

iea



International
Energy Agency

Oil 2023

Analysis and forecast to 2028

INTERNATIONAL ENERGY AGENCY

The IEA examines the full spectrum of energy issues including oil, gas and coal supply and demand, renewable energy technologies, electricity markets, energy efficiency, access to energy, demand side management and much more. Through its work, the IEA advocates policies that will enhance the reliability, affordability and sustainability of energy in its 31 member countries, 11 association countries and beyond.

Please note that this publication is subject to specific restrictions that limit its use and distribution. The terms and conditions are available online at www.iea.org/t&c/

This publication and any map included herein are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Source: IEA. All rights reserved.
International Energy Agency
Website: www.iea.org

IEA member countries:

Australia
Austria
Belgium
Canada
Czech Republic
Denmark
Estonia
Finland
France
Germany
Greece
Hungary
Ireland
Italy
Japan
Korea
Lithuania
Luxembourg
Mexico
Netherlands
New Zealand
Norway
Poland
Portugal
Slovak Republic
Spain
Sweden
Switzerland
Republic of Türkiye
United Kingdom
United States

The European Commission also participates in the work of the IEA

IEA association countries:

Argentina
Brazil
China
Egypt
India
Indonesia
Morocco
Singapore
South Africa
Thailand
Ukraine

Revised version, June 2023
Information notice found:
www.iea.org/corrections



Abstract

The global energy crisis has moved energy security to the fore of the international policy agenda and boosted the momentum behind the deployment of clean energy technologies. Investment in clean energy is accelerating at a faster rate than for fossil fuels, helping bring peak oil demand into view. *Oil 2023*, the IEA's medium-term outlook, provides a comprehensive overview of evolving oil supply and demand dynamics through to 2028. The report examines how a stronger drive by governments towards a low-emissions future and changes in behaviour will impact oil market fundamentals in the coming years. *Oil 2023* explores some of the challenges and uncertainties that lie ahead, including upstream investment, sources of new supply growth, spare capacity and shifting patterns of oil demand. It also provides insights as to how these changing dynamics will affect refining and trade flows.

Acknowledgements, contributors and credits

This publication was prepared by the Oil Industry and Markets Division of the Directorate of Energy Markets and Security. The principal authors are, in alphabetical order, Yuya Akizuki, Alexander Bressers, Joel Couse, Ciarán Healy, Peg Mackey, David Martin, Jacob Messing and Jenny Thomson. Julien Canu and Luis Fernando Rosa provided statistical support and essential research assistance. Toril Bosoni, head of OIMD, led the analysis and edited the *Report*. Keisuke Sadamori, director of the IEA's Directorate of Energy Markets and Security, provided expert guidance and advice. Deven Mooneesawmy provided essential editorial assistance.

The report benefited greatly from contributions from other experts within the IEA, including Yasmine Aarsalane, Alessandro Blasi, Laura Cozzi, Paolo Frankl, Tim Gould, Paul Grimal, Jérôme Hilaire, Christophe McGlade, Jeremy Moorhouse, Apostolos Petropoulos and Gianluca Tonolo.

The IEA Communications and Digital Office provided production and launch support. Particular thanks go to Jad Mouawad and his team; Astrid Dumond, Oliver Joy, Jethro Mullen, Therese Walsh and Isabelle Nonain-Semelin. Diane Munro edited the report.

Table of contents

Executive summary	8
Demand	11
Global summary	11
Fundamentals	14
Energy transition gathers pace	17
Petrochemicals power ahead, China takes centre stage	26
Aviation and marine demand growth resumes	30
Demand developments by region	33
Supply	42
Global summary	42
Investment and exploration	47
OPEC+ supply.....	51
Non-OPEC+ supply.....	65
Refining	80
Global summary	80
Refining capacity.....	82
Refining industry adapts to demand changes	86
Regional developments	90
Global oil trade	100
Global summary	100
Crude oil balances and trade.....	102
Product balances and trade.....	107
Tables	112
Abbreviations and acronyms	124
Units of measure	125

