

TENTH 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 Resources for the Future



RESOURCES
for the FUTURE



10TH ANNIVERSARY IEA IEF OPEC
SYMPOSIUM ON ENERGY OUTLOOKS



TENTH **IEA** **IEF** **OPEC** SYMPOSIUM ON ENERGY OUTLOOKS

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Acronyms and Abbreviations

bbf	Barrel
CPS	Current Policies Scenario (IEA)
CTLS	Coal to Liquids
EIA	U.S. Energy Information Administration
EOR	Enhanced Oil Recovery
EV	Electric Vehicles
FSU	Former Soviet Union
GDP	Gross Domestic Product
GHG	Greenhouse gas
GTLs	Gas to Liquids
HSFO	High Sulphur Fuel Oil
IEA	International Energy Agency
IEF	International Energy Forum
IMF	International Monetary Fund
IMO	International Maritime Organisation
kb/d	Thousand Barrels per Day
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
MTBE	Methyl Tertiary Butyl Ether
NDC	Nationally Determined Contribution
NGLs	Natural Gas Liquids
NPV	Net Present Value
OECD	Organisation for Economic Co-operation and Development
OMR	Oil Market Report (IEA)
OPEC	Organisation of the Petroleum Exporting Countries
ORB	OPEC Reference Basket
PHEF	Plug-in Hybrid Electric Vehicle
ppm	Parts per Million
R/P	Resources-to-Production
SDS	Sustainable Development Scenario (IEA)
SPR	Strategic Petroleum Reserve
UN	United Nations
URR	Ultimately Recoverable Resources
USGS	U.S. Geological Survey
WEO	World Energy Outlook (IEA)
WOO	World Oil Outlook (OPEC)

Key Observations

Overview

This Introductory Paper provides a comparative analysis of the short-, medium-, and long-term energy outlooks published by the IEA and OPEC in 2019 and serves to inform discussions at the 10th Anniversary Session of the IEA-IEF-OPEC Symposium on Energy Outlooks taking place in Riyadh, Saudi Arabia on 19 February 2020.

Comparisons focus on the short-, and medium-term liquid supply and demand projections, from 2018 to 2020 and from 2018 to 2024 respectively, and the long-term primary energy and oil projections from 2018 to 2040 that the IEA and OPEC published in 2019. The latter includes evaluations of the Current Policies Scenario and the newly introduced Stated Policies Scenario of the IEA on one hand, and the Reference Case of OPEC on the other. These are placed in the context of the Sustainable Development Scenario of the IEA and the Sensitivity Cases of OPEC that factor in the fulfilment of the UN Sustainable Development Goals by 2030, and implementation of the UN Paris Agreement among other variables. These range from economic and population growth rates to assumptions on technology advancements and oil price ranges. This year's introductory paper also includes a new section on energy demand and technology developments in the road transportation sector which is the subject of session III of this year's 10th IEA-IEF-OPEC Symposium on Energy Outlooks.

Recent Progress on Data Harmonisation and Comparability of Outlooks

The quality of producer - consumer dialogue on energy market and policy developments relies on readily comparable data, similar outlook timeframes, and transparent projection methodologies and assumptions. Over the past decade the IEA, IEF, and OPEC have strengthened their commitment to achieving greater data consistency and improving the comparability of energy outlooks for discussion at the annual joint IEA-IEF-OPEC Symposia of the Trilateral Work Programme. The insights gained from these high-level expert meetings in turn help to better inform investment and policy decisions that strengthen energy market stability and facilitate orderly transitions.

Two informal expert meetings were hosted by the IEF: in Riyadh on 16 February 2019 in advance of the Ninth IEA-IEF-OPEC Symposium on Energy Outlooks, and in Vienna on 29 March 2019 following the third IEA-IEF-OPEC Workshop on the Interactions between Physical and Financial Energy Markets. These meetings deepened understanding and further discussed options to bridge differences in the following key areas:

- Historical baseline data sets and revisions for the non-OECD region, with participation of the U.S. EIA.
- Classifications of countries and regions across both OECD, non-OECD regions, and OPEC Member Countries.
- Fuel type categorisations in both regional and global balances.

The IEF agreed with the IEA, OPEC, and U.S. EIA to exchange historical data for non-OECD regions up to 2018 to keep discrepancies under review, and strengthen cooperation to improve the comparability of energy outlooks.

Opportunities to Advance the Comparability of Outlooks

Apart from differing methodologies to make assumptions on economic and population growth, technology advancement, and price trends over projection periods, key opportunities to advance the comparability of outlooks include:

- Comparability of historical baseline data, particularly for non-OECD nations has improved but discrepancies still remain for demand in non-OECD Asia, supply in OPEC (mainly for NGLs and unconventional), and FSU nations.
- OPEC reports its main regional results in terms of OECD status while since 2018 the IEA does not group countries according to OECD status in its main results and Annex tables.

- Though OPEC disaggregated its member countries' demand data to improve direct comparison with IEA's outlook, an inconsistency still exists within the Middle East and Africa regions. While the IEA reports Middle East and Africa regions separately, OPEC groups them together as a single category.
- While OPEC includes biofuels in each region's total liquids supply, the IEA only includes global biofuels supply in its monthly reports. However, the IEA's Medium-Term Oil 2019 report publishes 2018 biofuels production by region.
- The IEA and OPEC continue to 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.
- Unlike previous years, OPEC did not publish the composition of its liquids supplies in the medium- or long-term (i.e. the share of crude and NGLs/unconventionals).
- Differences between the IEA and OPEC in their choice of units for primary energy demand also create challenges in making comparisons. OPEC uses million barrels of oil equivalent per day (mboe/d), while the IEA most frequently uses million tons of oil equivalent (mtoe) per year.

IEA and OPEC Short-Term Oil Outlooks

Both the IEA and OPEC have revised downward their estimates for global economic growth relative to estimates made in late 2018 by 70 and 50 base points respectively. For 2019, the IEA and OPEC both project global growth of 3.0%. For 2020, the IEA projects that global growth will increase to 3.4%, while OPEC projects continued global economic growth of 3.0%.

Liquids Demand

The IEA and OPEC project world liquids demand to reach 100.2 and 99.8 mb/d in 2019 respectively. Both surpass the 100 m/d threshold in 2020 when their estimates reach 101.5 and 100.9 mb/d respectively. Assessments diverge by 0.4 mb/d in 2019 and by 0.6 mb/d in 2020 largely on account of different estimates for non-OECD Asia. The IEA and OPEC revised down their global liquids demand growth estimates over the course of the year, with OPEC showing higher demand growth throughout most of 2019. Global estimates were 0.5 mb/d and 0.3 mb/d lower in December 2019 relative to January 2019 for IEA and OPEC respectively. The IEA and OPEC project that global liquids demand will grow by roughly 1 mb/d in 2019. In 2020, the IEA projects slightly faster growth of 1.2 mb/d, while OPEC sees growth of 1.1 mb/d.

The IEA is more bullish on demand growth in China for both 2019 and 2020 projecting 0.6 mb/d and 0.4 mb/d respectively relative to 0.4 mb/d and 0.3 mb/d projected by OPEC. Overall demand is substantially higher in the IEA's forecast due to remaining differences in historical baselines. Both organisations project demand growth of around 0.4 mb/d in the non-OECD Asia region from 2019 to 2020. In every other region, the IEA and OPEC both estimate modest annual growth of between 0.0 and 0.1 mb/d from 2019 to 2020.

Liquids Supply

The IEA and OPEC project world liquids supply to reach 100.2 mb/d and 99.8 mb/d in 2019 and surpass the 100 m/d threshold in 2020 when their estimates reach 101.5 and 100.9 mb/d respectively. Assessments diverge by 0.4 mb/d in 2019 and 0.6 mb/d in 2020 largely on account of different estimates for OECD Americas, OECD Europe and China and the FSU in the non-OECD region.

Projections for the annual rate of growth of non-OPEC liquids supply is similar between the IEA and OPEC though growth builds upon differing baseline data. The IEA and OPEC project that non-OPEC liquid supplies will grow from 64.8 mb/d and 64.3 mb/d in 2019 to 67.0 mb/d and 66.5 mb/d in 2020 varying by 0.5 mb/d, respectively. Substantial differences emerge in the OECD, with OPEC projecting 0.3 mb/d in additional supplies relative to the IEA from both OECD Americas and OECD Europe in 2019. In 2020, this difference grows to 0.4 mb/d for OECD Americas but falls to 0.1 mb/d for OECD Europe.

Neither the IEA nor OPEC make projections for short-term OPEC crude, but the difference between their

constructed estimates for OPEC supply has grown from 0 mb/d in 2018 (the baseline year) to 0.8 mb/d in 2019 and 0.6 mb/d in 2020.

IEA and OPEC Medium-Term Oil Outlooks

Liquids Demand

The IEA and OPEC expect 2024 world liquids demand to reach 106.4 mb/d and 104.8 mb/d respectively.

Like last year's assessment, both organisations expect robust medium-term growth in global liquids demand. The IEA is more bullish than OPEC over the medium term, projecting annual average growth of 1.2 mb/d, compared with 1.0 mb/d for OPEC. Liquids demand in the baseline year 2018 is 98.7 mb/d for OPEC and 99.2 mb/d for the IEA, a difference of 0.5 mb/d, slightly smaller than the difference observed in last year's report.

Demand growth is centred squarely in non-OECD nations. OPEC expects non-OECD liquids demand growth to average 1.1 mb/d per annum, while the IEA projects growth of 1.2 mb/d reaching 57.5 mb/d and 58.5 mb/d respectively by 2024 respectively. By 2024, OPEC projects total OECD liquids demand to decline by 0.09 mb/d per annum from 47.8 mb/d in 2018 to 47.3 mb/d in 2024, while the IEA projects liquids demand increasing slightly by 0.02 mb/d per annum from 47.8 mb/d in 2018 to 47.9 mb/d by 2024.

The IEA projects that HSFO demand will drop by 2.1 mb/d in 2020, while OPEC anticipates a decline of 1.8 mb/d in the marine bunkers sector alone. However, the resulting lower prices for HSFO is expected to spur additional consumption of the fuel for power generation, particularly in the Middle East.

Liquids Supply

Between 2019 and 2024, OPEC projects cumulative net supply growth of 9.9 mb/d for non-OPEC countries, while the IEA projects cumulative non-OPEC supply growth of 6.1 mb/d. Including constructed supply from OPEC producers, OPEC and IEA projections for liquids supply reach 105.0 mb/d and 106.4 mb/d in total by 2024, respectively. Though OPEC's medium-term supply projections are generally higher than those of the IEA, OPEC projects average annual growth of world liquids supply of 1.0 mb/d and the IEA 1.5 mb/d between 2018 and 2024.

Under OPEC's projection OECD Americas accounts for 66% of cumulative non-OPEC growth over the medium term, and 70% under the IEA's projections. OPEC projects 30.5 mb/d from OECD Americas in 2024, while the IEA sees production for the region of 27.7 mb/d.

The second largest contributor to non-OPEC supply growth through 2024 is Latin America, which grows by 1.5 mb/d for the IEA and by 1.8 mb/d for OPEC reaching 6.5 mb/d and 7.0 mb/d in 2024 respectively. OECD Europe, led by Norway, also plays a considerable role, growing by 0.4 mb/d under the IEA and by 0.7 mb/d under OPEC with liquid supplies at 3.9 mb/d and 4.5 mb/d in 2024 respectively.

Both the IEA and OPEC have once again increased their projections for the growth in medium-term oil supply from the United States and Canada recording 25.9 mb/d and 22.8 respectively by 2024. The difference of 1.3 mb/d in projected supply by the end of the forecast period is substantial, reflecting different assumptions about technologies and oil prices. For both organisations, the majority of this growth comes from US tight oil.

IEA and OPEC Long-Term Energy Outlooks

Primary Energy Demand

In 2018, the baseline year for the IEA's and OPEC's long-term projections, fossil fuels accounted for 81% of the primary energy mix. Fossil fuels continue to dominate the primary energy mix, with oil, gas, and coal in 2040 providing 74% under IEA's Stated Energy Policy Scenario, 75% under OPEC's Reference Scenario, and 78% under the IEA Current Policies Scenario. This share declines to 58% under the IEA Sustainable Development Scenario, and to 44% under OPEC's Below 2°C Scenario A.

Total primary energy demand grows under 3 of the 5 scenarios considered here, increasing by 1.0% per year on average for the IEA Stated Policy Scenario and OPEC's Reference case, and by 1.3% per year under the IEA's

Current Policies Scenario. Unlike previous year's projections, global primary energy demand declines on an absolute basis under the IEA's Sustainable Development Scenario, falling by an average of 0.3% per year, and declining by 0.4% per year under OPEC's Below 2°C Scenario A.

By 2040, global primary energy demand is 358 mboe/d in the IEA's Stated Policies Scenario, similar to the WEO 2018 projection under the New Policies Scenario. Under OPEC's Reference Case, global demand in 2040 is 357.5 mboe/d, slightly below the WOO2017 projection for 2040 of 365 mboe/d. Under the IEA's Current Policies Scenario and Sustainable Development Scenario global primary energy demand is 387.4 mboe/d and 268.2 mboe/d, respectively. Global primary energy demand reaches 261.7 mboe/d under OPEC's Below 2°C Scenario A.

The IEA's Current Policies Scenario projects the most robust growth in energy demand, followed by OPEC's Reference Case and the IEA's Stated Policies Scenario. The IEA's Current Policies Scenario's projection for coal, oil, and gas consumption is 14 mboe/d, 13 mboe/d, and 8 mboe/d higher, respectively, than OPEC's Reference Case. Under the IEA's Stated Policies Scenario, oil and natural gas consumption are equal to OPEC's Reference Case, and coal consumption is 1 mboe/d lower in 2040. The IEA's Sustainable Development Scenario sees a decline in overall primary energy demand, with a notable decrease in the share of fossil fuels in the primary energy mix. As the scenarios tighten to meet climate goals, coal is the biggest loser of relative market share, falling from 77 mboe/d in 2018 to 30 mboe/d by 2040 in the IEA Sustainable Development Scenario, and just 19 mboe/d under OPEC's Below 2°C Scenario A.

Energy Supply Mix

Oil maintains its position as the leading primary energy source globally, though its share shrinks from 31.5% in 2018 to 28% under IEA's Stated Policies-, and OPEC Reference scenarios, and to 29% under IEA's Current Policies Scenarios notwithstanding growth in volumetric terms. In the climate policy-focused scenarios, oil is the second largest primary energy source in 2040, declining to 23% under the IEA's Sustainable Development Scenario and 17% under OPEC's Below 2°C Scenario A.

Natural gas' share of the global energy mix increases under most scenarios, growing from 23% in 2018 to 25% under the IEA's Current Policies-, Stated Policies-, and OPEC Reference scenarios. Under the two climate-policy-focused scenarios, natural gas takes oil's place as the largest primary energy source by 2040, growing to 24% under the IEA's Sustainable Development Scenario, and falling to 19% under OPEC's Below 2°C Scenario A.

Coal's share of the mix declines substantially under all scenarios, falling from 27% of global primary energy supply in 2018 to 23% under the IEA's Current Policies Scenario and 21% under IEA Stated Policies-, and OPEC's Reference scenarios. This decline is accelerated under the IEA's Sustainable Development Scenario, where coal falls to 11% by 2040, and in OPEC Below 2°C Scenario A, where it declines to just 7%.

The share of renewables, which is currently dominated by biomass, is projected to increase in all scenarios from 14% in 2018 to 17% under the IEA's Current Policies Scenario, 19% in OPEC's Reference Case, 21% under the IEA's Stated Policies Scenario, and 34% under the IEA's Sustainable Development Scenario. Virtually all of this growth comes from renewable electricity such as wind, solar, and hydro.

Liquids Demand

The share of liquids in the world primary energy mix is expected to decrease, but the level of demand still enjoys robust growth over the projection period under most scenarios in volumetric terms.

In the IEA's Stated Policies Scenario and OPEC's Reference Case, world liquids demand reaches 112.9 mb/d and 110.6 mb/d, respectively, by 2040. In the IEA's Current Policies Scenario, 2040 world liquids demand grows to 124.6 mb/d but shrinks to 74.6 mb/d in the Sustainable Development Scenario.

In terms of average annual growth rates, OPEC's Reference Case projects liquids demand growth of 0.5 mb/d, just below IEA's Stated Policies Scenario projection of 0.6 mb/d, and well below the IEA's Current Policies Scenario projection of 1.1 mb/d per year. Under the IEA's Sustainable Development Scenario, global liquids demand shrinks

by 1.1 mb/d annually through 2040.

The difference between the highest and lowest projections for 2040 world liquids demand is 50 mb/d, well above the range of 42 mb/d found in the WEO2017 and 45.5 mb/d in WEO2018 between the Current Policies, Sustainable Development, and 450 Scenario, respectively. This difference highlights the growing “gap” between the greenhouse gas emissions goals articulated in the 2015 Paris climate agreement and those likely to occur in main scenarios.

Demand growth will slow in the coming decades, but to varying degrees. In the IEA’s Current Policies Scenario, demand growth slows somewhat after 2025, while a slowing rate of growth is more apparent in the IEA’s New Policies Scenario and OPEC’s Reference Case. Under the IEA’s Sustainable Development Scenario, there is just 1 mb/d of growth through 2025, followed by substantial declines in absolute levels of demand through to 2040.

Both the IEA and OPEC agree that OECD nations will experience a decline in oil demand in absolute and relative terms, yet this decrease is expected to be more than offset by robust demand growth in non-OECD nations, with the exception of the IEA’s Sustainable Development Scenario. Non-OECD nations’ share of global liquids demand increases from 52% to between 64% and 66% by 2040.

Transport

In 2018, the transportation sector accounted for 58% of global oil demand. Under the OPEC Reference and IEA Stated Policies scenarios, transport sector oil demand grows moderately over the projection period, increasing by 6.4 and 7.0 mb/d, respectively to 2040. Under the IEA’s Current Policies scenario, demand climbs by 18.5 mb/d, while under the Sustainable Development Scenario, it contracts by 22 mb/d by 2040.

In 2018, the IEA and OPEC respectively estimated that road transport accounted for 43% and 45% of global oil demand. The share converges to 43% under the OPEC Reference and IEA Current Policies Scenario respectively, but declines to 40% under IEA Stated Policies Scenario, and shrinks to just 31% under the IEA’s Sustainable Development Scenario by 2040.

The rate of electric vehicle deployment remains uncertain and relies on multiple variables. Under the IEA Stated Policies and OPEC Reference scenarios, electric vehicles market share grows from 0.5% of the global passenger vehicle fleet in 2018 to 16% and 15%, respectively, by 2040. Under the Sustainable Development Scenario, electric vehicles grow to 44% by 2040 and account for 72% of passenger vehicle sales by 2050.

1. Background and Introduction

The International Energy Agency (IEA) and the Organisation of the Petroleum Exporting Countries (OPEC) track global energy market trends to produce short-, medium-, and long-term energy outlooks. Their insights shape perceptions on how energy markets might evolve and influence important policy and investment decisions around the world.

In light of their influence, the Joint Statement of the Jeddah Energy Meeting (2008) called for shared analyses of oil market trends and outlooks produced by the IEA and OPEC. The Cancun Ministerial Declaration (2010) recognised the IEF's role as a platform for sharing insights and exchanging views about energy market trends, and called for the IEA, IEF, and OPEC to organise an annual Symposium on Energy Outlooks at the IEF Secretariat.¹ The three organisations held their First Symposium in 2011 and have collaborated since then to advance understanding of the factors that drive energy supply and demand.

An introductory paper comparing the most recent outlooks prepared by the IEA and OPEC has accompanied each Symposium. This paper is for the Tenth Symposium and takes as reference the outlooks published by both organisations in 2019. As in previous editions, the objectives of this analysis are:

- To identify similarities and differences in estimates for short-, medium-, and long-term oil demand and supply;
- To contrast the long-term outlooks for primary energy demand and the global energy mix; and
- To better understand the methodologies, definitions, and assumptions behind these projections and outlooks.

An on-going challenge in the comparison of energy outlooks concerns the different use each organisation makes of historical data, definitions, and geographical classifications. The introductory paper of the Ninth Symposium identified opportunities to harmonise a number of variables:

(i) Better align regional groupings. OPEC and IEA differ in their reporting of OECD and non-OECD status, as well as their groupings of nations in the Middle East and Africa.

(ii) Align baseline years for long-term outlooks. This year, the two organisations used the same base year (2018), enhancing the comparability of these outlooks.

(iii) Enhance consistency in the classification of liquid fuels at regional and global levels. There are issues with maritime and aviation fuels, bunkers, units as well as biofuels and product classifications.

(iv) Continue dialogue at the expert level on assumptions and methodologies to deepen understanding of the impact that different price assumptions and different views on the evolution of policy, technology, and economic growth have on longer term oil supply and demand balances, particularly as this relates to the role of unconventional production and other energy sources.

(v) Better align historical baseline data, particularly for non-OECD nations. In 2018, Differences were particularly noteworthy for demand in non-OECD Asia, and supply in OPEC and FSU nations.

(vi) Increase consistency in choice of units for primary energy demand. OPEC continues to use million barrels of oil equivalent per day (mboe/d), while the IEA predominately uses million tons of oil equivalent (mtoe).

(vii) Better align the publication dates of the medium-term oil market outlooks by the IEA and OPEC. In 2018, they were separated by a 6-month interval, and by an 8-month interval in 2019.

¹ Attachment II of the Cancun Declaration identifies specific areas of collaboration through a trilateral Programme of Work.

Table 1 lists the publications used for comparison in this introductory paper. Note that the IEA Medium-Term Oil 2019 report was published in March 2019, eight months earlier than the release of OPEC’s Medium-Term projections in its 2019 World Oil Outlook (WOO2019).

Table 1. IEA and OPEC Outlooks Analysed in this Introductory Paper

Report Type	IEA		OPEC	
	Report Name	Publication Date	Report Name	Publication Date
Short-term	Oil Market Report (OMR)	Dec. 2019	Monthly Oil Market Report (MOMR)	Dec. 2019
Medium-term	Oil 2019	Mar. 2019	World Oil Outlook (WOO 2019)	Nov. 2019
Long-term	World Energy Outlook (WEO 2019)	Nov. 2019	World Oil Outlook (WOO 2019)	Nov. 2019

2. Baseline 2018 Liquids Data

The harmonisation of baseline historical data between the IEA and OPEC is a necessary step to enhance the comparability of their outlooks. **Table 2**, **Table 3**, and **Table 4** compare IEA and OPEC base year (2018) demand, supply, and stock change data, respectively, primarily using the IEA's December OMR and OPEC's December MOMR, both the last short-term outlooks published in 2019. Note that as an outcome of the collaborative work on historical baseline data, the IEA and OPEC have mutually consistent base year oil demand data in their reports.

