same as Reference Case	Same as Reference Case	Considers both policies in place and commitments announced	Only considers policies that have been enacted as of mid-2013	Assumes policies to be taken to limit the concentration of GHG in the atmosphere to 450 ppm of CO2 equivalent
Carbon Price in EU Market (in 2012 $)	Not specified	Not specified	Not specified	$40/tonne by 2035	$30/tonne by 2035	$125/tonne by 2035

Annex 2: Long-term Outlook Results

	OPEC				IEA			
	Base Year	2035 Scenario			Base Year	2035 Scenario		
		Reference Case	LEG	HEG		New Policies	Current Policies	450
Global energy demand (mboe/d) [a] (2010-2035)	252	382	-	-	260	351	377	301
Global Oil Demand (mb/d) (2012-2035)	88.9	108.5	98.4	116	89.2	106.9	115.4	88.2
Non-OPEC Supply (mb/d) [b] (2012-2035)	52.9	61.6	61.3	61.8	53.7	61.7	66.1	53.7
OPEC Crude (mb/d) [c] (2012-2035)	31.1	37.5	27.6	44.7	30.5	35.1	38.6	26.9
OPEC NGLs and Other Liquids (mb/d) (2012-2035)	5.7	10.6	10.6	10.6	6.3	10.1	10.7	7.5

***Annex 2 notes**:*

[a] *IEA primary energy is converted from mtoe per year to mboe/d by multiplying by 7.37 mboe/mtoe and dividing by 365 days per year.*

[b] *Include biofuels and processing gains.*

[c] *OPEC crude includes Venezuela extra-heavy oil.*



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