List of figures

Annual oil demand growth, 2022-2028	11
Global cumulative oil demand growth by fuel, 2022-2028	12
Impact of alternative oil price forecast scenarios, 2023-2028	17
Cumulative transport fuels demand growth, 2022-2028	18
New EVs and improved efficiency will avoid 7.8 mb/d of extra oil demand, 2022-2028.....	19
Global annual EV sales by country/region, 2010-2028	20

Oil use in power generation by region, 2022-2028	22
OECD and non-OECD mobility indexes, March 2020 to October 2023.....	24
Estimated teleworking impact on oil demand, 2019-2028.....	25
World oil demand and petrochemical sector contribution	27
Annual olefins oil-based capacity change, (primary output), 2019-2028	28
Annual change in oil-based olefins feedstock use by region and by product, 2019-2028	29
Global air traffic, 2019-2023 (weekly).....	30
International marine bunker demand – impact of efficiency gains, 2022-2028.....	32
Global cumulative oil demand growth by region, 2022-2028	33
North America cumulative oil demand growth by product, 2022-2028	34
Gasoline versus diesel in European ICE car fleet, 2006-2028	35
Europe cumulative oil demand growth by product, 2022-2028.....	36
China cumulative oil demand growth by product, 2022-2028	37
India cumulative oil demand growth by product, 2022-2028.....	39
Global oil supply capacity and demand forecast, year-on-year change, 2022-2028	42
OPEC+ spare crude oil production capacity	43
Oil supply changes for select countries from 2022-2028	46
Middle East regains market share over the medium term.....	47
Global oil and gas upstream capital spending	48
Oil and gas capital spending by selected companies	48
Conventional production additions by sanction year.....	49
Conventional discoveries have slowed markedly over the last decade	50
OPEC crude oil production capacity change 2023-2028	52
Saudi Arabia estimated crude oil production and capacity	53
Iraq, UAE help drive OPEC+ supply gains.....	54
Kuwait estimated crude oil production and capacity, 2018-2028.....	56
Iran crude oil production, 1986-2028.....	57
Russia estimated total oil supply, 2021-2028.....	59
OPEC+ Africa crude oil production capacity (y-o-y change).....	61
Libya estimated crude oil production and capacity	63
Mexico total production and contribution by new fields.....	64
US growth expectations moderated by shifting investment strategies.....	66
Productivity increases have plateaued or reversed in key LTO basins	67
Canadian oil supply by product, 2018-2028.....	70
Western Canadian Sedimentary Basin takeaway capacity.....	71
Búzios and Mero drive Brazilian growth through the decade.....	72
Guyana growth driven by recent discoveries in the Stabroek block	73
Investments in Norway delay but do not offset North Sea decline.....	75
Asian oil supply by country, 2018-2028	77
Africa oil production by country, 2018-2028.....	79
Slowing demand growth raises risk of further refining industry closures	80
Refined product demand growth curtailed by competing sources of supply.....	81
Asia dominates 2022-2028 capacity expansions as Atlantic Basin closures diminish	82
After the first fall in 30 years in 2021, refining capacity growth rebounds.....	83
Net product exporters dominate refining capacity building, 2022-2028 (mb/d).....	84
Firm and proposed refinery capacity additions	85
Regional and country refinery throughputs, 2012-2028	86
Change in global refining yields, 2022-2028	88
Record refining margins posted in 2022, especially for US Gulf Coast	89
China refining capacity overtook United States in 2022, throughputs in 2025	90

Mexican refinery capacity, throughput, crude production and exports.....	91
OECD Europe refinery capacity, throughput, crude imports and product exports	92
European refinery throughputs and free emission allocations, 2013-2022.....	93
North, West and South and East African refinery crude throughput and net crude exports	94
China refinery capacity, throughput, net crude imports, and net product exports	96
India refinery capacity and crude runs, net crude import and products exports	98
Russian oil exports, January 2022-May 2023	100
World crude and condensate balances by region, 2019-2028.....	101
Shares in uptake of global volumes from net crude exporting regions	102
Crude oil balances by region, 2012-2028	103
Change versus 2022 for crude surplus in Atlantic Basin by region.....	105
Change versus 2022 for crude surplus East of Suez by region	106
World gasoline and naphtha balances, 2022 - 2028.....	109
World middle distillate balances (diesel, gasoil, jet fuel and kerosene), 2022-2028.....	110
World fuel oil balance, 2022-2028.....	111