As shown in **Table 2** and **Table 3**, differences in world liquids demand and supply baselines remain fairly high, diverging by 0.5 mb/d for demand and 1.2 mb/d for supply. These differences are similar in magnitude to those identified in last year's comparative analysis, but smaller than those identified in previous years. For 2018 world liquids demand, the IEA estimates 99.3 mb/d whereas OPEC estimates 98.8 mb/d. For supply, the IEA estimates 100.3 mb/d and OPEC estimates 99.1 mb/d. These data indicate a strong build in global stocks during 2018, with growth of 1.0 mb/d for the IEA and 0.3 mb/d for OPEC. Notably, most of these stock changes are attributable to the "miscellaneous to balance" item, and were not directly observed through data from public, private, or floating storage.

Table 2 provides details on the IEA's and OPEC's estimates for 2018 baseline liquids demand data by region. Globally, the IEA estimates liquids demand of 99.3 mb/d, 0.5 mb/d higher than OPEC. Similar to previous year's assessment, the historical difference is mostly attributable to non-OECD nations, particularly from Asia, where the IEA and OPEC diverge by 0.7 mb/d, 0.3 mb/d of which is attributable to China. There is also a notable difference in demand estimates for the Middle East (0.2 mb/d), and smaller differences (roughly 0.1 mb/d) from OECD Europe, Latin America, FSU nations, and Africa.

Table 2. Liquids Demand in 2018 (mb/d)

	IEA	OPEC	Difference (IEA-OPEC)
Total OECD	47.8	47.9	-0.1
OECD Americas	25.53	25.55	-0.02
OECD Europe	14.25	14.31	-0.06
Asia Oceania	8.1	8.1	0.0
Total Non-OECD	51.4	50.9	0.6
Asia	27.0	26.4	0.7
China	13.0	12.7	0.3
Other non-OECD Asia	14.0	13.6	0.4
Middle East	8.3	8.1	0.2
Latin America	6.4	6.5	-0.1
FSU	4.7	4.8	-0.1
Non-OECD Europe	0.8	0.7	0.0
Africa	4.2	4.3	-0.1
World	99.3	98.8	0.5

Table 2 data sources: IEA OMR Dec 2019, Table 1; OPEC MOMR Dec 2019, Table 4 - 1, 4 - 2.

Table 2 notes: Numbers rounded to nearest significant digit except when additional decimal points are needed for clarity. Sums may not total due to rounding.

As for world liquids supply, **Table 3** shows a number of modest differences. Unlike previous years, relatively large differences arise in production from OECD Americas, with differences of 0.2 mb/d. Outside of the OECD, we observe a difference of 0.3 mb/d for FSU nations, and differences of 0.1 mb/d for both China and Latin America. For OPEC, the IEA and OPEC both estimate crude supply of 31.9 mb/d, though they differ by 0.7 mb/d in their estimates of NGLs and unconventionals.

Different treatment of biofuels means that comparing regional non-OPEC supply forecasts between the IEA and OPEC still requires adjustments. While OPEC includes biofuels in each region's total liquids supply, the IEA only includes global biofuels supply separately. This paper adds these IEA regional biofuels data – both historical and forecast data – to each region's oil supply data.

Regarding supply from OPEC Member Countries, there remains a notable gap between the IEA's and OPEC's estimates of OPEC NGLs and unconvensionals supply (0.7 mb/d), equal to the discrepancy observed in last year's report, while estimates of OPEC crude supplies are equal. Note that IEA and OPEC treat NGLs and unconvensionals differently. IEA reports in its OMR glossary that NGLs and unconvensionals supply includes OPEC condensates, oil from non-conventional sources (e.g., Venezuelan Orimulsion, oil shales, CTLs, GTLs) and other sources of supply (e.g., blending components such as MTBE), while OPEC provides less detail about the specific components of this category.

Table 3. Liquids Supply in 2018 (mb/d)

	IEA ^(a)	OPEC	Difference (IEA-OPEC)
Total OECD	28.5	28.3	0.2
OECD Americas	24.2	24.1	0.2
OECD Europe	3.8	3.8	0.0
Asia Oceania	0.4	0.4	0.0
Total Non-OECD	32.1	31.9	0.2
Non-OECD Asia	7.5	7.6	-0.1
China	3.9	4.0	-0.1
Other non-OECD Asia	3.6	3.6	0.0
Middle East	3.3	3.2	0.0
Latin America	5.3	5.2	0.1
FSU	14.6	14.3	0.3
Non-OECD Europe	0.1	0.1	0.0
Africa	1.5	1.5	0.0
Processing gains	2.3	2.3	0.1
Total Non-OPEC ^(b)	62.9	62.5	0.5
Total OPEC ^(c)	37.4	36.6	0.8
OPEC crude	31.9	31.9	0.0
OPEC NGLs + unconvensionals	5.5	4.8	0.7
World	100.3	99.1	1.2

Table 3 data sources: IEA OMR Dec 2019, Table 1; IEA Oil 2019, Tables 5, 5a; OPEC MOMR Dec 2019, Tables 5-1 and 5-2.

Table 3 notes: Numbers rounded to one decimal point, and sums may not total due to rounding. IEA liquids supply calculated by summing IEA oil and IEA biofuel estimates.

^(a) IEA's "OPEC NGLs" includes condensates, oil from non-conventional sources (e.g. Venezuelan Orimulsion) and non-oil inputs (e.g. to Saudi Arabian MTBE).

^(b) Note that the IEA's Total Non-OPEC supply does not equal the sum of OECD and non-OECD supplies due to a 1 mb/d "miscellaneous to balance" item in the Dec 2019 OMR.

^(c) Total OPEC equals OPEC crude plus OPEC NGLs/unconvensionals.

Table 4 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 report 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. As **Table 4** shows, both organisations estimate a strong stock build in 2018, with the IEA estimating growth of 1 mb/d and OPEC estimating 0.3 mb/d. As noted above, the bulk of this difference is attributable to the “miscellaneous to balance” item. More broadly, the strong stock build reverses the trend seen in last year’s comparative analysis and suggests a growing mismatch between supply and demand.

Table 4. 2018 Stock Change and Miscellaneous Items (mb/d)

	IEA	OPEC	Difference (IEA-OPEC)
Reported OECD	0.0	0.0	0.0
Industry/commercial	0.1	0.0	0.1
Government/SPR	-0.1	0.0	-0.1
Oil-on-water	0.0	0.1	-0.1
Miscellaneous to balance ^(a)	1.0	0.2	0.8
Total stock change & misc.	1.0	0.3	0.7

Table 4 data sources: IEA OMR Dec 2019, Table 1; OPEC MOMR Dec 2019, Table 11 - 1.

Table 4 notes: Numbers rounded to nearest significant digit.

^(a) OPEC miscellaneous to balance is computed as the difference between total OPEC stock change/misc. and other reported stock changes.

3. Short-Term Oil Outlooks

Short-term oil market reports from the IEA and OPEC forecast oil demand and supply up to 18 months in the future based on regular monitoring of macroeconomic and energy market conditions, technology, and policy developments. Monthly oil market reports also include statistics and analyses of other topics that we do not focus on in this paper, such as fluctuations in benchmark oil prices, oil stocks, movements in product markets, and trade flows. Both the IEA and OPEC capture market-moving events and offer in-depth analyses in their respective reports.

In this section, we summarise and compare the IEA's and OPEC's perspectives on short-term macroeconomics, as well as oil demand and supply outlooks.²

3.1 Economic Growth Assumptions

The IEA and OPEC take different approaches for short-term GDP forecasts. The IEA primarily refers to the IMF's projections published in the World Economic Outlook and the World Economic Outlook Updates; occasionally, the IEA makes minor adjustments to the IMF forecasts in its OMRs. Unlike the IEA, OPEC has established its own GDP projections based on a modelling approach.

Both organisations' estimates for global economic growth have been revised downward relative to estimates made in late 2018. For 2019, the IEA and OPEC both project global growth of 3.0%, compared with last year's projections of 3.7% (IEA) and 3.5% (OPEC) for the same year. For 2020, the IEA projects that the global growth rate will increase to 3.4%, while OPEC projects continued growth of 3.0%. As **Table 5** shows, regional variation is modest across most major economies. Projections vary most substantially for India, where the IEA projects 2019 and 2020 growth of 6.1% and 7.0% respectively, while OPEC projects lower annual growth of 5.5% and 6.4%, respectively. Other notable differences emerge for the year 2020, as the IEA projects more rapid economic expansion in the US, EU, and Brazil, relative to OPEC's forecast. These differences may stem in part from the 2-month lag between the time the forecasts were made: October 2019 for the IMF (referenced by IEA) and December 2019 for OPEC.

Table 5. Short-term GDP Growth Assumptions

	2019			2020		
	IEA (IMF)	OPEC	Difference (IEA - OPEC)	IEA (IMF)	OPEC	Difference (IEA - OPEC)
World	3.0%	3.0%	0.0%	3.4%	3.0%	0.4%
US	2.4%	2.3%	0.1%	2.1%	1.8%	0.3%
China	6.1%	6.2%	-0.1%	5.8%	5.9%	-0.1%
EU¹	1.2%	1.2%	0.0%	1.4%	1.0%	0.4%
Japan	0.9%	0.9%	0.0%	0.5%	0.6%	-0.1%
India	6.1%	5.5%	0.6%	7.0%	6.4%	0.6%
Brazil	0.9%	1.0%	-0.1%	2.0%	1.7%	0.3%

Table 5 data sources: IMF World Economic Outlook Oct 2019, Table 1.1; OPEC MOMR Dec 2019, Table 3 - 1.

Note 1: The IEA provides estimates for the European Union, while OPEC uses the Euro Zone grouping.

3.2 Short-Term Liquids Demand

Both the IEA and OPEC revise their short-term liquids demand forecasts monthly, based on market and policy movements, as well as comparison between actual data and changes in macroeconomic conditions. In addition, they occasionally revise methodologies for calculating demand for specific regions, which may also result in changes to demand forecasts.

As **Figure 1** illustrates, the IEA and OPEC both saw modest revisions to their global liquids demand growth estimates over the course of the year, with OPEC estimating higher global demand growth throughout 2019.

² Though this introductory paper compares data from the December 2019 oil market reports, reports from January to December in 2019 from both organisations were reviewed to assess how their views evolved throughout the year.

While the IEA's demand estimates have seen more change on a month-to-month basis than OPEC's, both organisations revised their estimates downward over the course of the year, with the IEA declining by 0.5 mb/d and OPEC falling by 0.3 mb/d in December relative to January 2019.

Figure 1 indicates changes in projected growth rates for the world (solid line), OECD (dashed lines), and non-OECD (dotted lines). In the early part of 2019, OPEC revised downwards their estimates for both OECD and non-OECD nations, which changed relatively little from April through December. The IEA, on the other hand, revised its projections upwards during the first part of 2019, led by non-OECD nations, but then turned downward through the second half of 2019, primarily due to lower projections for the OECD.

Figure 1. Monthly Revisions of Annual Estimates for 2019 World, OECD, and Non-OECD Liquids Demand Growth

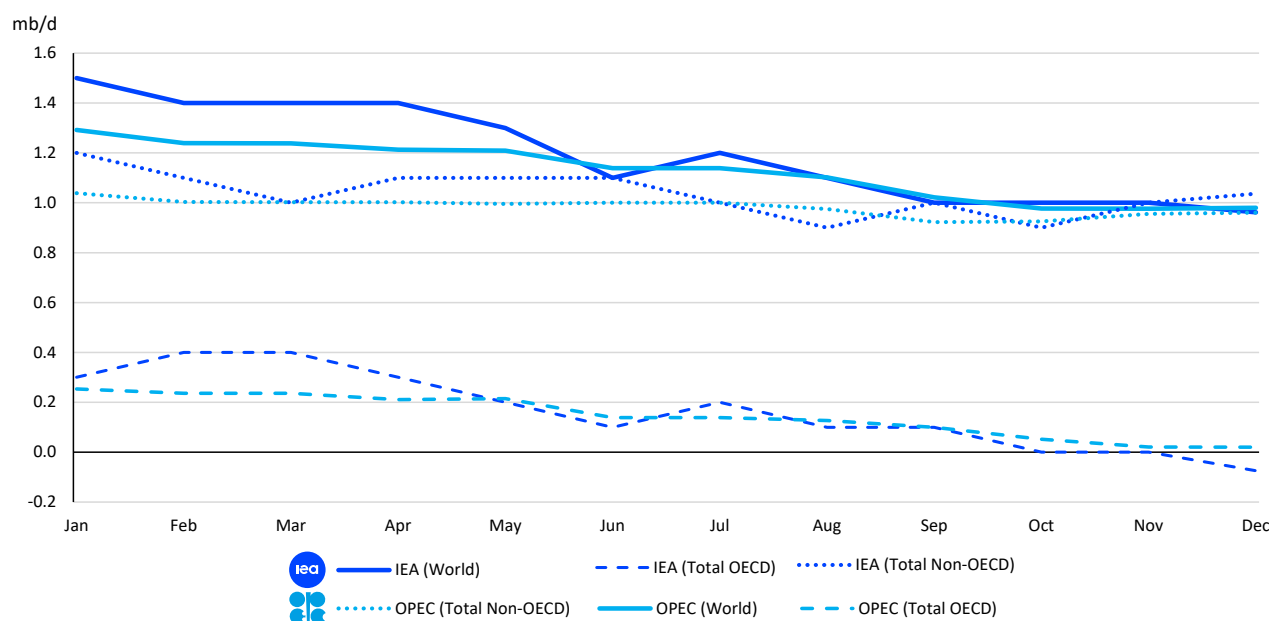


Figure 1 data sources: IEA OMR Jan–Dec 2019, Table 1; OPEC MOMR Jan–Dec 2019, Table 11 - 1.

Looking forward in **Figure 2**, both organisations project that global liquids demand will grow by roughly 1 mb/d in 2019. In 2020, the IEA projects slightly faster growth of 1.2 mb/d, while OPEC sees growth of 1.1 mb/d (note that these figures may differ from those suggested by Figure 2 due to rounding). These growth rates are at the low range of recent trends, reflecting in part the modest expectations for global economic growth.

Figure 2. Short-term World Liquids Demand: 2018-2020

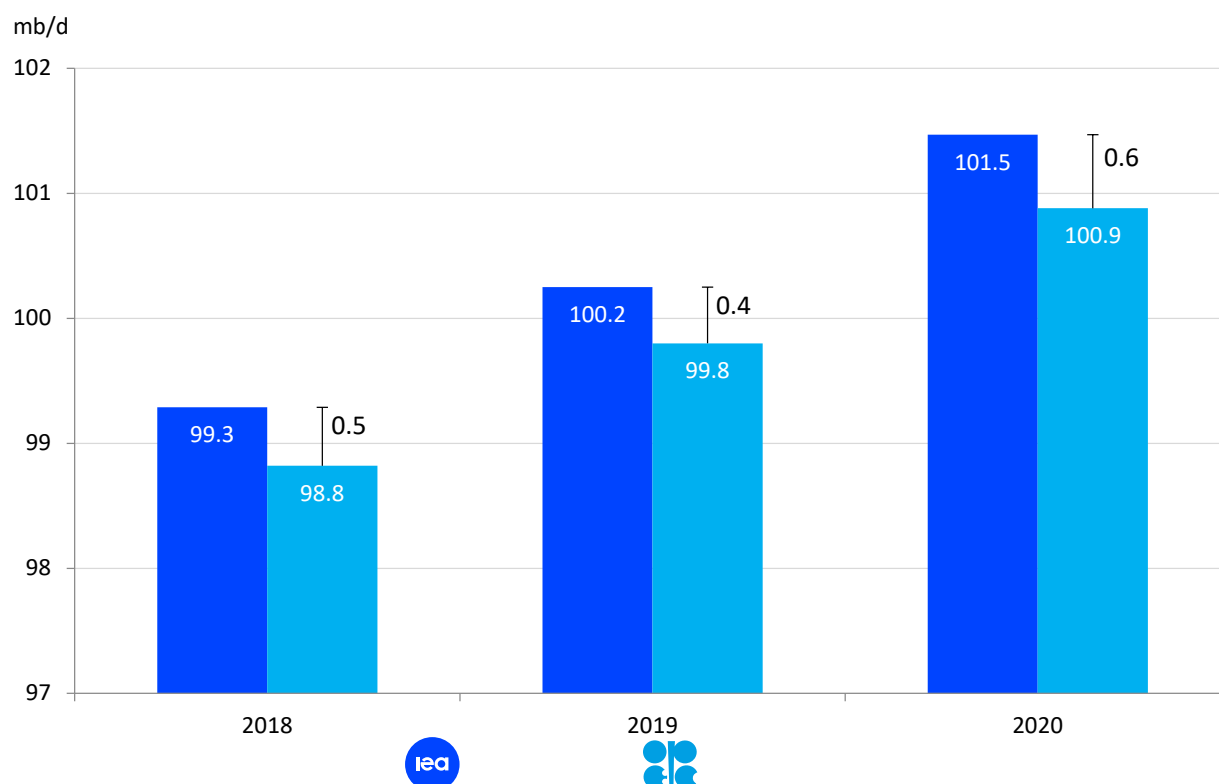


Figure 2 data sources: IEA OMR Dec 2019, Table 1; OPEC MOMR Dec 2019, Table 11 - 1.

Figure 2 notes: 2018 are historical data and 2019/2020 are projections. Sums in data callouts may not total due to rounding.

The IEA's and OPEC's regional liquids demand outlooks for 2019 and 2020, as well as the differences between them, are summarised in **Table 6**. These short-term demand outlooks have historically varied most widely in regions that have large differences in historical data – particularly in non-OECD regions including China, other non-OECD Asian nations, and the Middle East (see **Table 2**). In previous years such as 2015, differences between baseline liquids demand varied by as much as 1.7 mb/d.³ Over subsequent years, differences have become smaller. This is in part an outcome of the joint analysis of discrepancies in historical baseline data that both organisations pursue on the IEF platform.

Both the IEA and OPEC believe non-OECD regions will continue to lead global demand growth, particularly China and other non-OECD Asia. Despite this commonality, a variety of regional differences appear in **Table 6** and are highlighted in **Figure 3**. In particular, the IEA is more bullish on demand growth in China for both 2019 and 2020, and overall demand is substantially higher in the IEA's forecast due to remaining differences in historical baselines. Baseline differences are smaller for other non-OECD Asia, and both organisations project demand growth of 0.4 mb/d in that region from 2019 to 2020. In every other region (with the exception of OECD-Asia Oceania), the IEA and OPEC both estimate modest annual growth of between 0.0 and 0.1 mb/d from 2019 to 2020.

³ See Table 2 from the Introductory Paper to the 7th IEA-IEF-OPEC Symposium, published in February 2017.

Table 6. Short-term Liquids Demand Forecasts (mb/d)

	2019			2020		
	IEA	OPEC	Difference (IEA-OPEC)	IEA	OPEC	Difference (IEA-OPEC)
Total OECD	47.8	48.0	-0.2	48.1	48.0	0.0
OECD Americas	25.7	25.7	0.0	25.8	25.8	0.0
OECD Europe	14.2	14.3	-0.1	14.3	14.3	0.0
Asia Oceania	7.9	8.0	-0.1	8.0	7.9	0.1
Total Non-OECD	52.5	51.8	0.6	53.4	52.9	0.6
Non-OECD Asia	27.9	27.0	0.9	28.7	27.7	1.0
China	13.6	13.1	0.5	14.0	13.4	0.6
Other non-OECD Asia	14.3	13.9	0.3	14.7	14.3	0.4
Middle East	8.3	8.2	0.1	8.3	8.3	0.0
Latin America	6.4	6.6	-0.2	6.4	6.6	-0.3
FSU	4.8	4.9	-0.1	4.9	5.0	-0.1
Non-OECD Europe	0.8	0.8	0.0	0.8	0.8	0.0
Africa	4.3	4.4	-0.1	4.3	4.5	-0.2
World	100.2	99.8	0.4	101.5	100.9	0.6

Table 6 data sources: IEA OMR Dec 2019, Table 1; OPEC MOMR Dec 2019, Table 4 - 1, 4 - 2.

Table 6 notes: Columns may not sum to total due to rounding.

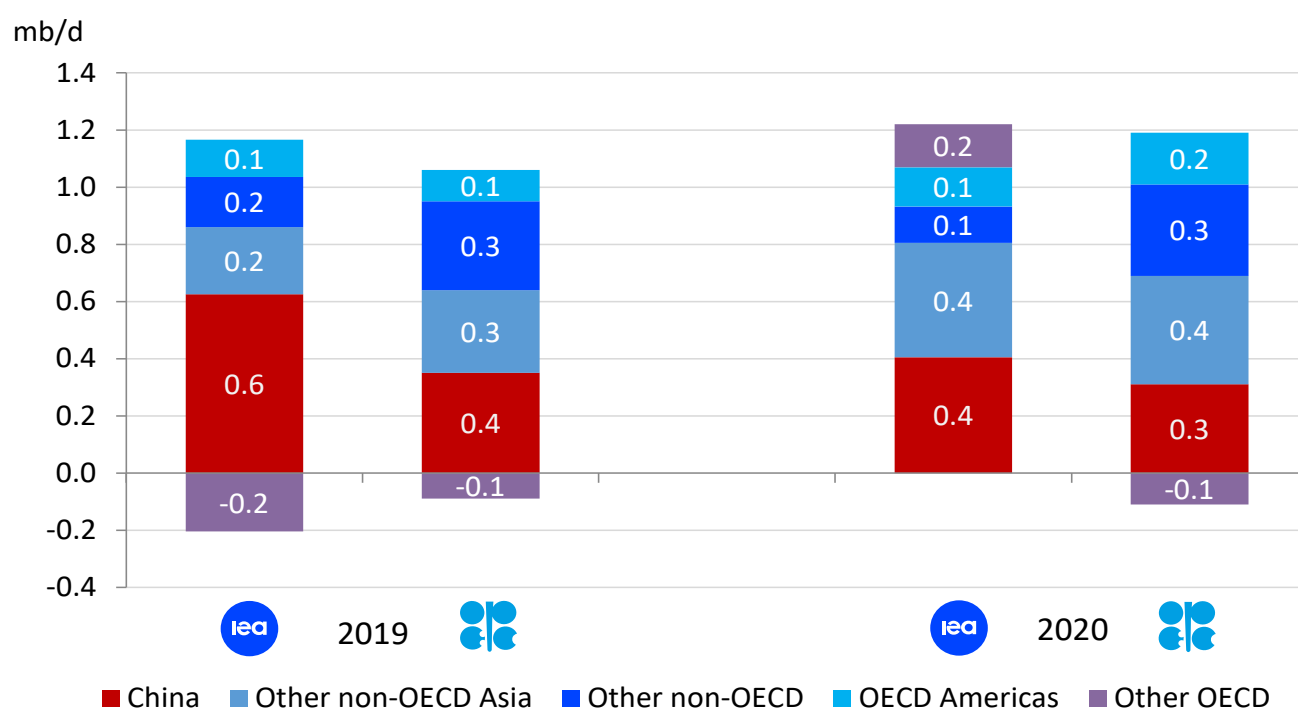
Figure 3. Short-term Liquids Demand Annual Growth

Figure 3 data sources: IEA OMR Dec 2019, Table 1; OPEC MOMR Dec 2019, Tables 4 - 1, 4 - 2.