List of boxes

How green is the growth?.....	44
Shale growth at risk from lower prices, higher costs.....	68
Biofuels to provide 10% of new liquid fuel supply growth to 2028	73
Chinese policy key to balancing global fuel markets.....	97

List of tables

Global oil demand by product (mb/d), 2019-2028.....	13
Global oil demand by region (mb/d), 2019-2028.....	14
Real GDP growth assumptions	15
Oil demand by product (mb/d): North America, 2019-2028	34
Oil demand by product (mb/d): Europe, 2019-2028.....	35
Oil demand by product (mb/d): Asia Pacific, 2019-2028.....	36
Oil demand by product (mb/d): China, 2019-2028.....	37
Oil demand by product (mb/d): India, 2019-2028.....	38
Oil demand by product (mb/d): Central and South America, 2019-2028	39
Oil demand by product (mb/d): Africa, 2019-2028	40
Oil demand by product (mb/d): Middle East, 2019-2028.....	40
Oil demand by product (mb/d): Eurasia, 2019-2028	41
OPEC crude oil production capacity (mb/d)	58
Total Non-OPEC+ supply (mb/d)	65
Regional refinery capacity and utilisation 2022-2028.....	83
Oil demand and call on refined products (mb/d), 2022-2028	87
Middle East refinery capacity expansions (kb/d), 2022-2028	95

Executive summary

World oil markets reset

Global oil markets are gradually recalibrating after three turbulent years in which they were upended first by the Covid-19 pandemic and then by the Russian Federation's (hereafter "Russia") invasion of Ukraine. Benchmark crude oil prices are back below pre-war levels and refined product cracks have now come off all-time highs after rising supplies coincided with a marked slowdown in oil demand growth in advanced economies. Moreover, an unprecedented reshuffling of global trade flows and two consecutive emergency stock releases by IEA member countries in 2022 allowed industry inventories to rebuild, easing market tensions.

While the market could significantly tighten in the coming months as OPEC+ production cuts temper the upswing in global oil supplies, the outlook improves over our 2022-28 forecast period. Russia's invasion of Ukraine sparked a surge in oil prices and brought security of supply concerns to the fore, helping accelerate deployment of clean energy technologies. At the same time, upstream investments in 2023 are expected to reach to their highest levels since 2015.

Our projections assume major oil producers maintain their plans to build up capacity even as demand growth slows. A resulting spare capacity cushion of at least 3.8 mb/d, concentrated in the Middle East, should ensure that world oil markets are adequately supplied throughout our forecast period.

As always, there are a number of risks to our forecasts that could affect market balances over the medium term. Uncertain global economic conditions, the direction of OPEC+ decisions and Beijing's refining industry policy will play a crucial role in the balancing of crude oil and product markets.

Energy crisis accelerates transition away from oil

Based on existing policy settings, growth in world oil demand is set to slow markedly during the 2022-28 forecast period as the energy transition advances. While a peak in oil demand is on the horizon, continued increases in petrochemical feedstock and air travel means that overall consumption continues to grow throughout the forecast. We estimate that global oil demand reaches 105.7 mb/d in 2028, up 5.9 mb/d compared with 2022 levels.

Crucially, however, demand for oil from combustible fossil fuels – which excludes biofuels, petrochemical feedstocks and other non-energy uses - is on course to peak at 81.6 mb/d in 2028, the final year of our forecast. Growth is set to reverse

after 2023 for gasoline and after 2026 for transport fuels overall. These trends are the result of a pivot towards lower-emission sources triggered by the global energy crisis, as well as policy emphasis on energy efficiency improvements and the rapid growth in electric vehicle (EV) sales.

The People's Republic of China (hereafter "China") was the last major economy to lift its stringent Covid-19 restrictions at the end of 2022, leading to a post-pandemic oil demand rebound in the first half of 2023. But demand growth in China slows markedly from 2024 onwards, and global oil demand growth shrivels from 2.4 mb/d in 2023 to just 400 kb/d by 2028. Nevertheless, burgeoning petrochemical demand and strong consumption growth in emerging economies will more than offset a contraction in advanced economies. For total oil demand to decline sooner, in line with the IEA's Net Zero Emissions by 2050 Scenario (NZE Scenario), additional policy measures and behavioural changes would be required.

The petrochemical sector will remain the key driver of global oil demand growth, with liquified petroleum gas (LPG), ethane and naphtha accounting for more than 50% of the rise between 2022 and 2028 and nearly 90% of the increase compared with pre-pandemic levels. The aviation sector will expand strongly as airline travel returns to normal following the reopening of borders. At the start of 2023, jet fuel demand was still lagging 2019 levels by more than 1 mb/d, or 13%. It quickly accelerates and contributes the highest growth across all products over the forecast period, increasing by a substantial 2 mb/d. However, efficiency improvements and behavioural changes will slow the pace of growth so consumption will only surpass 2019 levels by 2027.

Non-OPEC+ producers lead oil supply capacity growth

Global upstream oil and gas investment is on track to increase by an estimated 11% in 2023 to USD 528 billion, compared with USD 474 billion in 2022. While the impact of higher spending will be partly offset by cost inflation, this level of investment, if sustained, would be adequate to meet forecast demand in the period covered by the report.

Based on the current pipeline of projects underway and US light tight oil (LTO) growth expectations, we see 5.9 mb/d of net additional production capacity brought online by 2028. Despite easing from 1.9 mb/d on average over 2022-23 to just 300 kb/d by 2028, new capacity building still moves in line with projected demand growth over the forecast period.

Oil producing countries outside the OPEC+ alliance (non-OPEC+) dominate medium-term capacity expansion plans, with a 5.1 mb/d supply boost led by the United States, Brazil and Guyana. Saudi Arabia, the United Arab Emirates (UAE) and Iraq lead the capacity building within OPEC+, while African and Asian

members struggle with continuing declines, and Russian production falls due to sanctions. This makes for a net capacity gain of 800 kb/d from the 23 members in OPEC+ overall.

The relatively strong increases from non-OPEC+ producers, together with the projected slowdown in demand growth, tempers the requirement for OPEC+ crude. As a result, estimated effective spare capacity of at least 3.8 mb/d is maintained throughout the forecast period.

Refinery activity and trade upended

A third wave of refinery capacity closures, conversions to biofuel plants and project delays since the pandemic reduced the overhang in global refinery capacity. This, combined with a sharp drop in Chinese oil product exports and an upheaval of Russian trade flows, resulted in record profits for the industry last year. While net refinery capacity additions of 4.4 mb/d expected by 2028 outpace demand growth for refined products, contrasting trends among products means that a repeat of the 2022 tightness in middle distillates cannot be ruled out.

Refiners may need to shift their product yields towards middle distillates and petrochemical feedstocks to reflect changing demand patterns. Demand for petroleum-based premium road transport fuels, such as gasoline and diesel, is 1 mb/d below 2019 levels at the end of the forecast period. At the same time, robust petrochemical activity and slower growth in natural gas liquids (NGLs) supply raises demand for refinery-supplied LPG and naphtha. Chinese production policy will be pivotal for global markets. Close alignment with petrochemical plant feedstock needs could leave middle distillate markets very tight by 2028.

While East of Suez continues to propel growth in capacity additions and refinery runs, the Atlantic Basin could see throughputs decline despite substantial new plants starting up in Nigeria, Mexico and Brazil.

However, most of the increase in global crude and condensate production will come from the Atlantic Basin. The Western Hemisphere, and especially the Americas, will be the largest incremental supplier of oil to global markets, with exports up by 4.1 mb/d by 2028. This shift in trade flows comes in addition to most of the 2.5 mb/d of Russian crude oil backed out of Europe and G7 countries due to embargoes flowing eastward. The absence of additional Middle East exports in 2028 versus 2022 and surging Asian import requirements result in steadily rising flows from the Atlantic Basin to East of Suez.

The prevailing trend for both crude oil and products is increased supplies from the Americas and the Middle East to Asia. Refinery additions and dwindling crude production reduces Africa's crude export potential by around 15% over the forecast period but curbs its net product import requirements by 10%.