3.3 Short-Term Liquids Supply

Changes in short-term projections for global non-OPEC liquids supply were mixed in 2019, with OPEC revising its global estimates downwards and the IEA adjusting upwards. **Figure 4** reveals that OPEC's downward revision of 0.3 mb/d was driven primarily by non-OECD nations, while the IEA's upward revision of 0.3 mb/d was driven by OECD producers.

Figure 4. Monthly Revisions of Annual Estimates for 2019 Non-OPEC Liquids Supply Growth

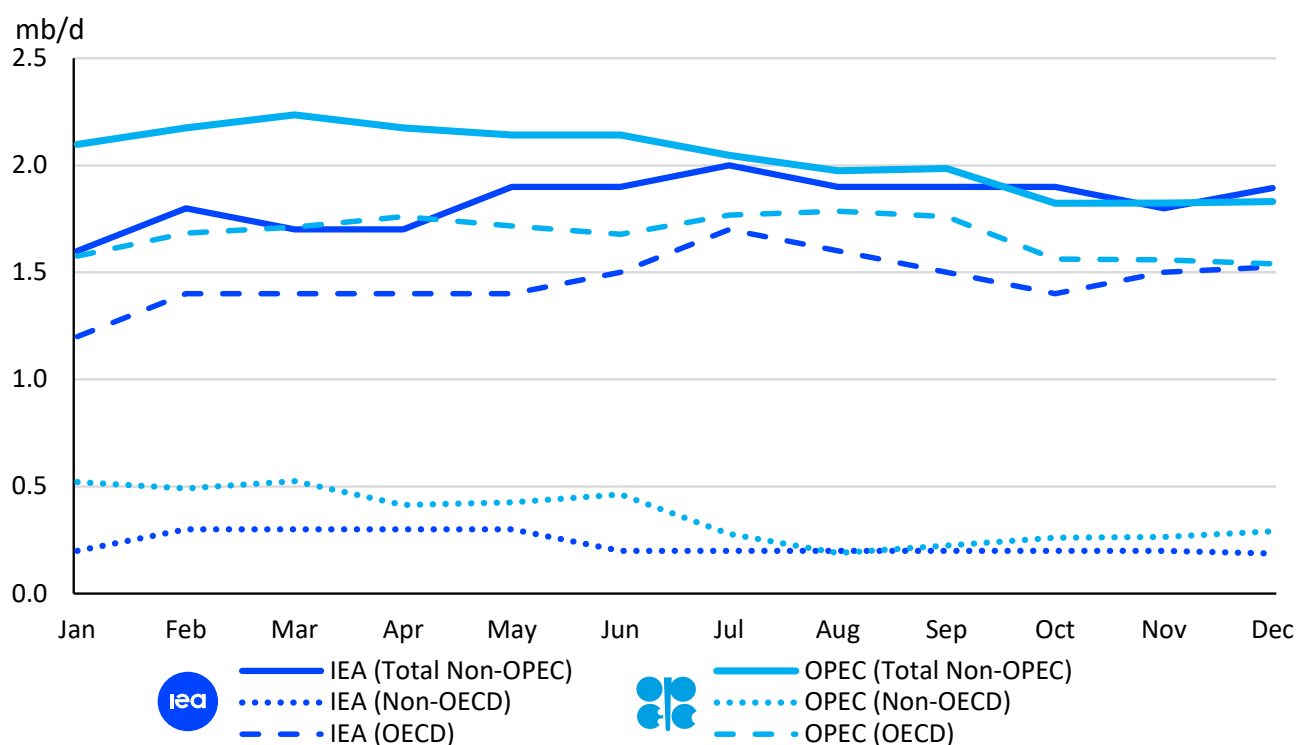


Figure 4 data sources: IEA OMR Jan-Dec 2019, Table 1; OPEC MOMR Jan-Dec 2019, Table 11 - 1.

Non-OPEC liquids supplies have grown robustly in 2018 and 2019, and are projected to continue growing. As **Figure 5** indicates, non-OPEC liquids supply growth is projected to increase by more than 2 mb/d in 2020. Unlike last year, when substantial differences emerged between the IEA and OPEC in their projections for supply growth, estimates for 2019 and 2020 are within 0.1 mb/d of one another.

Figure 5. Short-term Non-OPEC Liquids Supply Annual Growth

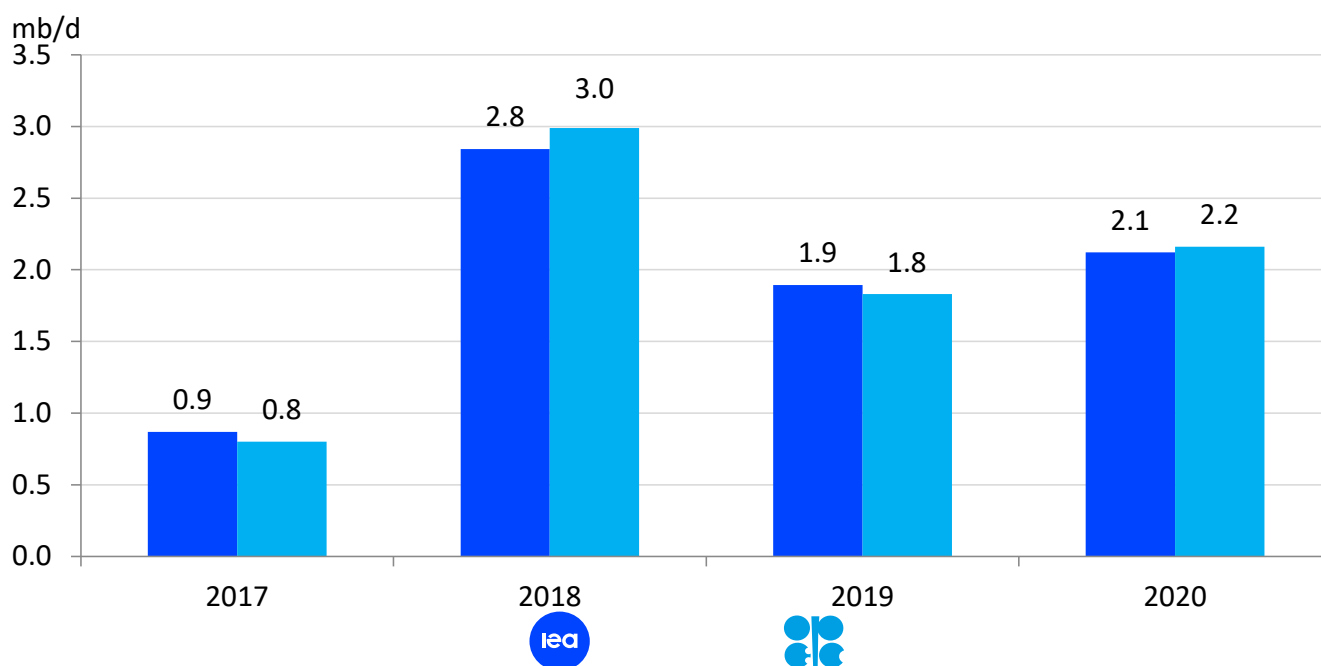


Figure 5 data sources: IEA OMR Dec 2019, Table 1; OPEC MOMR Dec 2019, Table 11 - 1.

Table 7 provides a detailed comparison of short-term liquids supply outlooks by region. While projections for the annual rate of growth of non-OPEC liquids supply is similar between the IEA and OPEC, as shown in **Figure 5**, that growth builds upon differing baseline data, as shown in **Table 3**. Substantial differences emerge in the OECD, with the IEA projecting 0.2 mb/d in additional supplies relative to OPEC in 2019, mostly from OECD Americas. In 2020, this difference declines to 0.1 mb/d for OECD Americas but grows to 0.2 mb/d for OECD Europe, leading to a total difference of 0.3 mb/d across the OECD. Notable differences also emerge for FSU nations, with the IEA projecting 0.3 and 0.2 mb/d in additional supplies relative to OPEC in 2019 and 2020, respectively. Differences of 0.1 to 0.2 mb/d also emerge between OPEC and the IEA for 2019 and 2020 supplies from China, Latin America, and Africa.

Variation also emerges between the two estimates for OPEC supply. While total OPEC supply in 2019 and 2020 differ by just 0.1 mb/d, this convergence masks substantial differences in the composition of those supplies. In particular, the IEA projects 0.7 mb/d more OPEC NGLs and unconvensionals than does OPEC for both 2019 and 2020, reflecting continued divergence in baseline (2018) data of 0.7 mb/d for OPEC NGLs and unconvensionals, shown in **Table 3**.

Neither the IEA nor OPEC make projections for short-term OPEC crude, but the difference between their constructed estimates for OPEC supply has grown from 0 mb/d in 2018 (the baseline year) to 0.8 mb/d in 2019 and 0.6 mb/d in 2020. This merits further discussion. “OPEC crude” in **Table 3** is an estimate based on reported supply data from OPEC Member Countries, whereas the **Table 7** item “Call on OPEC crude + stock changes & miscellaneous” is a constructed item. This item is calculated by subtracting total non-OPEC supply as well as OPEC NGLs and unconvensionals supply from world liquids demand projections, since neither the IEA nor OPEC projects OPEC crude production in their monthly oil market reports. Therefore, differences between the IEA and OPEC in the “Call on OPEC crude + stock changes & miscellaneous” item and “Total OPEC” item do not directly reflect different views regarding OPEC crude supply; rather the differences reveal their distinct projections of global liquids demand and non-OPEC crude supply.

Table 7. Short-term Liquids Supply Forecasts by Region (mb/d)

	2019			2020		
	IEA ^a	OPEC	Difference (IEA-OPEC)	IEA	OPEC	Difference (IEA-OPEC)
Total OECD	30.0	29.9	0.2	32.0	31.6	0.3
OECD Americas	25.8	25.7	0.2	27.2	27.1	0.1
OECD Europe	3.7	3.7	0.0	4.1	3.9	0.2
Asia Oceania	0.5	0.5	0.0	0.6	0.6	0.1
Total Non-OECD	32.4	32.1	0.2	32.6	32.5	0.1
Asia	7.4	7.5	-0.1	7.4	7.5	-0.1
China	4.0	4.1	-0.1	4.0	4.1	-0.1
Other non-OECD Asia	3.4	3.4	0.0	3.4	3.4	0.0
Middle East	3.2	3.2	0.0	3.3	3.3	0.0
Latin America	5.5	5.4	0.1	5.8	5.6	0.2
FSU	14.6	14.4	0.3	14.6	14.4	0.2
Non-OECD Europe	0.1	0.1	0.0	0.1	0.1	0.0
Africa	1.5	1.5	-0.1	1.4	1.6	-0.2
Processing gains	2.3	2.3	0.1	2.4	2.3	0.0
Total Non-OPEC	64.8	64.3	0.5	67.0	66.5	0.5
Total OPEC^(b)	35.4	35.5	-0.1	34.5	34.4	0.1
Call on OPEC crude + stock ch. & misc. ^(c)	29.9	30.7	-0.8	29.0	29.6	-0.6
OPEC NGLs + unconventional	5.5	4.8	0.7	5.6	4.8	0.7
World Supply^(c)	100.2	99.8	0.4	101.5	100.9	0.6

Table 7 data sources: IEA OMR Dec 2019, Table 1; IEA Oil 2019, Table 5 & 5a; OPEC MOMR Dec 2019, Table 5 - 2, 5 - 3, 11 - 1.

Table 7 notes: Numbers rounded to nearest significant digit.

^(a) Biofuels from IEA Oil 2019 are added to IEA regional oil supply data for comparability with OPEC estimates.

^(b) 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.

^(c) Equals total liquids demand minus non-OPEC supply minus OPEC NGLs/unconventionals.

Figure 6 illustrates how the IEA's and OPEC's regional supply growth estimates differ in 2019 and 2020 and highlights the central role of supply growth in the OECD Americas region, along with a reduced “call” on OPEC. In addition, both OPEC and the IEA anticipate new growth from the “Other OECD” category, which is driven by increased output from Norway.

Figure 6. Short-term Liquids Supply Net Annual Growth Forecast

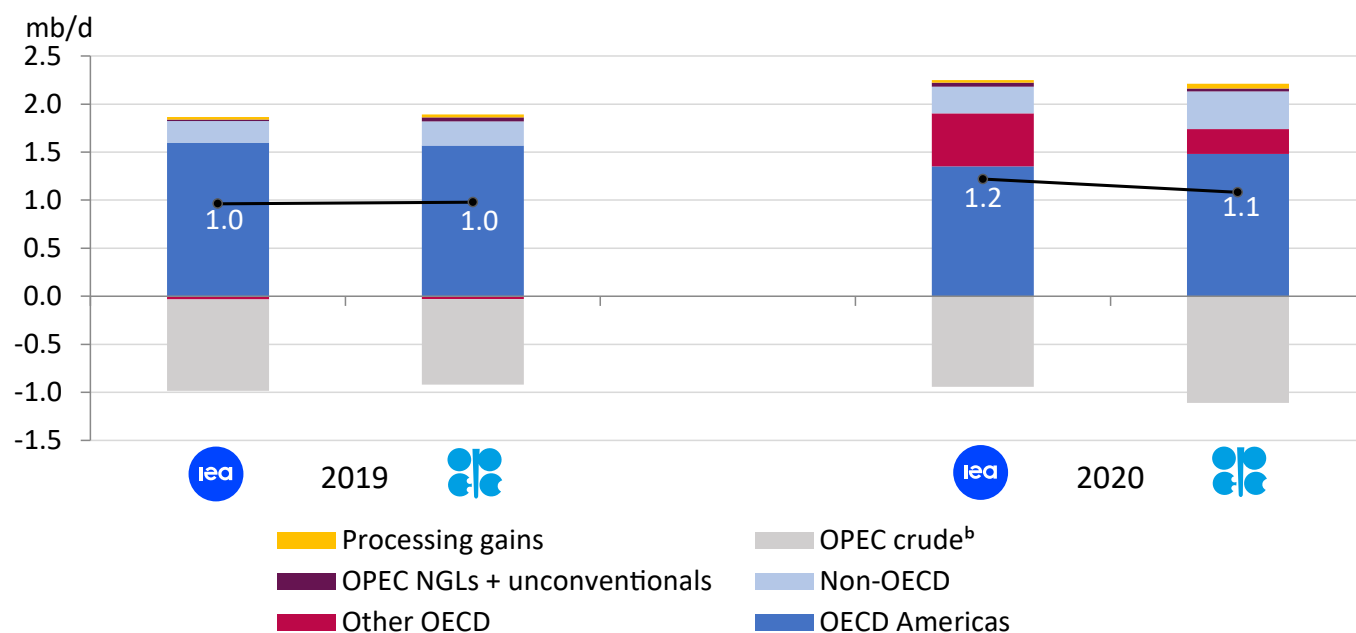


Figure 6 data sources: IEA OMR Dec 2019, Table 1; IEA Oil 2019, Table 5, 5a; OPEC MOMR Dec 2019, Table 5 - 1, 5 - 2, 11 - 1.

Figure 6 notes:

^(a) Biofuels from the IEA Oil 2019 report are added to IEA regional oil supply data for comparability with OPEC estimates.

^(b) IEA and OPEC do not forecast OPEC crude; this estimate is constructed as the “call on OPEC crude” including “stock change and miscellaneous”.

4. Medium-Term Oil Outlooks

Our comparison of medium-term outlooks assesses the IEA's Oil 2019 published in March 2019, and OPEC's World Oil Outlook (WOO) published in November 2019 (**Table 1**). Both organisations make their medium-term projections through 2024, using 2018 as a base year. However, there is an eight-month gap between publication dates of the two reports, and given the dynamic nature of market conditions, this gap complicates the comparison of the projections.

4.1 Oil Price and Economic Growth Assumptions

4.1.1 Oil Price

The price of oil is one of the primary factors influencing the projections of oil demand. Since 2017, OPEC has not published its oil price assumptions for the medium or long term, preventing detailed comparison between the IEA and OPEC.

When considering historical and future prices, 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 representative OPEC crudes driven by the cost estimates of marginal supply. The IEA uses an "IEA Average Import Price", which reflects the IEA's perspective on its member countries' future crude import prices.

The IEA utilises market information – the Brent futures price curve – to derive its medium-term price assumptions. From the IEA's perspective, Brent futures prices reflect what market players will accept to pay in the future, which in turn shapes the medium-term demand and supply outlook. In previous years, OPEC's medium-term price assumptions mainly reflected its assumptions on the ORB price detailed above, while its longer-term price assumptions have also taken into account its estimates of the cost of supplying the marginal barrel.

As **Figure 7** illustrates, the IEA's medium-term Oil 2019, published in early 2019, shows the nominal "IEA Average Import Price" dropping from an average of US\$71/bbl in 2018 to \$60/bbl in 2019. Prices remain at this level through 2021, then increase by \$1/bbl each year, reaching \$63/bbl by 2024.

Figure 7. Oil Price History and Medium-Term IEA Assumptions (nominal US\$)

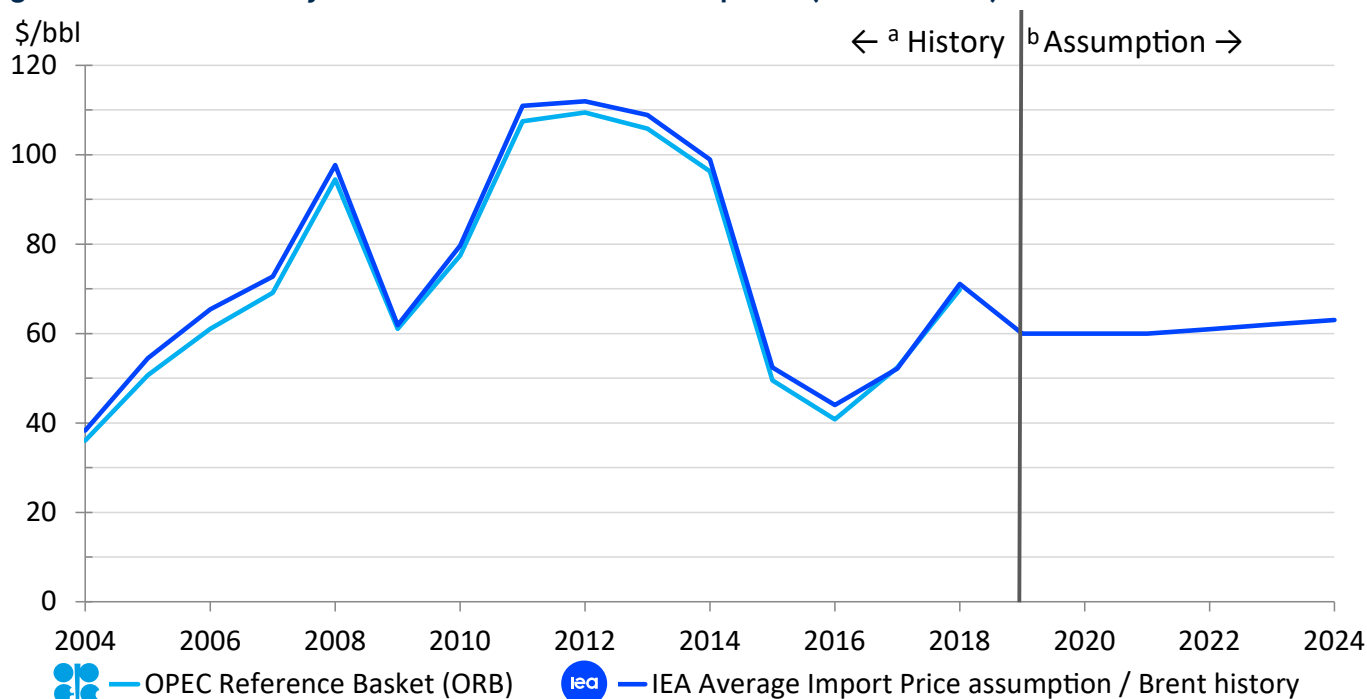


Figure 7 data sources: Historical OPEC ORB price from https://www.opec.org/opec_web/en/data_graphs/40.htm.

Annual average IEA import price provided via internal communication and Brent history from https://www.quandl.com/data/ODA/POILBRE_USD-Brent-Crude-Oil-Price

Figure 7 notes: Numbers rounded to nearest significant digit.

(a) Only historical prices up to the time IEA and OPEC released their reports were included.

(b) IEA Average Import Price assumption is based on the Brent futures strip.

4.1.2 Economic Growth

Both the IEA and OPEC have revised their medium-term economic assumptions downward relative to the respective 2018 outlooks. For OPEC, expected GDP growth for both 2019 and 2020 decreased from 3.6% to 3.2% in 2019 and 2020. As shown in **Table 8**, OPEC expects global growth to slowly strengthen, reaching 3.4% by 2024. The IEA's GDP assumptions, which are based on projections from the IMF's January 2019 World Economic Outlook, are higher than OPEC's, partly due to the 8-month gap between publications of Oil2019 and WOO2019. Like OPEC, however, the IEA's GDP assumptions have declined fairly substantially. In 2018, the IEA (based on the IMF) projected 2019 growth of 3.9%, compared with 3.5% in IEA Oil 2019. Over the next several years, the IEA assumes relatively steady GDP growth of 3.5% to 3.6%, lower than assumptions of 3.8% growth from 2021 through 2023 used in IEA Oil 2018.