Demand

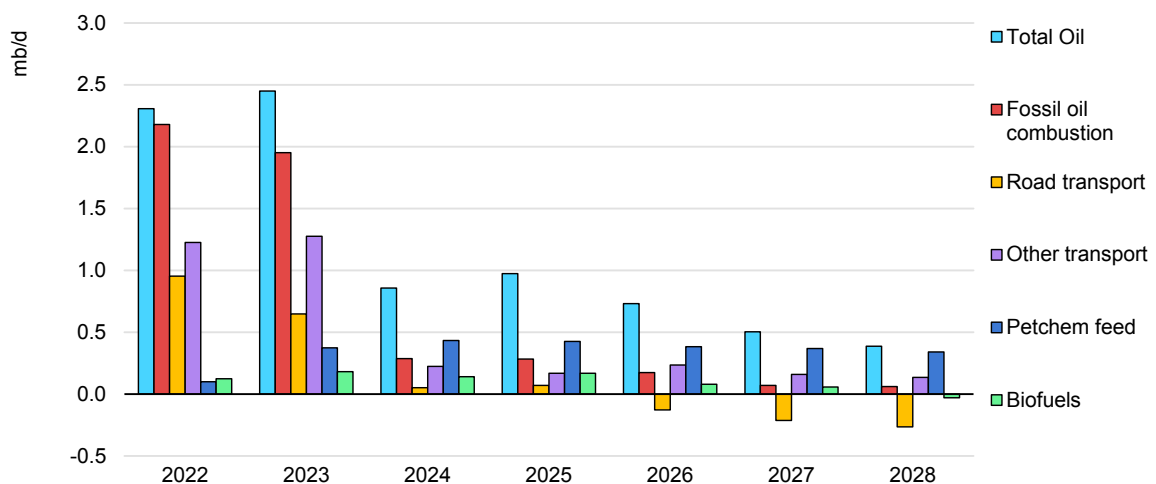
Global summary

World oil demand reaching peak milestones

Growth in world oil demand is set to lose momentum over the 2022-28 forecast period as the energy transition gathers pace, with an overall peak looming on the horizon. Led by continued increases in petrochemical feedstocks, total oil consumption growth will remain narrowly positive through 2028 as usage rises to 105.7 mb/d, 5.9 mb/d above 2022 levels.

Crucially, however, demand for oil from combustible fossil fuels (which excludes biofuels, petrochemical feedstocks and other non-energy uses) will hit its apex at 81.6 mb/d during the final year of our forecast. This milestone marks a historic pivot towards lower-emission sources. The slowdown has been hastened by Russia's invasion of Ukraine amid heightened energy security concerns and by governments' post-Covid recovery spending plans, with more than USD 2 trillion mobilised for clean energy investments by 2030.

Annual oil demand growth, 2022-2028



IEA. CC BY 4.0.

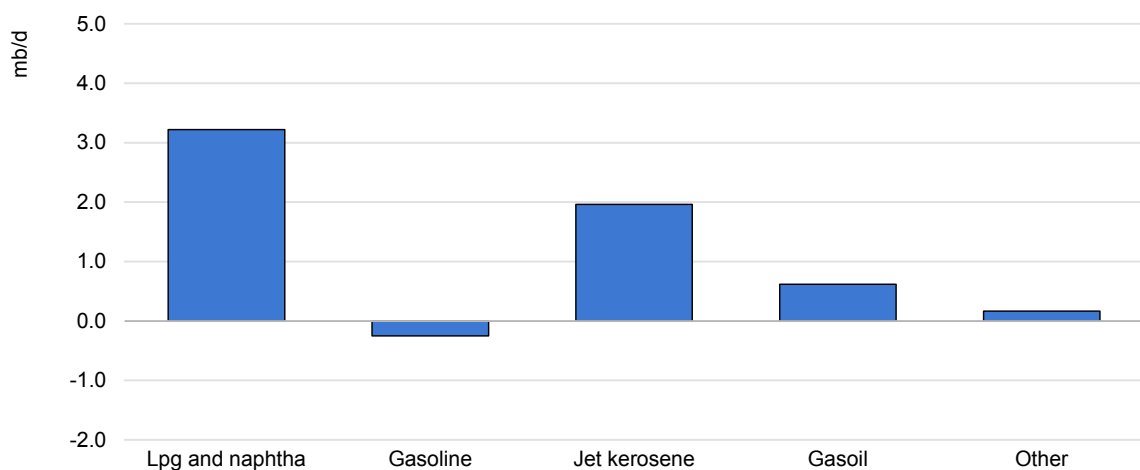
Note: Fossil oil combustion is total demand minus feedstock use, other non-energy uses and biofuels consumed.