Table 8. Medium-Term Annual GDP Growth Assumptions (%)

	2019	2020	2021	2022	2023	2024
OPEC	3.2	3.2	3.3	3.3	3.4	3.4
IEA	3.5	3.6	3.6	3.6	3.6	3.5

Table 8 data sources: IEA Oil 2019, Table 1.3; OPEC WOO 2019, Table 1.4. IEA's forecast relies on IMF's January 2019 World Economic Outlook.

Under both projections, OECD and non-OECD economies expand over the medium-term, with non-OECD nations generally growing at a faster rate. Projections vary between some key countries, however. For example, the IEA's assumptions for GDP growth in India are substantially higher than OPEC's, averaging 7.6% annually from 2018 to 2024, compared with 6.9% for OPEC. Conversely, assumptions for annual GDP growth in Russia are stronger under OPEC's assumptions, which average 1.7%, compared with 1.5% for the IEA. Assumptions for GDP growth in China are quite similar, averaging 6.0% and 5.9% for the IEA and OPEC over the medium term. **Figure 8** illustrates these trends.

Figure 8. Regional GDP growth assumptions (%)

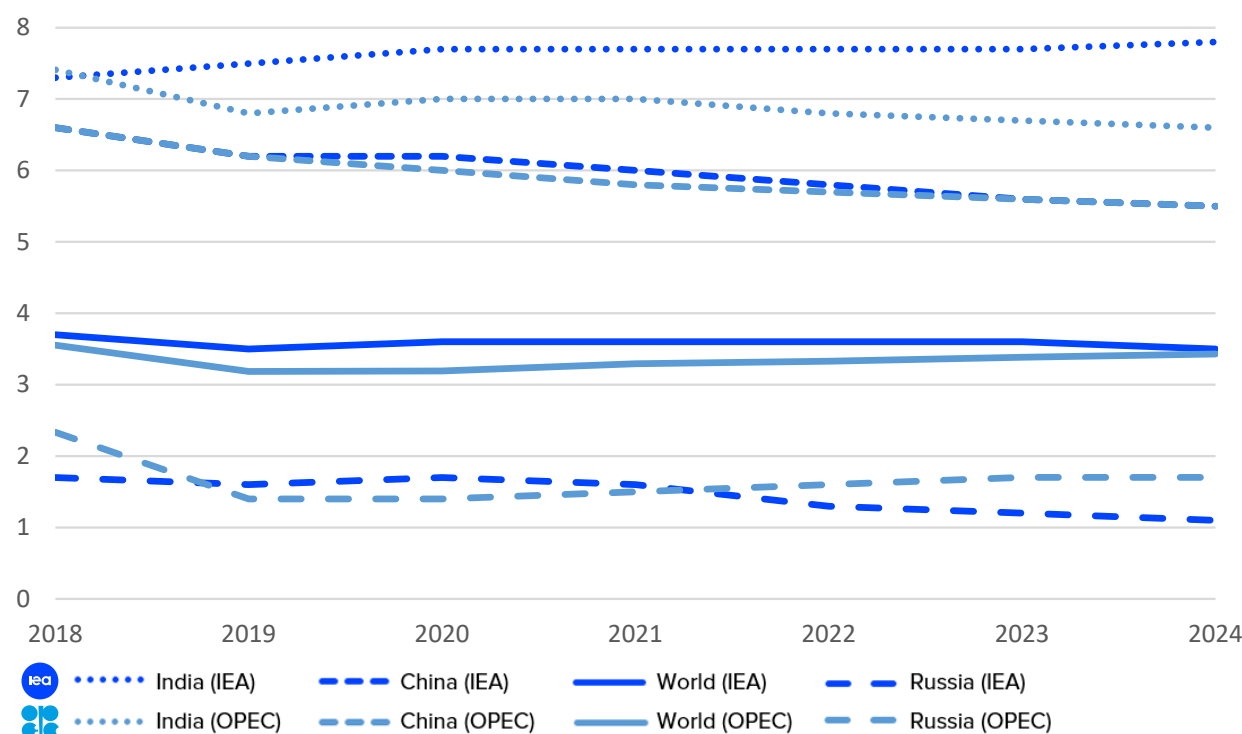


Figure 8 data sources: IEA Oil 2019, Table 1.3; OPEC WOO 2019, Table 1.4. IEA's forecast relies on IMF's January 2019 World Economic Outlook.

4.2 Medium-Term Liquids Demand

4.2.1 Global and Regional Demand Growth

Like the previous two years, both organisations expect strong medium-term growth in global liquids demand. Liquids demand in the baseline year of 2018 is 98.7 mb/d for OPEC and 99.2 mb/d for the IEA, a difference of 0.5 mb/d, slightly smaller than the baseline difference of 0.6 mb/d observed in last year's report. As **Table 9** shows, the IEA is more bullish than OPEC over the medium term, projecting annual average growth of 1.2 mb/d, compared with 1.0 mb/d for OPEC. By 2024, demand under the IEA's projection reaches 106.4 mb/d, compared with 104.8 mb/d for OPEC (**Figure 9(a)**).

As in other recent years, demand growth is centred squarely in non-OECD nations. OPEC expects non-OECD liquids demand growth to average 1.1 mb/d per annum, while the IEA projects growth of 1.2 mb/d. In the OECD, liquids demand grew from 2018 to 2019, but is expected to decline under both projections in the coming years. By 2024, OPEC projects total OECD liquids demand to decline from 47.8 mb/d in 2018 to 47.3 mb/d, while the IEA projects liquids demand increasing slightly from 47.8 mb/d to 47.9 mb/d (**Figure 9(b)**).

Figure 9. Medium-term Liquids Demand

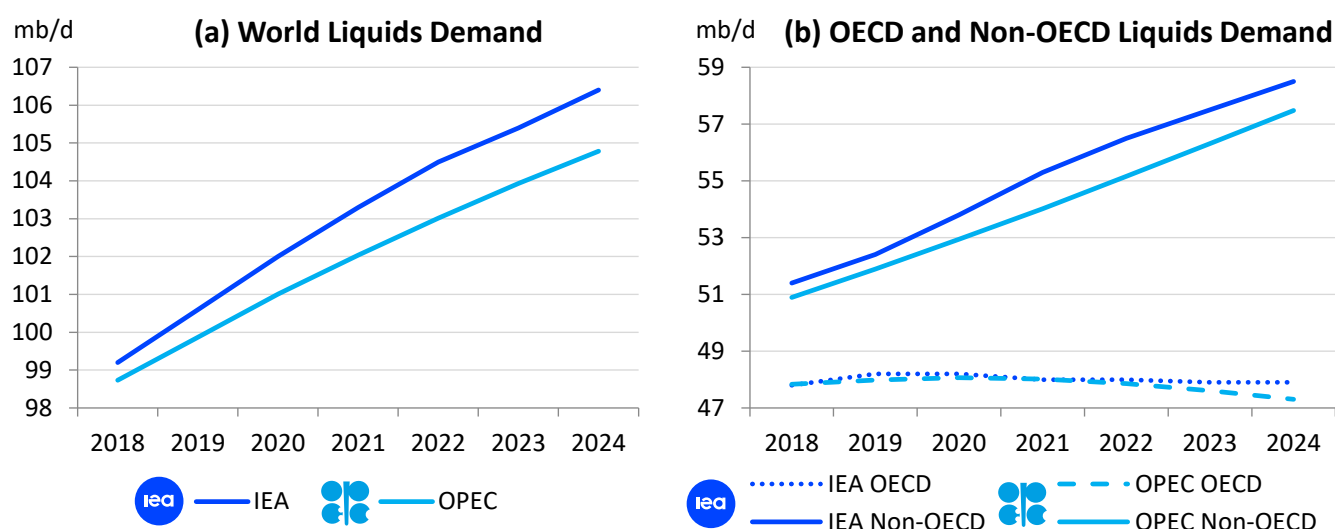


Figure 8 data sources: IEA Oil 2018, Table 2; OPEC WOO 2018, Table 3.1.

Table 9 presents a detailed comparison of the IEA and OPEC medium-term liquids demand outlooks for comparable regions. Modest differences arise in projected 2024 demand, with OPEC's projections generally lower than the IEA for most regions, particularly. Interestingly, the IEA and OPEC project the same level of demand growth in India despite the IEA's more bullish projection for Indian GDP growth. Comparison of non-OECD regions is complicated by the fact that, in the WOO medium-term projections, OPEC excludes its member countries from regional groupings and publishes OPEC liquids demand separately. The IEA does not make a similar distinction. To allow for comparison across the regions where OPEC members are located, we group together the Middle East, Africa and Latin America for regional demand projections, which allows for the inclusion of all OPEC members into this category.

Table 9. Medium-term Liquids Demand Forecasts (mb/d)

	2024		Avg. annual growth (2018-2024)		
	IEA	OPEC	IEA	OPEC	Difference (IEA-OPEC)
Total OECD	47.9	47.3	0.02	-0.09	0.11
OECD Americas	26.1	25.7	0.08	0.04	0.05
OECD Europe	14.1	14.0	-0.03	-0.06	0.02
Asia Oceania	7.7	7.6	-0.03	-0.07	0.03
Total Non-OECD	58.5	57.5	1.18	1.10	0.09
Asia	31.4	30.5	0.77	0.68	0.09
China	14.9	14.5	0.32	0.29	0.03
India	6.0	6.0	0.20	0.20	0.00
Other non-OECD Asia	10.5	10.1	0.25	0.18	0.07
Middle East, Africa & Latin America ^(a)	21.0	20.9	0.32	0.34	-0.02
Europe & Eurasia	6.1	6.1	0.10	0.15	-0.05
World	106.4	104.8	1.20	1.01	0.19

Table 9 data sources: IIEA Oil 2019, Table 2; OPEC WOO2019, Table 3.1.

Table 9 notes: Numbers rounded to nearest significant digit.

^(a) OPEC calculates demand from OPEC member countries as a whole by excluding them from corresponding geographical region. To allow for comparison across the regions where OPEC members are located, we group together the Middle East, Africa, and Latin America for regional demand projections, which allows for the inclusion of all OPEC members into this category.

4.2.2 Sectoral Demand

The WOO2019 provides sectoral oil demand projections for 2018 through 2024, identifying road transport as the largest source of cumulative growth at 2.3 mb/d. The petrochemicals sector grows by a total of 1.4 mb/d, followed by aviation at 0.8 mb/d through 2024.

The IEA's medium-term Oil 2019 report does not include detailed global sectoral data, but instead focuses on the composition of liquids demands through different products. The report discusses some key shifts in oil market dynamics, with a particular focus on fuel demand for aviation, which is growing rapidly in China and elsewhere. In addition, Oil 2019 details strong growth in demand for liquefied petroleum gases (LPG) and ethane which grows by an average of 0.35 mb/d annually. This growth is driven by demand for LPG, ethane, and naphtha feedstocks in the United States and China.

Both organisations take note of the 2020 changes in fuel specifications from the International Marine Organisation, which will reduce demand for high sulphur fuel oil (HSFO), currently accounting for roughly 75% of bunker fuel demand. The IEA projects that HSFO demand will drop by 2.1 mb/d in 2020, while OPEC anticipates a decline of 1.8 mb/d in the marine bunkers sector alone. However, the resulting lower prices for HSFO is expected to spur additional consumption of the fuel for power generation, particularly in the Middle East.

4.3 Medium-Term Liquids Supply

4.3.1 Liquid Fuels Classification and Projection Methodology

For their medium-term liquids supply outlooks, both the IEA and OPEC take a “bottom-up” approach of assessing field-level supply capabilities for each country. However, they may take different upstream oil production projects into account and estimate different levels of productivity for each field. Differing supply projections between the IEA and OPEC could also result from their respective oil price assumptions.

In addition, an understanding of the differences in the IEA's and OPEC's categorisation of liquid fuels is necessary to enhance comparison of their projections. **Figure 10(a)** and **(b)**, respectively, illustrate the IEA's and OPEC's distinct liquids classification systems.

First, the two institutions differ in their categorisation of certain types of unconventional oil supplies. **Figure 10(a)** shows that the IEA groups together conventional crude oil, NGLs (including conventional and unconventional supplies) and condensate into one category, and “unconventional oil,” including tight oil, into another. OPEC, as shown in **Figure 10(b)** accounts for tight crude in its “crude oil” category and distinguishes between conventional and unconventional NGLs. It groups other unconventional liquids such as oil sands and oil shale into its “non-crude supply” category.

Figure 10. Liquid Fuels Categorisation by the IEA and OPEC

(a) IEA Liquid Fuels Schematic,

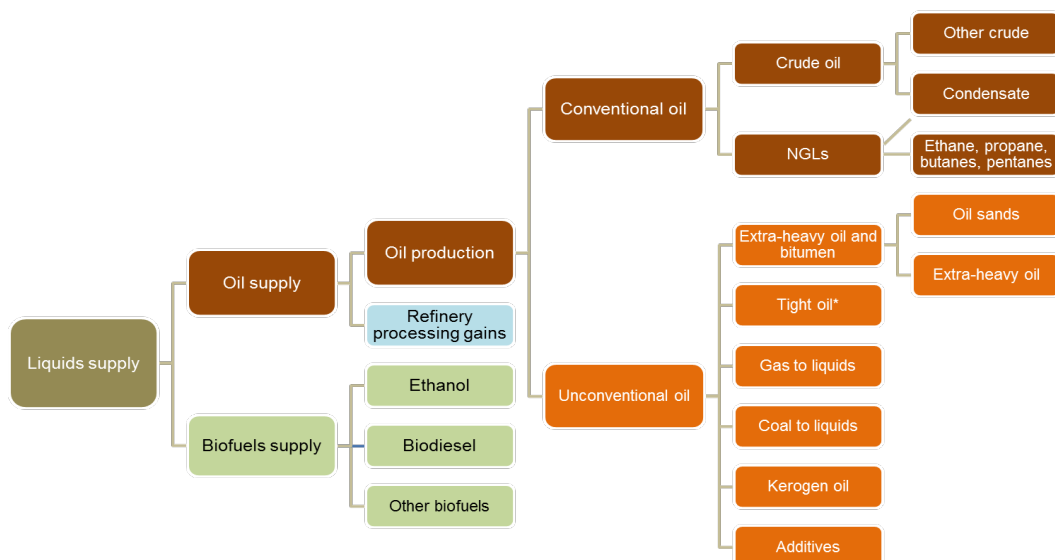


Figure 10(a) data sources: Resources for the Future and IEF based on IEA WEO 2019 and internal communication. a IEA previously referred to “tight oil” as “light tight oil”.

(b) OPEC Liquid Fuels Schematic,

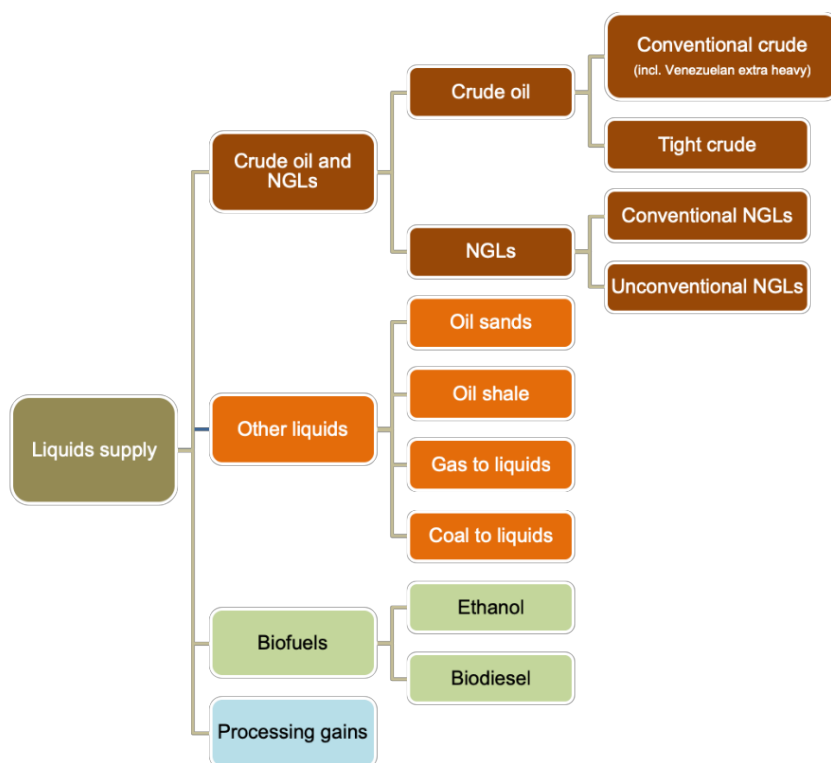


Figure 10(b) data sources: Resources for the Future and IEF based on WOO2019 and internal communication.

4.3.2 Global and Regional Liquids Supply

Both OPEC and the IEA project robust non-OPEC supply growth in the near term, followed by slower growth from 2021 to 2024 (**Figure 11(a)** and **Figure 11(b)**). OPEC's projections are generally higher than those from the IEA. Between 2019 and 2024, OPEC projects cumulative net non-OPEC supply growth of 9.9 mb/d, while the IEA projects cumulative supply growth of 6.1 mb/d.

The large majority of this supply growth comes from OECD Americas, particularly the United States. Under OPEC's projection, OECD Americas accounts for 66% of cumulative non-OPEC growth over the medium term, and 70% under the IEA's projections. Growth in supplies from OECD Americas is concentrated in the early years of the outlook, with production growth slowing considerably towards 2024. The second largest contributor to supply growth through 2024 is Latin America, which grows by 1.5 mb/d for the IEA and by 1.8 mb/d for OPEC. These gains are driven by new offshore Brazilian production. OECD Europe, led by Norway, also plays a considerable role, growing by 0.4 mb/d under the IEA and by 0.7 mb/d under OPEC. Finally, both organisations project negative growth for non-OECD Asian nations, shrinking by 0.6 mb/d for the IEA and by 0.2 mb/d for OPEC through 2024.

Figure 11. Medium-Term Non-OPEC Liquids Supply Annual Growth

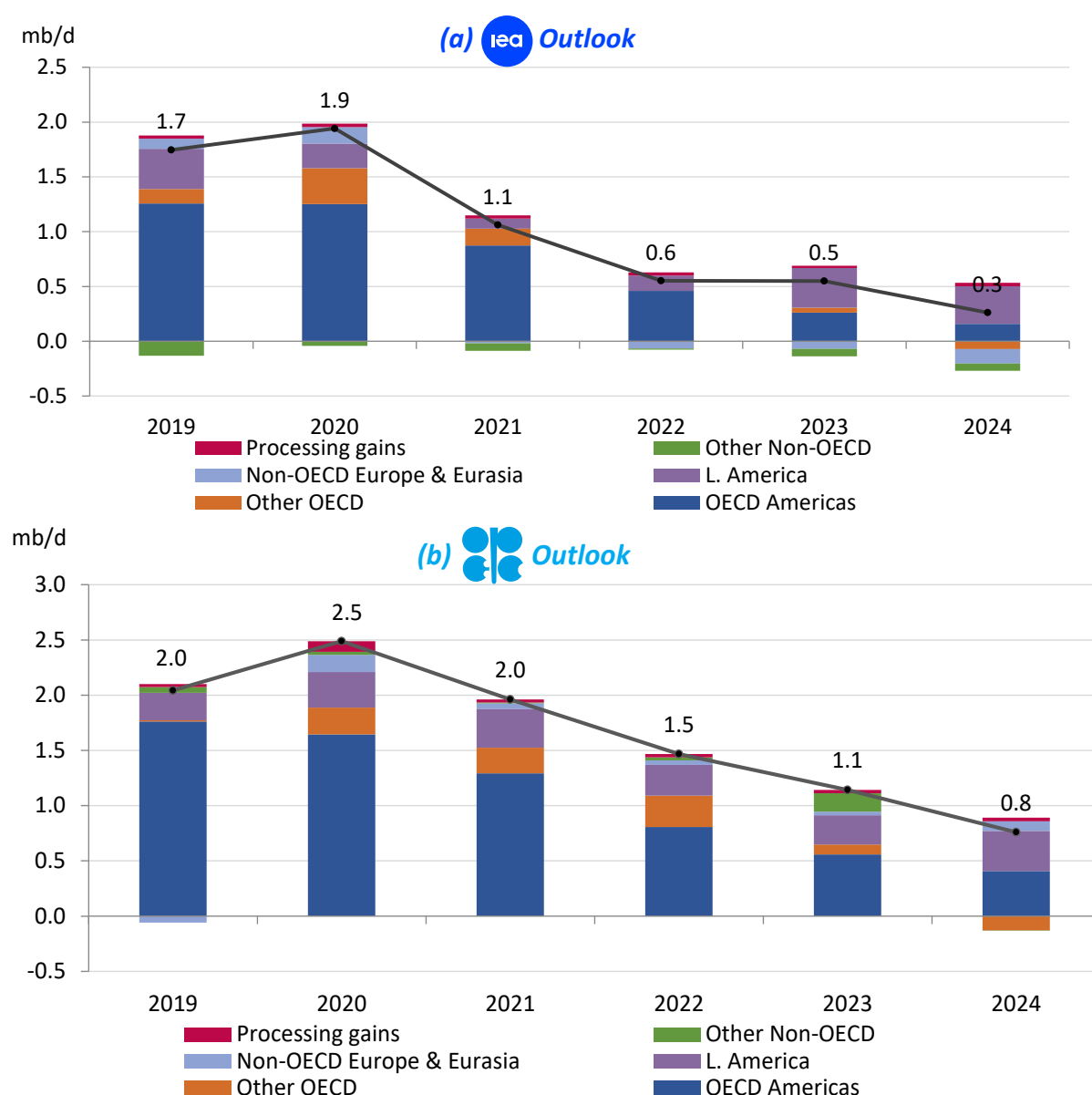


Figure 11 data sources: IEA Oil 2019, Table 3, Table 5, Table 5a; OPEC WOO 2019, Table 4.1. Sums may differ due to rounding.

Figure 11 notes: Other OECD is the sum of data from OECD Europe and Asia Oceania; Other Non-OECD is the sum of data from Middle East & Africa and Non-OECD Asia.

Table 10 provides a detailed regional comparison of medium-term liquids supply between the two outlooks. As noted above, OPEC's projections show substantially stronger non-OPEC supply growth than the IEA, particularly for the OECD Americas. OPEC projects 30.5 mb/d from OECD Americas in 2024, while the IEA sees production for the region of 28.2 mb/d. Both of these projections continue the trend in recent years of upward revisions to projections of US tight oil supplies and both estimates for OECD Americas production are above or within range of total OPEC-14 preliminary crude oil production that averaged 29.55 mb/d in November 2019 according to secondary sources. OPEC also projects substantially stronger production from OECD Europe, with production in 2024 at 4.5 mb/d, compared with 4.2 mb/d for the IEA. Similarly, OPEC projects higher production levels from Non-OECD Asia (7.4 mb/d compared with 6.9 mb/d for the IEA), Latin America (7.0 mb/d compared with 6.8 mb/d for the IEA), and non-OPEC Middle East and African nations (5.2 mb/d compared with 4.8 mb/d for the IEA).

In total, the IEA forecasts 68.7 mb/d in liquids supply from non-OPEC nations in 2024, while OPEC estimates 72.2 mb/d, a 6.7 mb/d difference. The IEA's projections imply supply from OPEC member nations of 37.7 mb/d, 4.9 mb/d higher than the assessments by OPEC. Overall, the IEA's stronger estimates for global demand helps pull in a larger volume of supplies, with the IEA projecting total global supplies of 106.4 mb/d and OPEC projecting 105.0 mb/d in 2024. In that year, the IEA projects that OPEC provides 38% of global liquids, compared with an estimate of 31% from OPEC.

Average annual growth figures shown in **Table 10** are somewhat complicated by divergent baseline (2018) data for certain regions. For example, the IEA's estimate for non-OECD Europe and Eurasia supplies in 2018 are 0.3 mb/d higher than OPEC's. OPEC and IEA baseline estimates for liquids supplies from OPEC also vary substantially, with a 0.8 mb/d difference (note that these baseline data are taken from each organisation's medium-term outlooks). Unlike previous years, OPEC did not publish the composition of its liquids supplies (i.e., crude and NGLs/unconventionals), making it difficult to determine the source of this variation.

Table 10. Medium-Term Liquids Supply Forecasts (mb/d)

	2024		Avg. annual growth (2018-2024)		
	IEA ^(a)	OPEC	IEA	OPEC	Difference (IEA-OPEC)
Total OECD	33.0	35.4	0.8	1.2	-0.4
OECD Americas	28.2	30.5	0.7	1.1	-0.4
OECD Europe	4.2	4.5	0.1	0.1	0.0
OECD Asia Oceania	0.6	0.5	0.0	0.0	0.0
Total Non-OECD	33.2	34.3	0.2	0.4	-0.2
Asia	6.9	7.4	-0.1	0.0	-0.1
China	3.8	4.0	0.0	0.0	0.0
Other non-OECD Asia	3.1	3.4	-0.1	0.0	0.0
Middle East & Africa	4.8	5.2	0.0	0.1	-0.1
Latin America	6.8	7.0	0.3	0.3	0.0
Europe & Eurasia	14.7	14.7	0.0	0.1	-0.1
Processing Gains	2.5	2.5	0.0	0.0	0.0
Total Non-OPEC	68.7	72.2	1.0	1.6	-0.6
Total OPEC ^(b)	37.7	32.8	0.1	-0.6	0.7
OPEC crude	32.0		0.0		
OPEC NGLs + unconventionals	5.7		0.0		
World	106.4	105.0	1.1	1.0	0.1

Table 10 data sources: IEA Oil 2019, Tables 3, 5, and 5a; OPEC WOO2019, Table 4.1.

Table 10 notes: Numbers rounded to nearest significant digit.

^(a) For IEA includes stock change and miscellaneous. OPEC also includes stock change in medium-term and long-term projections. IEA regional supply estimates include biofuels, based on IEA Oil 2019 Tables 5 and 5a.

^(b) Estimates for total OPEC supply and world supply are constructed from other components because IEA does not directly provide these forecasts in their reports.

As noted above, both the IEA and OPEC have once again increased their projections for the growth in medium-term oil supply from the United States and Canada. The difference in projected supply by the end of the forecast period is substantial, reflecting different assumptions about technologies and oil prices. For both organisations, the majority of this growth comes from U.S. tight oil (**Figure 12**).

Figure 12. Medium-term US and Canadian Oil Supply (excluding biofuels)

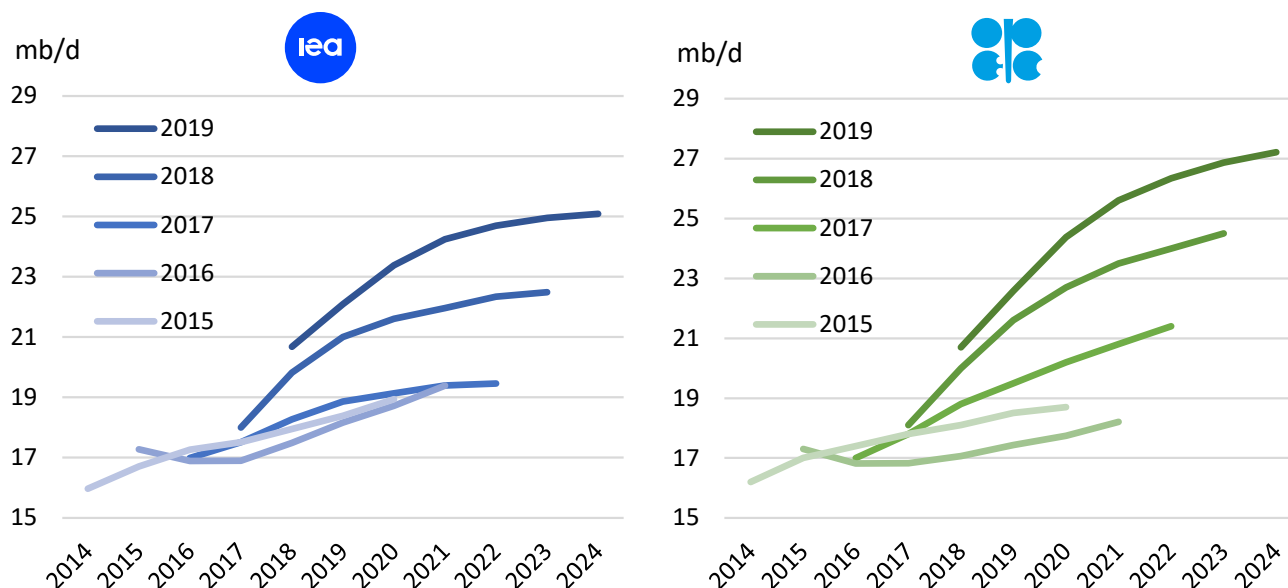


Figure 12 data sources: IEA Oil 2019 Table 3; OPEC WOO 2019 Tables 4.1 and 4.2, Figure 4.7. IEA Oil 2018 Table 3; OPEC WOO 2018 Tables 4.5 and 4.10; IEA Oil 2017 Table 3; OPEC WOO2017, Table 4.1; IEA MTOMR 2016 Table 3; OPEC WOO2016, Table 4.1

5. Long-Term Energy Outlooks

The following comparison of long-term outlooks evaluates the IEA's World Energy Outlook 2019 (WEO2019) and OPEC's World Oil Outlook 2019 (WOO2019). In these reports, the IEA and OPEC make projections extending through to 2040. Unlike some previous years, these long-term outlooks base their projections on the common baseline year of 2018, facilitating comparison.

Differences between the IEA and OPEC in their choice of units for primary energy demand create some challenges in making comparisons. OPEC uses million barrels of oil equivalent per day (mboe/d), while the IEA uses million tons of oil equivalent (mtoe) for primary energy projections (the IEA also publishes fuel-specific volumetric data for certain measures). Where necessary, we convert the IEA's units of primary energy from mtoe per year to mboe/d by multiplying by 7.37 mboe/mtoe and dividing that total by 365 days per year, yielding a conversion factor of 0.0202 mboed/mtoe.

A more substantial challenge in comparing long-term outlooks arises from differences in regional groupings between the IEA and OPEC. While OPEC reports its main regional results in terms of OECD status (i.e., OECD Americas, OECD Europe, non-OECD Asia, etc.), and the IEA publishes aggregate projections for the broader OECD and non-OECD categories, since 2018 it does no longer group regions according to OECD status in its main results and Annex tables. The IEA has graciously provided additional data with these regional groupings for this report to enhance comparability.

5.1 Key Assumptions

5.1.1 Scenarios and Sensitivity Cases

As in previous years, the IEA presents three scenarios on the future of energy. Alternatively, OPEC focuses on a single Reference Case, then provides a more limited range of sensitivity analyses to address uncertainties through 2040. **Table 11** lists key assumptions for core scenarios included in the WEO2019 and WOO2019. A more detailed comparison is provided in **Annex 1**, and a comparison of key outlook results for each scenario is featured in **Annex 2**.

Table 11. Long-term Scenario Key Assumptions

IEA WEO Scenarios	OPEC WOO Scenarios
Current Policies Scenario: Only considers policies that have been enacted as of mid-2019	Reference Case: Only considers policies that have been enacted, but also recognises that the policies change and evolve over time
Stated Policies Scenario: Considers both policies in place and announced targets	Scenario A: Scenario consistent with a below 2°C-compatible pathway
Sustainable Development Scenario: Ensures universal energy access by 2030; sharply reduces air pollution; aligns with Paris Agreement goals to limit global warming "well below 2°C"	Scenarios B and C: Considers different levels of economic diversification within the energy sector (Scenario B) and economy-wide (Scenario C) for major energy exporters

In 2019, the IEA renamed its central scenario, replacing the New Policies Scenario (NPS) with the Stated Policies Scenario (STEPS). As discussed in the introduction section in WEO2019, the name change is intended to enhance the notion that the central projection is not a "forecast," but rather a reflection of public policies that have been announced by governments.

As in previous years, the IEA continues to publish a Current Policies Scenarios (CPS) and Sustainable Development Scenario (SDS), which replaced the 450-ppm scenario in 2017. Like the NPS before it, STEPS considers both policies in place as well as policies and commitments that have been announced. It also includes assumptions about the continued evolution of technologies, including cost reductions associated with increased deployment and "learning-by-doing." The Current Policies Scenario is provided as a baseline scenario to show how the global energy market might evolve without further policies. Finally, the SDS creates an energy path consistent with the United Nations' Sustainable Development Goals, and projects that carbon dioxide emissions from fossil fuel consumption will decline through 2040 consistent with the long-term temperature goals outlined in the 2015 Paris climate agreement. All three IEA scenarios share the same GDP and population assumptions, while variations in policy affect technological development and energy markets.

OPEC employs a limited set of sensitivity analysis to examine specific issues in the WOO2019, building upon its World Energy Model (OWEM) for upstream liquids demand and supply projections. In the WOO series, the Reference Case is the central scenario. The Reference Case not only considers enacted policies, but also accepts that the policy process evolves over time, with regional policy assumptions highlighted in Section 1.3, and sensitivity cases outlined in Chapter 9 of WOO2019. Because OPEC's Reference Case is not strictly based on energy policies already in place, it is challenging to find a single counterpart in IEA's WEO2018 for comparison. As a result, we compare the WOO2019 Reference Case with both the IEA's Current Policies Scenario and the Stated Policies Scenario, selectively providing other scenarios and sensitivity cases for additional context.

⁴ IEA, Oil Information 2015, IV.93. In WEO2019 (p. 618), the IEA notes that there is no standard conversion factor from boe to toe, with common factors ranging from 7.15 to 7.40. Exact factors depend on the type of oil. Per internal communication, OPEC uses a factor of 7.33, which would result in a conversion factor of 0.02008.

OPEC examines several sensitivity cases for specific topics in WOO2019. The first, called “Sensitivity A,” reflects an energy pathway compatible with limiting global average temperature rise to 2°C above pre-industrial levels by 2100. In this scenario, global energy demand is roughly 26% lower in 2040 than under the Reference Case, with a higher share of renewables in the energy mix. Scenarios B and C explore the potential economic effects of different levels of economic diversification for various nations in the context of a below-2°C pathway, with a focus on energy-exporting developing countries.

5.1.2 Demography

As in previous outlooks, both the IEA and OPEC base their demographic assumptions primarily upon projections made by the United Nations Department of Economic and Social Affairs Population Division. Globally, both organisations project growth of 0.9% per annum from 2018 through 2040,

For both outlooks, the large bulk of new population comes from developing countries. For OPEC, the Middle East and Africa region (which excludes OPEC countries) experiences annual average population growth of 2.8%, while the population in OPEC nations grows by 2.2% annually. For the IEA, a combination of the “Africa” and “Middle East” groupings (which includes both OPEC and non-OPEC nations) sees annual average population growth of 2.7%. Population assumptions for other regions are either identical or very similar.

In addition to population growth assumptions, urbanisation continues to accelerate under both projections, with the share of people living in cities growing from 55% in 2018 to 64% in 2040. This trend occurs most rapidly in Africa and non-OECD Asia, with China in particular accelerating urbanisation from a rate of 57% in 2016 to 77% by 2040. Other crucial demographic factors that may impact energy consumption include age, structure, and global migration patterns. For example, energy demand projections will be higher if demographic assumptions include a larger percentage of working-age population and more immigrants from non-OECD nations to OECD nations.

5.1.3 Economic growth

The IEA and OPEC take similar approaches in deriving GDP assumptions. For medium-term projections, both use internal expertise in combination with economic forecasts published by the IMF, World Bank, and other organisations. Their long-term projections, however, are based on assumptions about working population and productivity levels, key factors in determining economic growth rates. The IEA and OPEC use slightly different assumptions, with the IEA assuming average annual GDP growth of 3.4% from 2018 to 2040, compared with OPEC’s assumption of 3.3%.

The IEA and OPEC both use 2018 as a base year and make GDP assumptions in Purchasing Power Parity (PPP) terms, though the IEA also publishes its assumptions in Market Exchange Rate (MER) terms. However, the two organisations use different projection years in their outlooks to calculate compound average annual growth. OPEC publishes growth assumptions from 2018-2040, with increments of 2018-2024 (corresponding with its Medium-Term outlook), 2024-2035, and 2035-2040. The IEA also publishes assumptions from 2018-2040, but with increments of 2018-2030, and 2030-2040.

To allow for comparability, we use standardised annual economic growth estimates from 2018-2040 in **Figure 13**. As noted above, comparisons between regions are complicated by different regional groupings and by OPEC’s separation of its member countries into a distinct “OPEC” category. Still, some comparisons are instructive. For example, OPEC projects annual average growth in China of 4.6%, compared with 4.3% for the IEA. This trend reverses when examining other Asian nations. In India, OPEC projects growth of 6.3%, while the IEA projects 6.4%. For other non-OECD Asian nations OPEC’s projection of 3.9% is well below the IEA’s forecast of 4.4% in its “Southeast Asia” grouping. There is also a small difference between projections for OECD Europe, with OPEC estimating annual growth of 1.6%, compared with 1.5% for the IEA’s “Europe” category.

⁵ The World Bank’s International Comparison Program (ICP) released revised data for Purchasing Power Parity (PPP) in 2014. In this revision, emerging economies see large upward GDP adjustments, and China becomes the world’s largest economy. Both organisations have incorporated this change into their reports.

Figure 13. Annual Average GDP Growth Assumptions for Selected Regions, 2018-2040

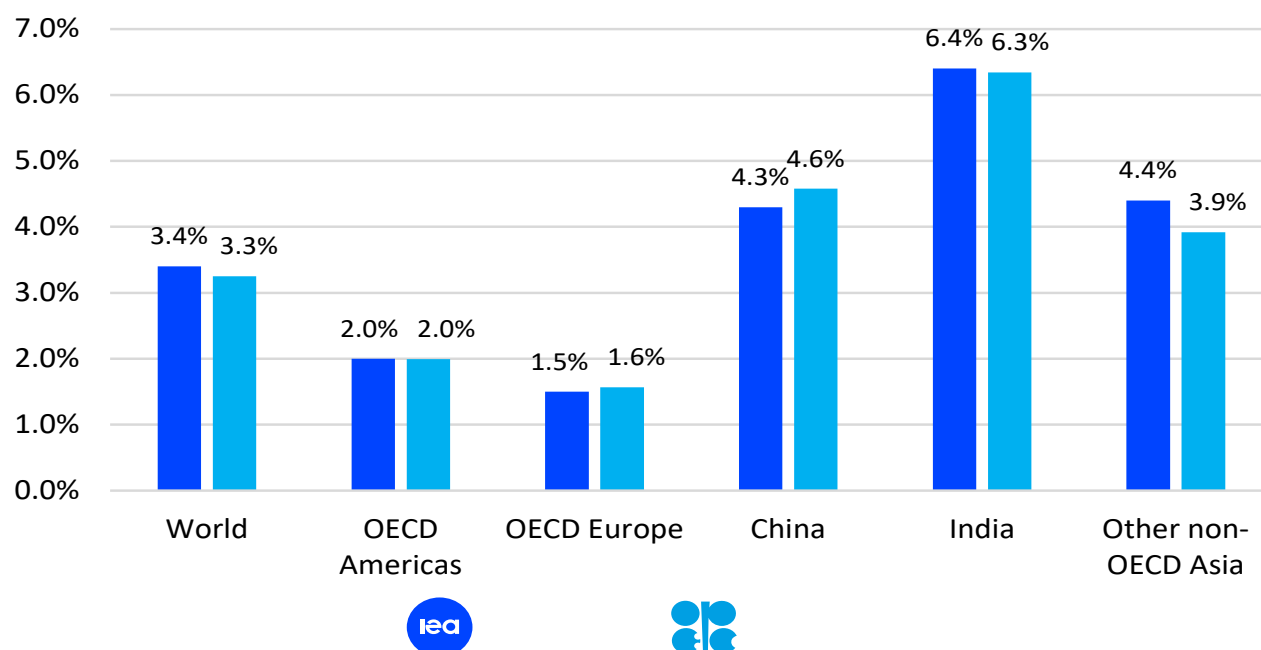


Figure 13 data sources: IEA WEO 2019 Table B.2; OPEC WOO2019 Table 1.5.

Figure 13 notes: Because the IEA and OPEC's regional classifications differ, we construct the following regional classifications to allow for intercomparison: OECD Americas is North America for IEA, and OECD Americas for OPEC; OECD Europe is the European Union for IEA, and OECD Europe for OPEC, Other non-OECD Asia is Southeast Asia for IEA, and Other non-OECD Asia for OPEC.

5.1.4 Oil Prices

As stated above, in its WOO2019, OPEC does not publish its medium-, or long-term oil price assumption. The IEA WEO series takes a different approach from its medium-term Oil series to derive long-term oil prices. Instead of referring to the Brent futures curve (which does not extend to 2040), the IEA's long-term price assumptions are based on the equilibrium prices reached in a supply-demand model. The IEA's equilibrium price factors in marginal cost assumptions, investment return requirements, and country-specific policy and risk factors.

As shown in **Figure 14**, the IEA's Current Policies Scenario has the highest oil price assumptions due to higher oil demand, reaching \$134/bbl in 2040. This price assumption is well below those from the previous two years, which assumed 2040 oil prices under the CPS of \$141/bbl (WEO2017) and \$140/bbl (WEO2018). Similarly, the 2040 price assumption of \$103/bbl for STEPS is more than \$10 below the 2017 and 2018 NPS assumptions of \$115/bbl and \$114/bbl, respectively. Finally, the IEA's price assumptions under the SDS are \$59/bbl in 2040, compared with \$67/bbl in WEO2017 and \$65/bbl in WEO2018.

Figure 14. Long-Term Oil Price Assumptions in 2040

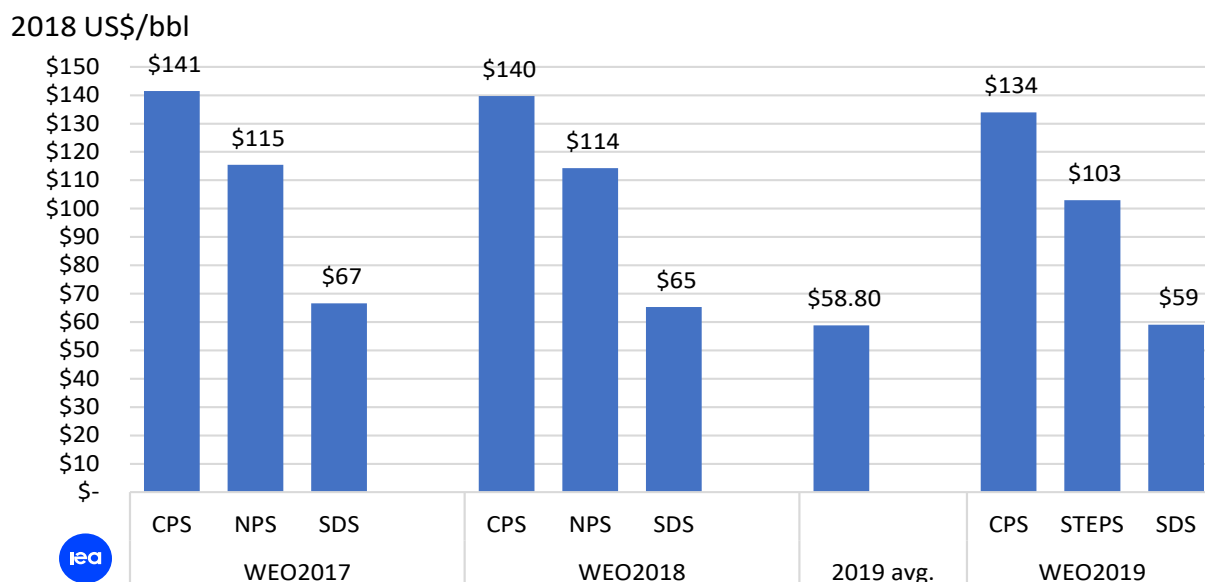


Figure 14 data sources: IEA WEO 2018 and 2019 Table B.4, IEA WEO2017 Table 1.4. US EIA for 2019 average Brent price (includes January through November, 2019).

Figure 14 notes: OPEC has not published medium- or long-term oil price assumptions since WOO2016.

5.1.5 Energy and Environmental Policies

Each year, projections incorporate new policies, enacted or proposed. Since the announcement of the 2015 Paris Climate Agreement, policies related to climate change have received substantial attention. For the most part, these policies have remained in place, with the notable exception of the United States, which announced its intention to withdraw from the agreement and to relax or eliminate a suite of federal climate policies. However, other nations appear committed to pursuing their NDCs and various domestic policies. In WEO2019, the IEA highlights this and other changes in national and subnational policies in major energy consuming nations, laying out key policy assumptions in its introduction and providing details in Annex B, including details on carbon pricing, air pollution, and energy efficiency standards.

Like last year, OPEC dedicates Chapter 8 of its WOO2019 to policy issues with a focus on climate change policies. It describes policies related to road transportation, the power sector, and more for the United States, the EU, China, and India, and other regions. It also focuses on environmental and fiscal policies that may affect oil and natural gas supplies in the United States, Mexico, and Russia.

5.2 Long-Term Energy Demand

5.2.1. Primary Energy Consumption

Despite continued developments in energy markets, public policies, and energy technology, the overarching trend in global energy demand is one of continued growth across all fuels. In their central projections, both the IEA and OPEC see global energy demand rising through 2040, and while the percentage rate of growth is slower, absolute levels of growth are similar to previous decades. Consumption growth is driven primarily by an expanding population and economy, with the majority of new demand coming from developing countries, particularly in Asia. Fossil fuels continue to dominate the primary energy mix, with oil, gas and coal in 2040 providing 74% under IEA STEPS, 75% under OPEC's Reference scenario, and 78% under the IEA CPS. This share declines to 58% under the IEA SDS, and to 44% under OPEC's Below 2°C scenario. In 2018, fossil fuels accounted for 81% of the primary energy mix.

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 the composition of the fuel mix.

Total primary energy demand grows under 3 of the 5 scenarios considered here, increasing by 1.0% per year on average for the IEA NPS and OPEC's Reference case, and by 1.3% per year under the IEA CPS. Unlike previous

year's projections, global primary energy demand declines on an absolute basis under the IEA SDS, falling by an average of 0.3% per year, and declining by 0.4% per year under OPEC's Below 2°C scenario.

Figure 15 provides a comparison of projections for total primary energy supply by energy source, highlighting a number of differences. Of the three major Scenarios, the IEA's CPS projects the most robust growth in energy demand, followed by OPEC's Reference Case and the IEA's STEPS. The IEA's CPS projection for coal, oil, and gas consumption is 14 mboe/d, 13 mboe/d, and 8 mboe/d higher, respectively, than OPEC's Reference Case. Under the IEA's STEPS, oil and natural gas consumption are equal to OPEC's Reference Case, and coal consumption is 1 mboe/d lower in 2040. As noted above, the IEA's SDS sees a decline in overall primary energy demand, with a notable decrease in the share of fossil fuels in the primary energy mix. As the scenarios tighten to meet climate goals, coal is the biggest loser of relative market share, falling from 77 mboe/d in 2018 to 30 mboe/d by 2040 in the IEA SDS, and just 19 mboe/d under OPEC's Below 2°C scenario.

Figure 15. World Primary Energy in 2018 and Outlook for 2040

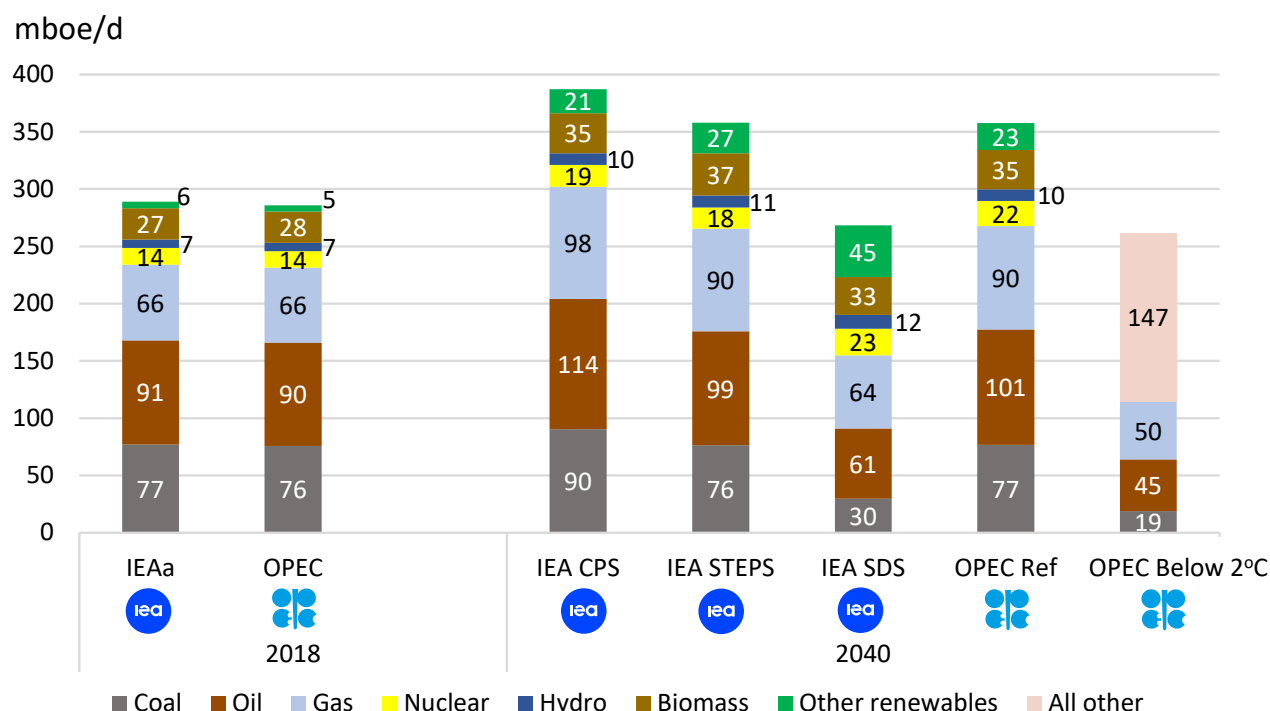


Figure 15 data sources: IEA WEO 2019, Annex Tables; OPEC WOO2019, Table 2.2 and Figure 9.1.

Figure 15 notes:

(a) IEA primary energy is converted from mtoe per year to mboe/d by multiplying by 0.0202 mboe/d/mtoe. OPEC Sensitivity Scenarios do not provide fuel-specific data for non-fossil fuels.

Figure 16 presents the share of each fuel in the global energy mix in 2018 along with projections for 2040. In 3 of the 5 scenarios examined here, oil maintains its position as the leading primary energy source globally, though its share shrinks from 31.5% in 2018 to 28% under IEA STEPS and OPEC Reference scenarios, and to 29% under IEA's CPS notwithstanding growth in volumetric terms. In the two climate policy-focused scenarios, oil is the second largest primary energy source in 2040, declining to 23% under the IEA's SDS and 17% under OPEC's Below 2°C scenario, as well as in volumetric terms.

Natural gas' share of the global energy mix increases under most scenarios, growing from 23% in 2018 to 25% under the IEA CPS, STEPS, and OPEC Reference scenarios. Under the two climate policy-focused scenarios, natural gas takes oil's place as the largest primary energy source by 2040, growing to 24% under the IEA's SDS, and falling to 19% under OPEC's Below 2°C scenario (though it continues to play a larger role than coal or oil).

Coal's share of the mix declines substantially under all scenarios, falling from 27% of global primary energy supply in 2018 to 23% under the IEA CPS and 21% under IEA STEPS and OPEC's Reference scenarios. This decline is accelerated under the IEA's SDS, where coal falls to 11% by 2040, and in OPEC Below 2°C scenario, where it declines to just 7%.

The share of renewables, which is currently dominated by biomass, is projected to increase in all scenarios from 14% in 2018 to 17% under the IEA's CPS, 19% in OPEC's Reference Case, 21% under IEA STEPS, and 34% under the IEA's SDS. Virtually all of this growth comes from renewable electricity such as wind, solar, and hydro. OPEC's Sensitivity scenarios do not provide fuel-specific data for non-fossil fuels.

Figure 16. World Primary Energy Fuel Shares in 2018 and Outlook for 2040

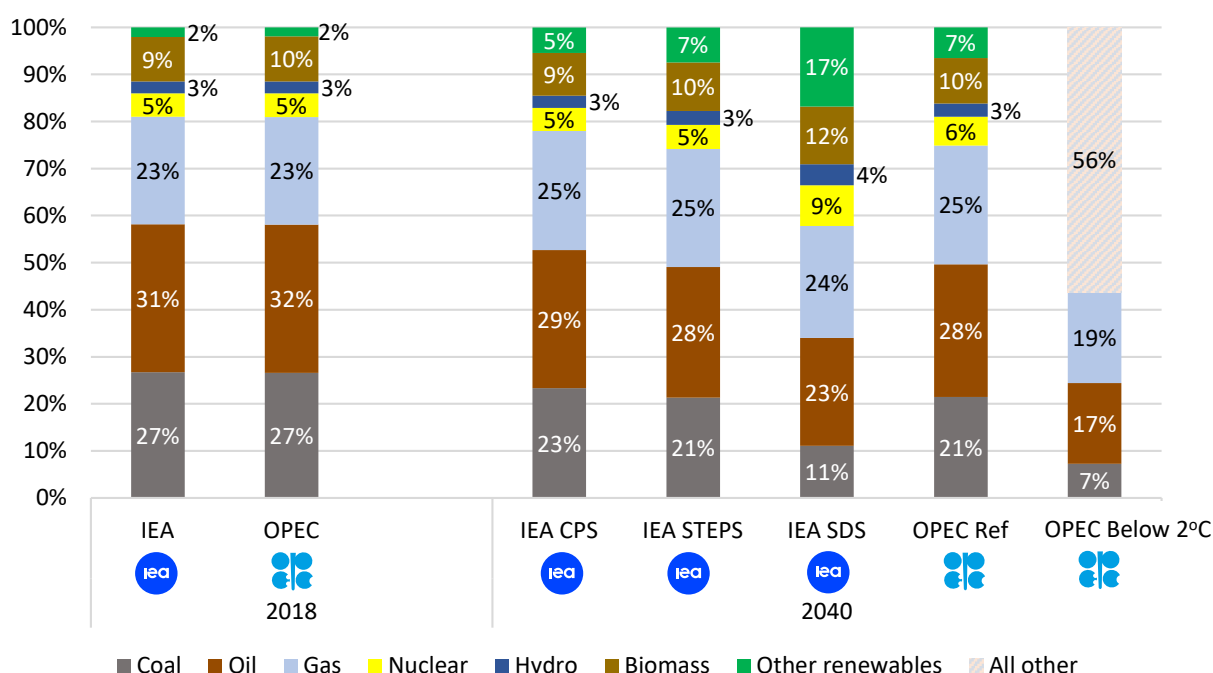


Figure 16 data sources: IEA WEO 2019, Annex Tables; OPEC WOO2019, Table 2.2 and Figure 9.1.

Figure 16 notes:

^(a) IEA primary energy is converted from mtoe per year to mboe/d by multiplying by 0.0202 mboed/mtoe. Sums in the data callouts may not total due to rounding. OPEC Sensitivity Scenarios do not provide fuel-specific data for non-fossil fuels.

5.2.2 Liquids Demand

Several differences between the IEA and OPEC create challenges in directly comparing long-term liquids demand projections.

As in previous years, the IEA and OPEC diverge on their classification of biofuels. First, the IEA groups biofuels into the renewables category, and projects demand for biofuels and oil separately. OPEC includes biofuels in the liquids category, as the IEA does in its short- and medium-term outlooks (but not in the WEO). To adjust for this difference, we aggregate the IEA's oil and biofuels demand for each region, making the numbers comparable with OPEC's.⁶ Secondly, in some cases, we also must convert IEA biofuels data from energy equivalent units (mboed) to volumetric units (mb/d) for comparison with OPEC.⁷

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. For this reason, we do not compare bunker and aviation fuels between the IEA and OPEC, although we do show "bunkers" as a category for the IEA's world oil demand projections.

Fourth, although OPEC disaggregated its member countries demand data to improve direct comparison with IEA's outlook, an inconsistency still exists within the Middle East & Africa regions as reported in the two outlooks. While IEA reported the Middle East and Africa regions separately, OPEC groups them together as a single

⁶ These regional biofuels projections were provided via internal communication with IEA, and supplemented with data from the WEO2019 Annex Tables.

⁷ The IEA has provided, via internal communication, biofuels demand data by OECD status, in energy-equivalent units (mboed). We convert from these energy-equivalents to physical units (mb/d) using a factor of 1.383. This factor is derived from published 2018 global biofuels demand data of 1.9 mboed (see WEO2018 Annex Tables) and 2.6 mb/d (based on IEA Oil2018 Tables 5 and 5a).

category. This paper aggregates the Middle East and Africa in WEO2019 to more directly compare oil demand projections between the two organisations.

Incorporating the adjustments described above, **Table 12** presents a comparison of long-term world liquids demand projections using the major scenarios from WEO2019 and WOO2019. Although the share of liquids in the world primary energy mix is expected to decrease, the level of demand still enjoys robust growth over the projection period under most scenarios in volumetric terms. In IEA's STEPS and OPEC's Reference Case, world liquids demand reaches 112.9 mb/d and 110.6 mb/d, respectively, by 2040. In the IEA's CPS, 2040 world liquids demand grows to 124.6 mb/d, but shrinks to 74.6 mb/d in the SDS. In terms of average annual growth rates, OPEC's Reference Case projects liquids demand growth of 0.5 mb/d, just below IEA's STEPS projection of 0.6 mb/d, and well below the IEA's CPS projection of 1.1 mb/d per year. Under the IEA's SDS, global liquids demand shrinks by 1.1 mb/d annually through 2040.

Table 12. Long-term Liquids Demand Forecasts (mb/d)

	2040				Growth p.a. (2018-2040)				Difference (IEA-OPEC)		
	IEA SDS	IEA STEPS ^(a)	IEA CPS	OPEC Ref.	IEA SDS	IEA STEPS	IEA CPS	OPEC Ref.	SDS	STEPS	CPS
Total OECD	23.5	35.3	40.0	38.3	-0.9	-0.4	-0.2	-0.4	-0.5	0.0	0.2
OECD Americas	14.8	21.8	24.1	21.1	-0.4	-0.1	0.0	-0.2	-0.2	0.1	0.2
OECD Europe	5.3	8.5	10.5	11.3	-0.3	-0.2	-0.1	-0.1	-0.2	-0.1	0.0
Asia Oceania	3.4	5.0	5.4	5.9	-0.2	-0.1	-0.1	-0.1	-0.1	0.0	0.0
Total Non-OECD	45.2	65.5	72.6	72.3	-0.1	0.8	1.2	1.0	-1.1	-0.1	0.2
Asia	24.0	35.5	40.5	40.1	0.0	0.5	0.7	0.6	-0.7	-0.1	0.1
China	10.6	16.5	19.2	17.1	-0.1	0.2	0.3	0.2	-0.3	0.0	0.1
India	6.7	9.3	10.6	10.2	0.1	0.2	0.3	0.2	-0.2	0.0	0.0
Other non-OECD Asia	6.7	9.7	10.7	12.8	0.0	0.1	0.2	0.2	-0.2	-0.1	0.0
Middle East & Africa	5.6	7.8	8.4	7.3	0.0	0.1	0.1	0.1	-0.1	0.0	0.0
Latin America	11.9	17.3	18.4	6.8	0.0	0.3	0.3	0.1	-0.1	0.2	0.2
Europe & Eurasia	3.9	0.0	5.4	6.3	0.0	-0.2	0.0	0.0	-0.1	-0.3	0.0
Bunkers ^(b)	8.8	12.1	13.4	n/a	0.0	0.2	0.2	n/a	n/a	n/a	n/a
World	74.6	112.9	124.6	110.6	-1.1	0.6	1.1	0.5	-1.7	0.1	0.6

Table 12 data sources: IEA WEO 2019, Table 3.2, Annex A Tables, and internal communication; OPEC WOO2019, Table 34 and 3.6.

Table 12 notes: OPEC regional estimates exclude OPEC member nations. IEA 2018 data are preliminary. Numbers rounded to one decimal point. IEA and OPEC regional classifications differ. IEA oil demand figures that align with OPEC's regional classification system were provided via internal communication.

^(a) Biofuels from IEA WEO 2019 (provided via internal communication) are added to IEA regional oil demand data for comparability with OPEC estimates.

^(b) Global bunkers in the IEA WEO include international marine bunkers and aviation fuels. In the OPEC WOO, all bunkers are included within regional demand.

The difference between the highest (IEA CPS) and lowest (IEA SDS) projections for 2040 world liquids demand is 50 mb/d, well above the range of 42 mb/d found in the WEO2017 and 45.5 mb/d in WEO2018. This difference highlights the growing "gap" between the greenhouse gas emissions goals articulated in the 2015 Paris climate agreement and those likely to occur under current policies.

Figure 17 also suggests that demand growth will slow in the coming decades, but to varying degrees. In the IEA's CPS, demand growth slows somewhat after 2025, while a slowing rate of growth is more apparent in the IEA's New Policies Scenario and OPEC's Reference Case. Under the IEA's SDS, there is just 1 mb/d of growth through 2025, followed by substantial declines in absolute levels of demand through 2040. Different rates of electric vehicle deployment, highlighted in our special section on transportation and oil demand, play a meaningful role in reducing global oil demand, particularly in the IEA's SDS.

Figure 17. World Liquids Demand Projections in Various Scenarios

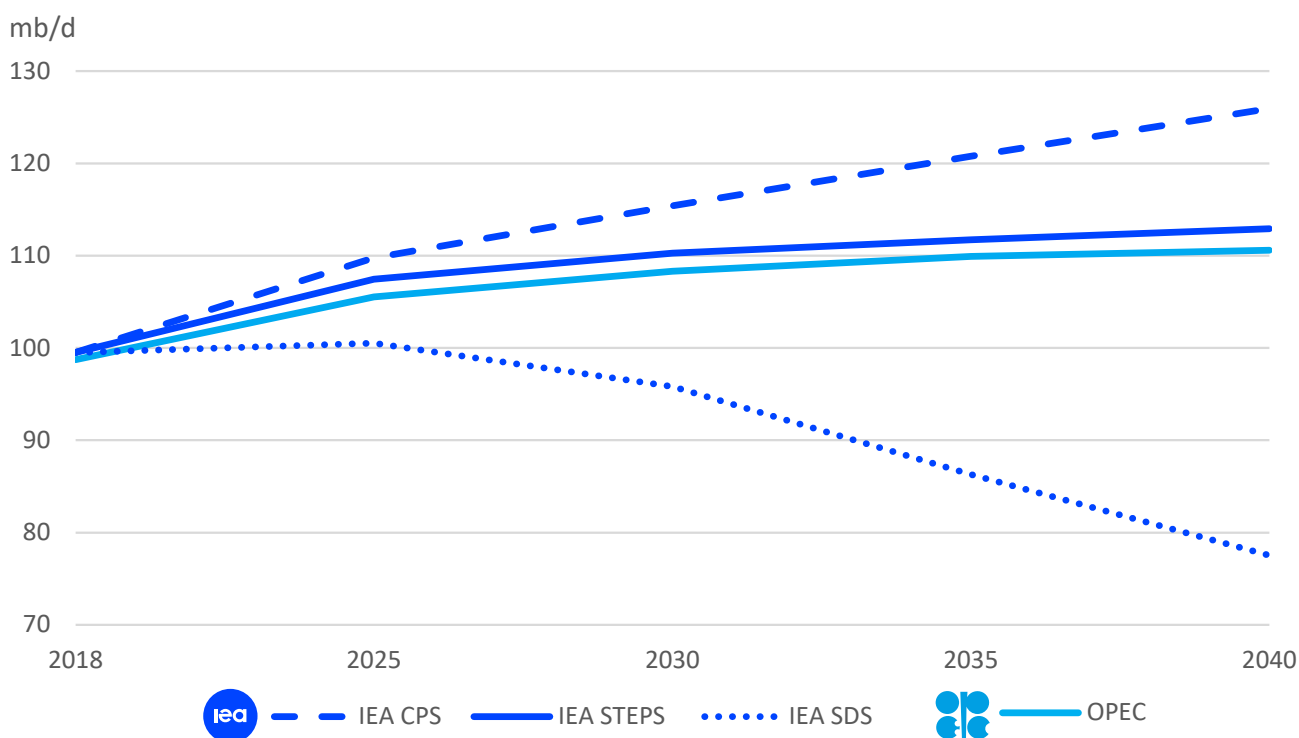


Figure 17 data sources: IEA WEO 2019, Annex A Tables. IEA biofuels data converted from energy-equivalent units to volumetric units using a conversion factor of 1.383; OPEC WOO 2019, Executive Summary, p.8.

Projections for the share of liquids demand from aggregate OECD and non-OECD groups are remarkably similar across all scenarios. All agree that OECD nations will experience a decline in oil demand in absolute and relative terms, yet this decrease is expected to be more than offset by robust demand growth in non-OECD nations, with the exception of the IEA's SDS. The centre of demand growth continues to shift to developing countries, with non-OECD nations' share of global liquids demand increasing from 52% to between 64% and 66% by 2040 (**Figure 18**). As noted above, the IEA provides bunker fuels data separately from regional demand, while OPEC includes bunkers within each regional grouping.

Figure 18. OECD and Non-OECD Shares of Liquids Demand in 2018 and Outlook for 2040

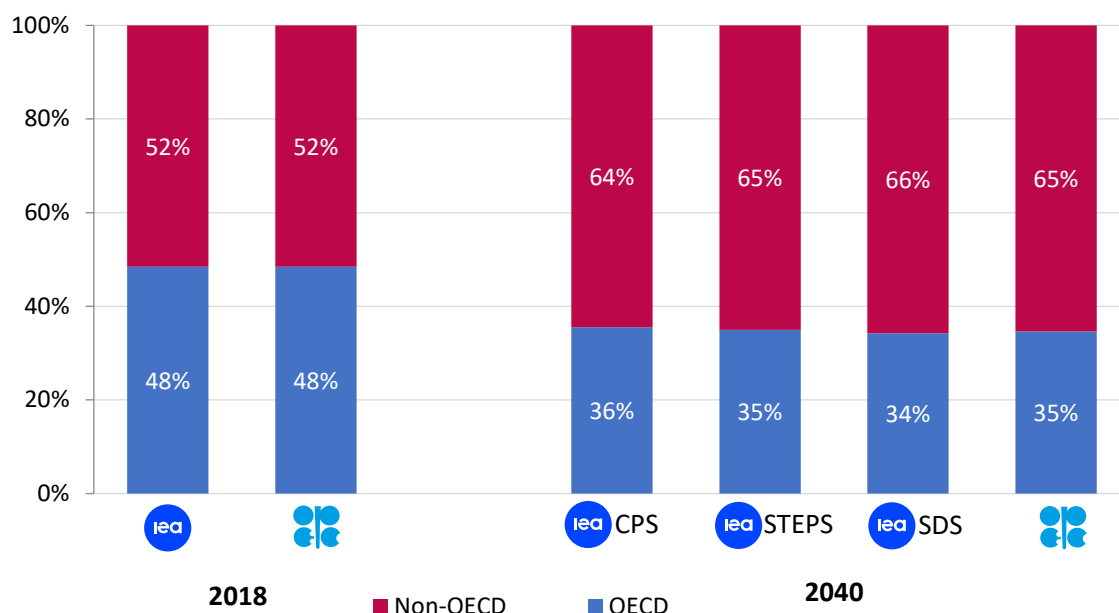


Figure 18 data sources: IEA WEO 2019, Annex Tables; OPEC WOO 2019, Table 3.2.

Figure 18 notes: IEA 2018 data are preliminary.

(a) The "bunkers" group in the IEA's WEO report is excluded from calculation for OECD and non-OECD oil demand shares.

(b) Biofuels from IEA WEO 2019 (provided via internal communication) are added to IEA regional oil demand data for comparability with OPEC estimates..

For specific regions and nations, the IEA and OPEC share similar views on overarching trends of oil demand, with some moderate differences. For instance, both project that non-OECD Asia will lead consumption growth over the forecast period. **Figure 18a** shows projected oil demand for China, India, and other non-OECD Asia in 2040. OPEC's projections appear more bullish than the IEA's STEPS, but less than the CPS. However, direct comparisons between regions are challenging, because OPEC includes bunker fuels within these regional estimates, while the IEA does not.

Figure 18a. Non-OECD Asia Oil Demand in 2040

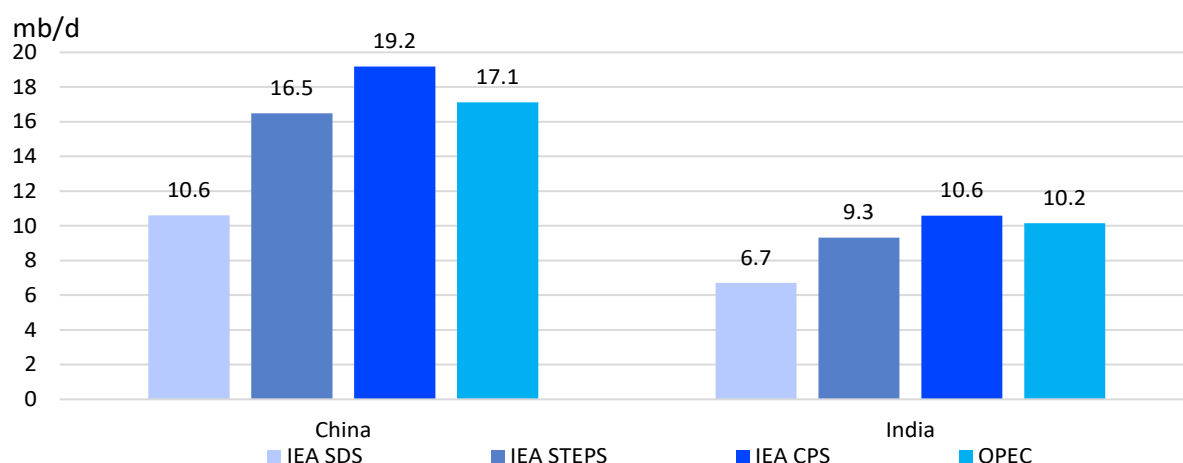


Figure 18a data sources: IEA WEO 2019, Annex A Tables, with biofuels demand data provided via internal communication; OPEC WOO 2019, Tables 3.2.

Figure 18a notes: Regional demand projections from OPEC WOO 2019 include bunker fuels, while the IEA does not.

Perspectives on sectoral trends are broadly consistent between the IEA and OPEC. Transportation and the petrochemicals industry are expected to remain the largest oil consumers and contribute the majority of demand growth. Oil consumption for power generation is projected to decrease in all regions. As a result, shares of oil consumption in transport and petrochemical sectors become larger.

5.3 Long-Term Energy Supply

5.3.1 Mathematical Models

In Section 3, we noted that both the IEA and OPEC base their medium-term supply projections on bottom-up approaches. However, their long-term supply projection methodologies are more distinct.

In its WOO series, OPEC uses a resources-to-production (R/P) model to verify estimates of annual future oil production based on variables including discovery rates, development cost and profitability, and drilling footage. In this model, the focus is on estimating the economic accessibility of oil resources in each country. OPEC primarily relies on U.S. Geological Survey (USGS) data (updated most recently in 2012) for country-level estimates of Ultimately Recoverable Resources (URR), supplemented by regional updates and other sources. The advantage of using R/P to verify estimates is its simplicity and ease of understanding. However, URR estimates are subject to substantial uncertainty, and past research has identified cases where URR estimates may be low due to the possible exclusion of new discoveries and underestimates of reserve growth⁸. In addition, unanticipated technological advancements and policy developments may substantially affect the economic viability of known resources.

Like the previous years, the WOO2019 includes a detailed assessment of active tight oil plays in the United States (Section 4.3.1), though it does not include a sensitivity analysis as it has in other recent years. The WOO2019 also updates its estimates for tight oil supplies outside of the U.S. (Section 4.3.2), estimating growth of 0.5 mb/d from Russia and Argentina from 2018 to 2040, 0.3 mb/d in additional supplies from Canada, and 0.1 mb/d from both Bahrain and China.

The IEA employs a bottom-up modelling approach for its long-term oil supply projection. Unlike in the IEA medium-term Oil 2019, however, the IEA largely takes a country-by-country approach instead of the field-by-field approach (though the first five years of the long-term projection employs field-by-field analysis). For the long-term projections, production in most countries is derived by simulating the investment process, considering existing and potential resources, global oil demand, and a net present value (NPV) ranking of possible projects in that country.

However, the IEA in 2016 began estimating U.S. tight oil production on a play-by-play basis, and in the WEO2019 estimates production from 23 plays or sub-plays. In a new development, this year's WEO estimates production using upwardly revised ultimately recoverable resource (URR) estimates from both the US Geological Survey (USGS) and the US Energy Information Administration (US EIA), whereas in previous years, their projections had been based solely on URR estimates from the US EIA. These estimates endogenously incorporate a certain level of learning, which affects production costs over time. The IEA also examines a range of factors that could affect US tight oil supply, including sensitivity analyses focused on technological development, URR, oil prices, and the cost of capital.

Another important difference between the IEA's long-term supply forecast and its medium-term forecast lies in the methodology for calculating OPEC supply. As shown in **Table 10**, OPEC crude is constructed by subtracting non-OPEC supplies and OPEC NGLs/unconventionals supply from total world oil demand in Oil2019. In the long-term WEO model, however, supplies from OPEC Member Countries are projected using the same methodology used for non-OPEC nations.

5.3.2 Liquids Supply

This year, direct comparison of liquids supplies between the IEA and OPEC has become more difficult. As in previous years, OPEC includes biofuels supplies within its regional liquids supply estimates, while the IEA does not. Unlike previous years, however, OPEC does not publish region-specific biofuels production data, meaning that we are unable to adjust OPEC data to match the IEA's. In addition, the IEA does not provide region-specific biofuels supply data, meaning that we are unable to adjust the IEA's data to match OPEC's. Finally, OPEC did not publish data on the composition of OPEC supplies (i.e., OPEC crude and OPEC NGLs + unconventionals) in the WOO2019.

⁸ Adam R. Brandt, Review of mathematical models of future oil supply: Historical overview and synthesising 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>.

Table 13 summarises the available data regarding long-term liquids supply outlooks in the major scenarios. For regional data, biofuels are included for OPEC, but excluded for the IEA (global biofuels supply data are included). The IEA's STEPS projects 112.9 mb/d in supplies in 2040, compared with 110.8 for OPEC's Reference Case. Under the IEA's CPS, global supplies grow to 125.9 mb/d, but decline to 77.5 mb/d under the SDS.

Other differences emerge regarding regional supplies, though some of these differences are complicated by the difference in biofuels classification. The most notable difference is that OPEC projects non-OPEC supplies to be 4.0 mb/d higher in 2040 than in 2018, while the IEA projects that non-OPEC supplies in 2040 are 5.5 mb/d higher under STEPS and 14.3 mb/d higher under the CPS. Conversely, OPEC projects that OPEC supplies in 2040 will be 7.8 mb/d higher than in 2018, compared with growth of 2.7 mb/d under the IEA STEPS and 8.0 mb/d under the IEA CPS. The IEA's projections for supplies from OECD Americas is more bullish than OPEC's, with the IEA seeing average annual growth of 0.2 mb/d and 0.4 mb/d under the STEPS and CPS, respectively, while OPEC projects average annual growth of roughly 0.1 mb/d through 2040.

Table 13. Long-term Liquids Supply (mb/d)

	2040				Growth p.a. (2018-2040)				Difference (IEA-OPEC)		
	IEA SDS	IEA STEPS	IEA CPS	OPEC Ref. ^(a)	IEA SDS	IEA STEPS	IEA CPS	OPEC Ref.	SDS	STEPS	CPS
Total OECD	22.9	32.1	36.0	29.7	-0.2	0.2	0.4	0.1	-0.2	0.2	0.4
OECD Americas	20.6	28.6	32.2	26.5	-0.1	0.3	0.4	0.1	-0.2	0.2	0.3
OECD Europe	1.7	2.5	2.6	2.9	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
Asia Oceania	0.5	1.0	1.2	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Non-OECD^(c)	42.2	71.4	81.7	78.2	-1.2	0.1	0.6	0.4	-1.6	-0.3	0.2
Non-OECD Asia	3.4	5.4	6.5	6.5	-0.2	-0.1	0.0	0.0	-0.1	0.0	0.0
Middle East, Africa & Latin America	31.6	53.5	60.8	57.2	-0.7	0.3	0.6	0.4	-1.1	-0.1	0.2
Europe & Eurasia	7.2	12.5	17.0	14.5	-0.3	-0.1	0.1	0.0	-0.3	-0.1	0.1
Processing Gains	1.8	2.9	3.3	3.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
World Biofuels	10.6	6.5	5.0	3.8	0.4	0.2	0.1	0.0	0.4	0.2	0.1
Total Non-OPEC	40.8	63.4	72.3	66.4	-0.8	0.2	0.7	0.2	-0.9	0.1	0.5
Total OPEC	24.3	40.1	45.4	44.4	-0.6	0.1	0.4	0.3	-0.9	-0.2	0.0
OPEC crude ^(b)	19.2	32.5	37.1	nd	-0.6	0.0	0.2	nd			
OPEC NGLs+unconventionals	5.0	7.6	8.3	nd	0.0	0.1	0.1	nd			
World Liquids Supply	77.5	112.9	125.9	110.8	-1.4	0.4	1.1	0.5	-1.9	-0.1	0.6

Table 13 data sources: IEA WEO 2019, Annex A Tables; OPEC WOO2019, Table 4.3.

Table 13 notes: IEA 2018 data are preliminary. Numbers rounded to one decimal place.

^(a) Neither the IEA WEO nor the OPEC WOO includes regional biofuels supply. As a result, OPEC regional data includes biofuels supplies, while the IEA's do not. Only world biofuels supply is provided for both outlooks.

^(b) "OPEC crude" category includes Venezuelan extra heavy oil. OPEC does not provide the breakdown of OPEC supplies in WOO2019.

^(c) OPEC regional groupings in WOO2019 exclude OPEC member nations. To enhance comparability with IEA groupings, we add the "total OPEC" category to OPEC's "Total Non-OECD" and "Middle East, Africa, & Latin America" data. Thus, all OPEC production is included in the regional groupings above.

OPEC and the IEA differ in their projections for global unconventional supplies. Both organisations project strong growth in tight oil supplies, with OPEC estimating global tight crude supplies reaching a peak of 12.7 mb/d in 2030 before declining to 10.0 mb/d in 2040. The IEA shows tight oil growing more quickly, reaching 13.4 mb/d in the STEPS in 2040, a substantial increase from last year's level of 11 mb/d in the New Policies Scenario in 2040. Under the Sustainable Development Scenario, global tight oil production reaches 10.1 mb/d in 2030 before declining to 9.2 mb/d in 2040. In each of these scenarios, tight oil production is dominated by the U.S.

Recall from **Figure 10** (Section 3) that the IEA and OPEC use different classification systems for liquids fuels, presenting challenges when comparing long-term supply forecasts. Analysis of the IEA's and OPEC's views about the composition of world supply by fuel type, as shown in **Figure 19** and **Figure 20**, also yields notable points. **Figure 19** shows that all three scenarios project increasing liquids supply both from OPEC and non-OPEC sources, with the majority of growth coming from non-crude liquids such as tight oil, NGLs, and unconventionals. **Figure 20** shows OPEC's share of global supply holding steady under the IEA STEPS and CPS at 38% through 2040, but declining to 36% under the IEA SDS. OPEC projects that OPEC supplies grow from 37% in 2018 to 40% by 2040.

Figure 19. Liquids Supply Sources in 2018 and Outlook for 2040

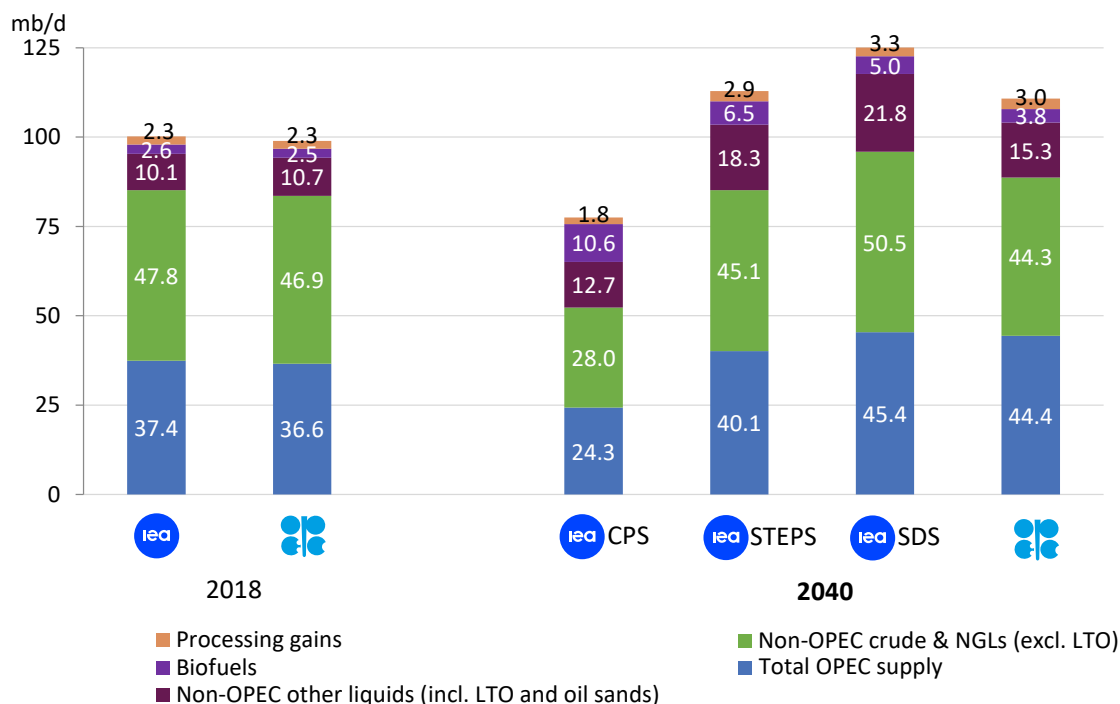


Figure 19 data sources: Internal communication with IEA; IEA WEO2019 Tables 3.3 and 3.4; OPEC WOO2019, Table 4.3.

Figure 19 notes: IEA 2018 data are preliminary.

Figure 20. Shares of Liquids Supply by Types in 2018 and Outlook for 2040

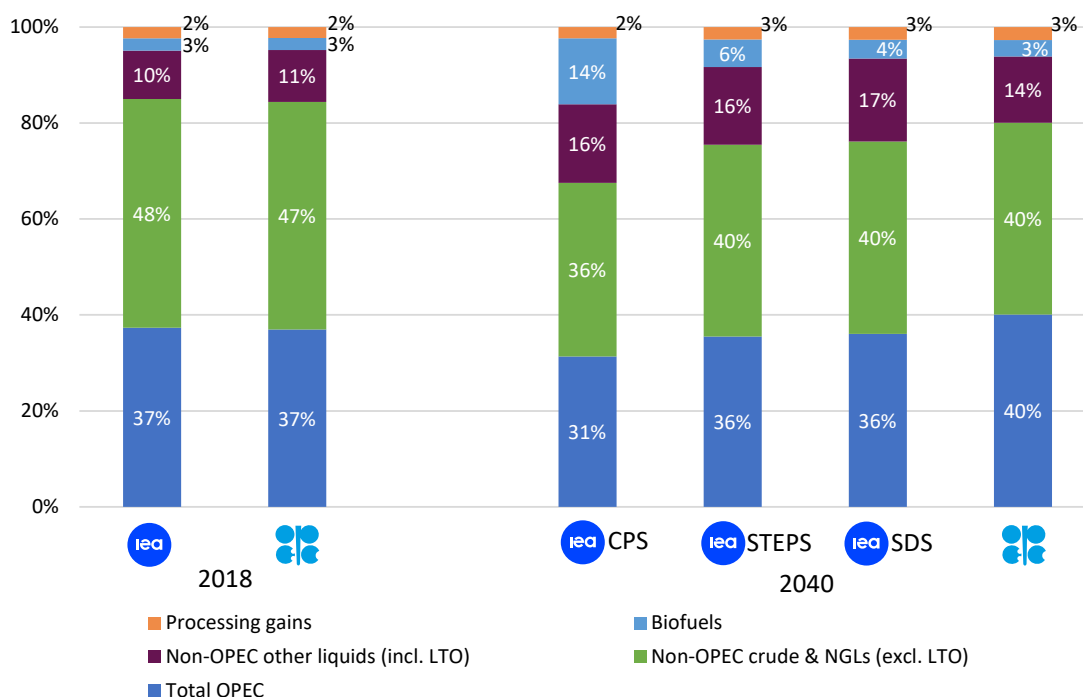


Figure 20 data sources and notes: See Figure 19. Sums in the data callouts may not total due to rounding. IEA 2018 data are preliminary.

Finally, **Figure 21** presents a comparison of world liquids supply forecasts from the three WEO2019 scenarios and the WOO2019 Reference Case. This figure highlights how dramatically world supply outlooks can be affected by different scenario assumptions. The IEA's SDS demonstrates far lower liquids supplies than any of the other three scenarios examined here, at 37% below the IEA STEPS, 40% below the OPEC Reference Case, and 45% below the IEA's CPS.

Figure 21. 2040 Liquids Supply Outlook in Different Scenarios (mb/d)

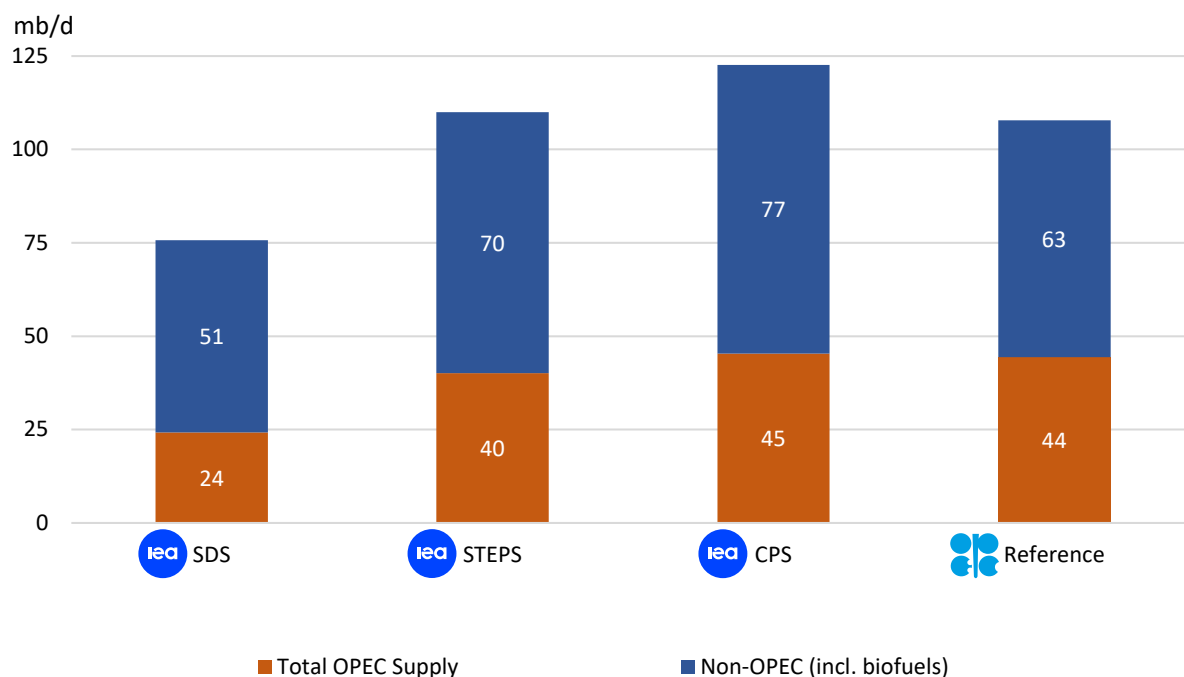


Figure 21 data sources: IEA WEO2019 Annex Tables. OPEC WOO2019 Table 4.3.

Figure 21 notes: OPEC did not publish details on the composition of OPEC supplies (e.g., NGLs and unconventionals) in WOO2019. Processing gains are not included in this figure.

6. Electrification, biofuels, and oil demand in the transport sector

In 2018, the transportation sector accounted for 58% of global oil demand. In recent years, declining battery costs, government subsidies, and other factors have increased the penetration of electric vehicles (EVs), particularly in smaller vehicles such as cars. EV sales (including fully electric vehicles (EVs) and plug-in hybrid electric vehicles (PHEVs)) have grown rapidly, with 2 of the 5 million EVs on today's roadways sold in the year 2018.

This growth is projected to continue under all projections, but the rate of acceleration is highly uncertain. Under the OPEC Reference and IEA STEPS projections, EVs respectively grow from 0.5% of the global passenger vehicle fleet in 2018 to 15% and 16% by 2040. Under the SDS, EVs grow to 44% by 2040, and account for 72% of passenger vehicle sales by 2050 (sales data for 2040 are not published in the WEO2019).

Figure 22. Number of passenger vehicles by type, 2018 and 2040

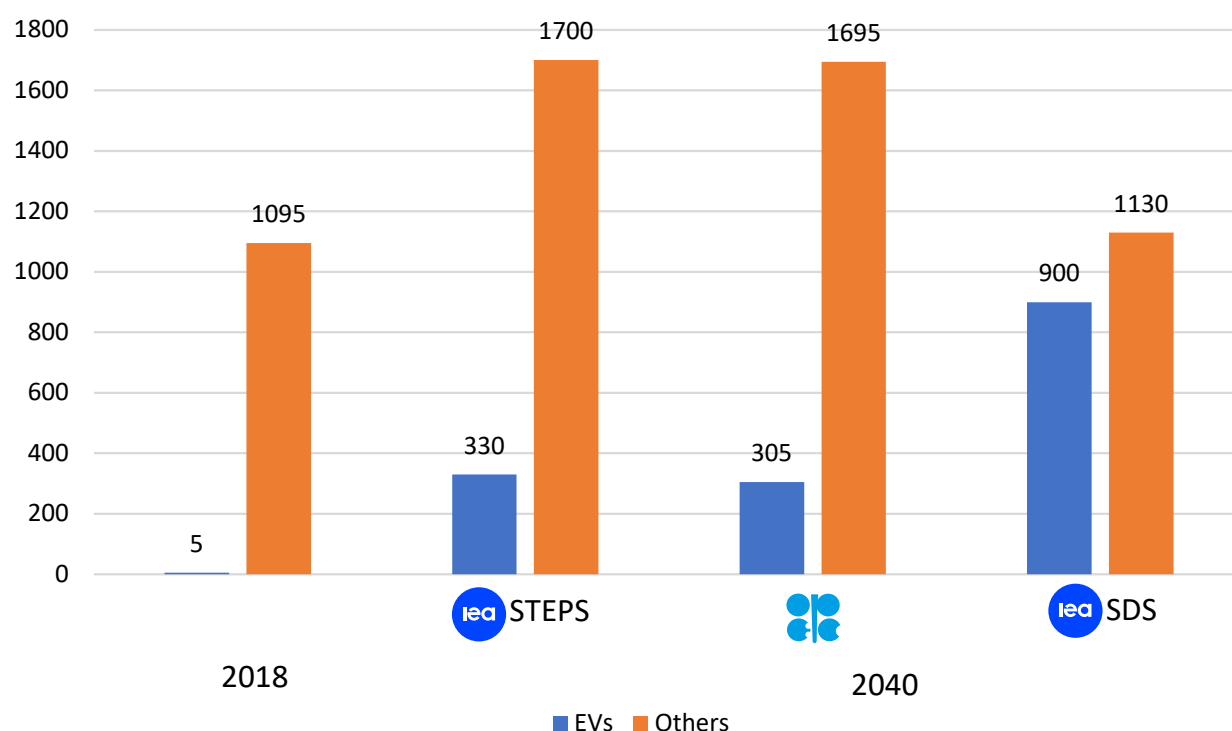


Figure 22 notes: Assumes that the number of passenger vehicles in 2040 is equal under the SDS and STEPS scenario. IEA provides estimates for the number of EVs under both STEPS and the SDS, but publishes the total number of passenger vehicles only under STEPS.

EV growth has been driven by declining battery costs. The IEA reports that battery costs in 2014 were roughly \$650/kWh, and that they are projected to decline to less than \$100/kWh by the mid-2020s.

Under IEA STEPS, a rising share of electric vehicles has a noticeable effect on global oil demand. The IEA estimates that under STEPS, EV growth reduces demand by roughly 4 mb/d by 2040. Under the SDS, the number of EVs on the road in 2040 is 2.7 times greater than under STEPS, suggesting a reduction in global oil demand of more than 10 mb/d. OPEC does not publish its estimate of the effects of EV penetration on oil demand.

While EVs have the potential to have a material impact on liquids demand in the transportation sector, other factors play larger roles on aggregate. These include vehicle efficiency improvements (driven in part by public policies), the growth of demand for jet fuel, marine bunkers, and more. Under OPEC Reference and IEA STEPS scenarios, transport sector oil demand grows moderately over the projection period, increasing by 6.4 and 7.0 mb/d, respectively. Under the IEA CPS scenario, demand climbs by 18.5 mb/d, while under the SDS, it contracts by 22 mb/d.

Figure 23. Liquids demand in the transportation sector

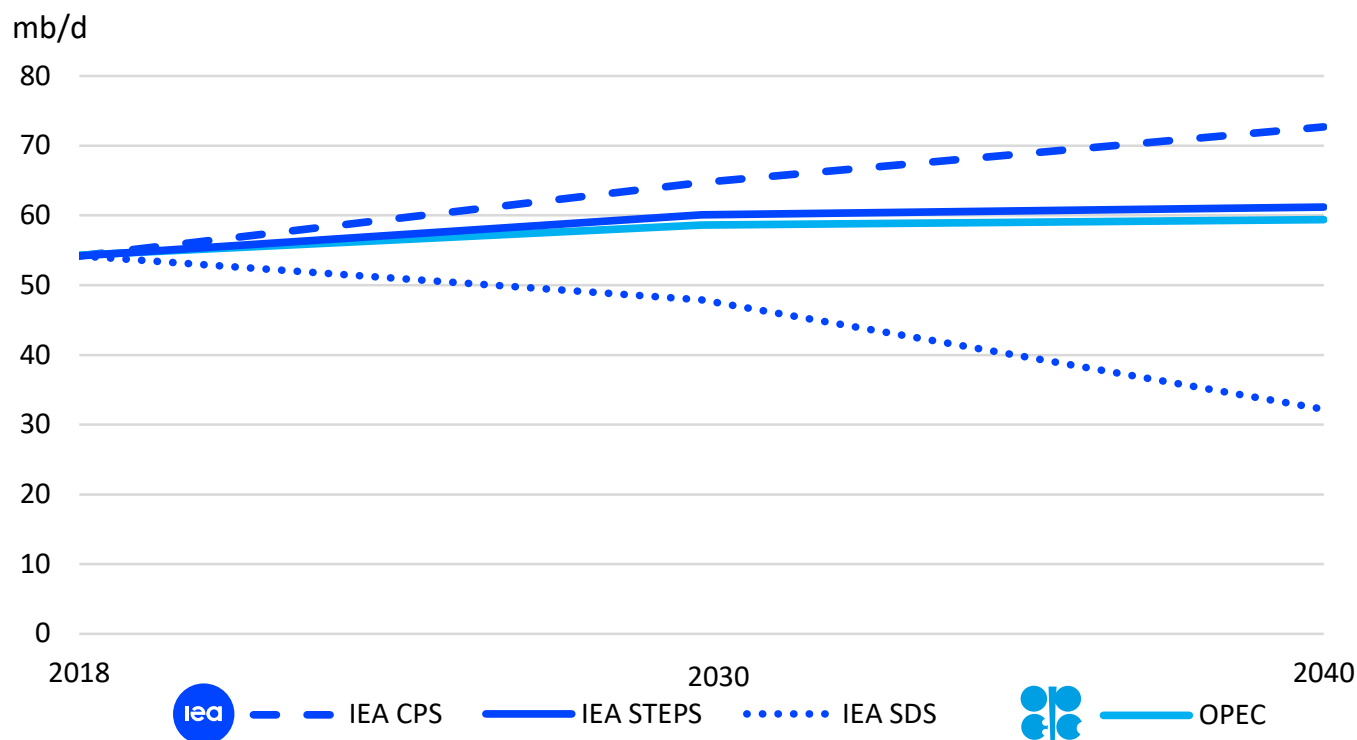


Figure 23 data sources: IEA WEO2019, OPEC WOO2019

Figure 23 notes: Includes road transport, aviation, and shipping (i.e., water and rail). Excludes biofuels.

Along with oil and electricity, biofuels and natural gas are projected to play larger roles in the transportation sector in the years to come. Under the IEA's STEPS, biofuels grow from providing 3% of energy demand in the transportation sector in 2018 to more than 6% by 2040 (electricity provides 5%). Under the CPS and OPEC's Reference Case, biofuels grow more slowly, reaching 4% of transportation energy demand in 2040. Under the SDS, however, biofuels play a major role, increasing to 14% of transportation sector energy demand (electricity grows to 13% in 2040).

In 2018, natural gas provided roughly 4% of transportation sector energy demand. The IEA projects that this share will grow under all scenarios, increasing by similar rates as biofuels under different scenarios. Under the CPS, STEPS, and SDS, natural gas respectively grows to account for 5%, 7%, and 11% of global transportation energy demand by 2040. The IEA reports that the bulk of this growth comes from compressed natural gas (CNG) for passenger vehicles and liquified natural gas (LNG) for marine bunkers and heavy road transport (i.e., trucks and buses). OPEC discusses the role of natural gas in the road and marine transport sectors in Chapter 3 and 7 of its WOO 2019, but does not provide detailed projections on natural gas consumption for transportation.

Figure 24 illustrates the IEA's projections for the changing composition of the transportation fuel mix.

Figure 24. Transportation sector fuel mix

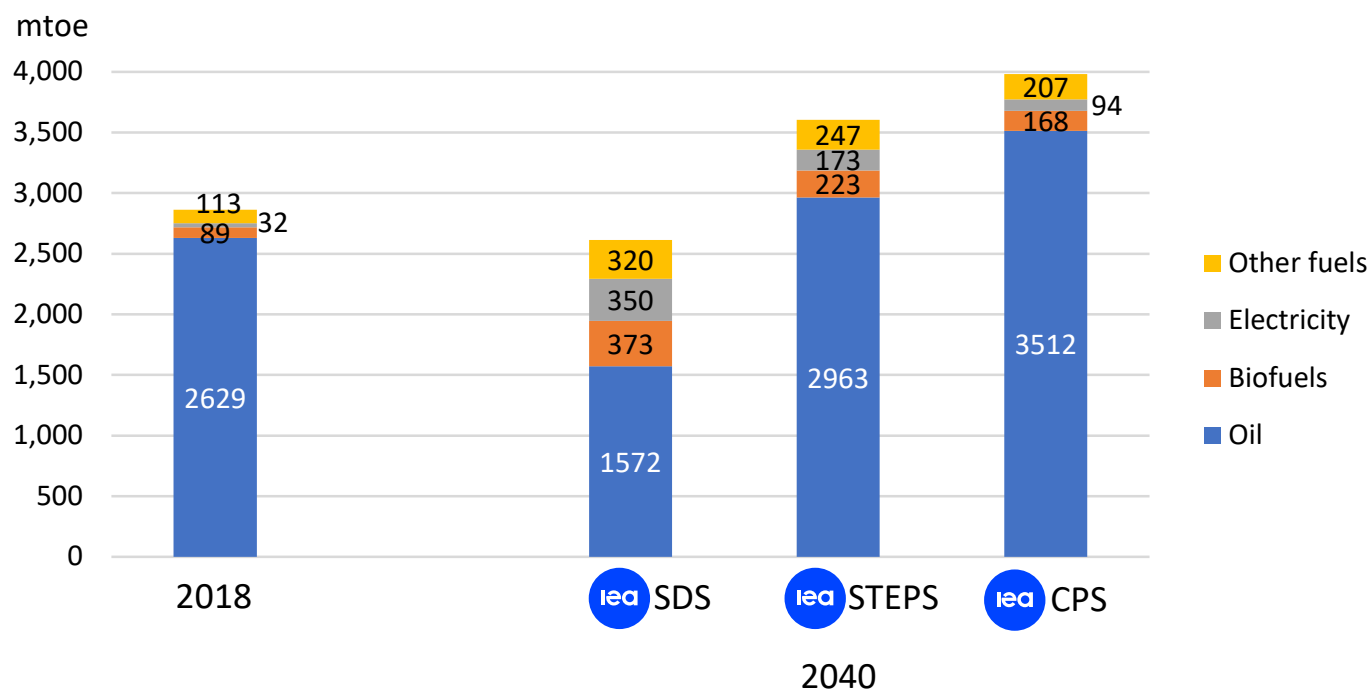


Figure 24 data sources: IEA WEO2019, Annex Tables

Returning to oil, the composition of global demand changes substantially under different scenarios. Because the technological pathways to reduce oil consumption in the passenger vehicle fleet are relatively well-understood (compared with sectors such as aviation and petrochemicals), the IEA's SDS sees oil demand in the road transport sector shrinking rapidly, while demand in other sectors declines relatively little.

In 2018, road transport accounted for 43% of global oil demand according to the IEA and 45% according to OPEC. This figure converges to 43% under the OPEC Reference and IEA CPS, declines to 40% under IEA's STEPS, and shrinks to just 31% under the IEA's SDS by 2040. **Figure 25** illustrates these changing patterns of consumption under different scenarios.

Figure 25. Oil demand in the road transport sector and all other sectors, 2018 and 2040

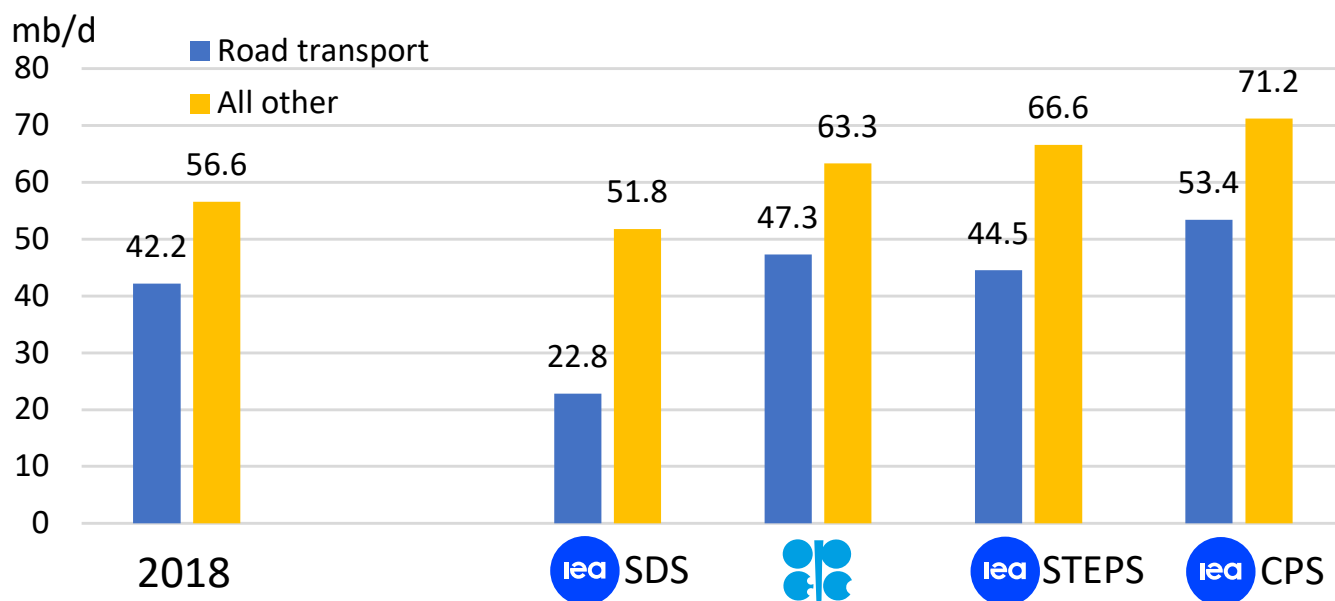


Figure 25 data sources: IEA WEO2019, OPEC WOO2019

7. Final Remarks

Compared with 2018, 2019 witnessed less volatile oil prices despite continued macroeconomic and geopolitical uncertainty. Prices were generally lower than 2018, reflecting strong supplies and somewhat muted demand. This fairly weak demand reflects in part the continued international trade disputes, as well as moderating growth from major developing nations. Towards the end of 2019, OPEC members in collaboration with several non-OPEC countries decided to adjust production in the months ahead. As always, substantial uncertainties will continue to weigh on oil markets in the years to come.

Looking to 2020, markets will continue to be influenced by the decisions taken by OPEC and non-OPEC nations. Other key areas of interest will include the effects of the upcoming IMO rule implementation, the growth rate of U.S. tight oil supplies, global economic growth rates will continue to be impacted by U.S. China trade dispute, ongoing geopolitical tensions between the U.S. and Iran, and more.

Notwithstanding these short-term uncertainties, some long-term fundamentals are clear. Economic expansion and population growth will continue to boost global oil demand, with the majority of growth contributed by non-OECD nations, particularly non-OECD Asia, the Middle East and Africa. Unless policies or technologies change significantly more than currently known, oil in 2040 – along with other fossil fuels – is currently on a path to maintain a central position in the global fuel mix. However, as major emerging economies mature, new and more efficient technologies are deployed, concerns over urban pollution increase, and environmental efforts announced under the Paris Agreement come into effect, global oil demand growth rates will likely be tempered.

The key questions for long-term oil supply are which nations and what types of oil production are likely to supplant production declines from existing conventional projects and support demand growth. As in 2018, non-OPEC supply from unconventional plays grew more rapidly than expected, driven by U.S. tight oil. The industry has made efficiency gains to cope with lower oil prices, and infrastructure constraints have moderated in recent months. Nonetheless, to meet long-term demand, OPEC member countries will likely continue to play a central, if not increasing role in global oil supply as high cost non-OPEC supplies remain under pressure from market volatility, moderate growth in prices, and shifting consumer preferences.

This introductory paper seeks to enhance understanding of views and methodologies from two widely acknowledged information providers, the IEA and OPEC, by comparing their outlooks over corresponding time horizons. Various similarities and differences between their historical data, assumptions and projections are described in this paper. Our objective is not to harmonise all assumptions or to eliminate differences in perspectives. Instead, the goal is to pursue higher-quality data and insight and control for differences in convention in order to better inform stakeholders worldwide.

As a continuous effort, the Tenth IEA-IEF-OPEC Symposium on Energy Outlooks aims to provide an open platform to facilitate consumer-producer dialogue on global energy security. After a careful comparison of the IEA's and OPEC's multi-horizon outlooks, this paper proposes the following issues for further discussion at the symposium:

- Advancing efforts to standardise regional classifications across long-term outlooks;
- Advancing efforts to increase comparability of medium- and long-term oil price assumptions;
- Advancing efforts to increase comparability and transparency of liquids supplies, particularly concerning biofuels and the composition of OPEC liquids supplies;
- Ongoing analysis of differences in historical data, particularly in non-OECD demand, as well as FSU and OPEC NGLs/unconventionals supply;
- Advancing efforts to standardise liquids fuel supply categories;
- Adopting consistent approaches in classifying fuels at regional versus global levels (e.g. biofuels, bunkers);
- Understanding policy assumptions made in each long-term energy outlook;
- Sharing viewpoints on oil supply forecast models, and analysing potential enhancement of long-term oil supply projection models, particularly with respect to unconventional resources; and
- Standardising unit conversion processes across mb/d, mboe/d, and mtoe.

Annex 1: Long-term Outlook Assumptions

	OPEC	IEA		
Variables	Reference Case	Stated Policies	Current Policies	Sust. Development
Global Economic Growth Rate (2018-2040)	3.3%	3.4%	same as New Policies	same as New Policies
Population, Billion (2016-2050)	2018: 7.6; 2040: 9.2	2018: 7.6; 2040: 9.2	2018: 7.6; 2040: 9.2	2018: 7.6; 2040: 9.2
Oil Price Assumptions (in 2018\$)	Not specified	2030: \$88/bbl 2040: \$103/bbl	2030: \$111/bbl 2040: \$134/bbl	2030: \$62/bbl 2040: \$59/bbl
Oil and gas investment (2019-2040 in 2018\$)	Oil only: Upstream: \$8.1T Midstream: \$1.0T Downstream: \$1.4T	Upstream: \$15.2T Transport: \$3.7T Oil refining: \$0.9T	Upstream: \$18.8T Transport: \$4.3T Oil refining: \$1.3T	Upstream: \$10.1T Transport: \$2.6T Oil refining: \$0.5T
Energy and Environmental Policies	Primarily considers policies that have been enacted, but attempts to reflect policy developments as they emerge over time	Considers both policies in place and announced intentions.	Only policies enacted by mid-2018	Universal energy access by 2030; fully aligned with Paris Agreement's climate targets; dramatically reduces air pollution from energy.
Carbon prices (per tonne in 2018\$)	Not specified	2040: \$39 in Canada; \$20 in Chile; \$36 in China; \$43 in EU; \$44 in Korea; \$24 in S. Africa	2040: \$39 in Canada; \$5 in Chile; \$31 in China; \$38 in EU; \$39 in Korea	2040: \$140 in Advanced Economies; \$125 in select developing economies

Annex 2: Long-term Outlook Results

	OPEC		IEA			
	2018	2040 Reference	2018	2040 Scenario		
				Stated Policies	Current Policies	Sust. Development
Global energy demand (mboe/d) ^(a)	285.9	357.5	289.1	358.0	387.4	268.2
Global Liquids Demand (mb/d)	98.7	110.6	98.8	111.1	124.6	74.6
Non-OPEC Supply (mb/d) ^(b)	62.4	66.4	59.6	63.4	72.3	40.8
Total OPEC supply (mb/d)	36.6	44.4	37.4	40.1	45.4	24.3
OPEC Crude (mb/d) ^(c)	-	-	31.1	31.3	37.1	19.2
OPEC NGLs and Other Liquids (mb/d)	-	-	6.3	8.8	8.3	5.0

Annex 2 notes:

^(a) IEA primary energy is converted from mtoe per year to mboe/d by multiplying by a factor of 0.0202 mboed/mtoe.

^(b) Include biofuels and processing gains.

^(c) OPEC did not publish the composition of OPEC liquids supply (e.g., crude, NGLs, other unconventional) in WOO2019.



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