The expected pinnacle in oil demand for combustible fossil fuels results from peak post-pandemic consumption for gasoline by 2023, road transport by 2025 and total transport in 2026. Some economies, notably China and India, will continue to

register growth throughout the forecast. By contrast, the OECD as a whole may crest to its peak this year – a harbinger of the sweeping impact of mounting vehicle efficiencies and electrification.

The global post-pandemic economic rebound ended conclusively in 2022, after unprecedented government stimulus and supply chain disruptions caused consumer inflation to soar. This prompted an extraordinary tightening of monetary policy that is set to weigh on GDP deep into 2024. On a global level, subpar expansion in advanced economies is counterbalanced by robust activity in Asia. This was initially fuelled by China's reopening and will be more permanently underpinned by India as it consolidates its status as the world's fastest-growing major economy. Added to resilient gains in Africa and the Middle East, this casts non-OECD nations as the principal engine of growth, accounting for almost 80% of the 2022-28 increase in global GDP.

Global cumulative oil demand growth by fuel, 2022-2028



IEA. CC BY 4.0.

Growth in road transport fuel use, long the mainstay of oil demand, is forecast to go into reverse from 2025 and will only narrowly surpass its pre-crisis high point. Projected demand for 2028 would be 7.8 mb/d higher without the savings from new EVs and efficiency improvements since 2022. This is equivalent to more than the total 2022 jet/kerosene or naphtha deliveries and stands 40% higher than demand in India last year – the world's third-largest consuming nation.

Post-pandemic changes in consumer behaviour provide an additional drag on transport fuels consumption, as hybrid working and video conferencing have become established for some business sectors in advanced economies. However, at the same time, daily travel in cities has seen a relative shift from public transport to car journeys.

New natural gas and renewable electricity generation will also dent oil consumption given their key role in wider energy transition policies. The displacement of fuel oil, gasoil and crude oil used in power generation will be especially pertinent in the Middle East. Several countries in the region, including Saudi Arabia, Kuwait and Iraq, have ambitious plans to move away from their dependence on oil-fired power plants, which will have a major impact on domestic demand in these countries by 2028.

The stalwart of demand growth over the past decade, petrochemical feedstocks will account for more than 40% of overall gains during our forecast period. Roughly 65% of this increase (1.5 mb/d of 2.3 mb/d) will be in naphtha, driven by new liquids-based steam crackers and aromatics facilities, both heavily concentrated in China. These burgeoning capacities will outpace underlying end-user polymer and fibre demand, especially during the first half of our forecast, reshaping global trade flows and pressuring higher-cost operators. The steady pace of growth for petrochemicals will not relent as with other sectors, with scant opportunities for efficiency gains and circular economy initiatives only offering a limited restraint on upward momentum.

Global oil demand by product (mb/d), 2019-2028

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2022-28	
											Growth Rate	2022-28 Growth
LPG/Ethane	13.2	13.2	13.8	14.2	14.4	14.6	14.8	15.1	15.5	15.9	1.9%	1.7
Naphtha	6.6	6.4	6.9	6.8	7.0	7.4	7.8	8.0	8.2	8.3	3.4%	1.5
Gasoline	26.7	23.7	25.6	26.0	26.6	26.6	26.6	26.4	26.1	25.8	-0.2%	-0.3
Jet/Kerosene	8.0	4.7	5.2	6.2	7.3	7.5	7.6	7.9	8.0	8.2	4.7%	2.0
Gasoil/Diesel	28.3	26.1	27.5	28.3	28.4	28.5	28.7	28.7	28.8	28.9	0.4%	0.6
Residual fuel oil	6.2	5.6	6.2	6.5	6.7	6.7	6.7	6.7	6.7	6.7	0.4%	0.2
Other products	11.8	11.9	12.2	11.8	11.8	11.9	11.9	12.0	12.0	12.0	0.3%	0.2
Total products	100.7	91.7	97.5	99.8	102.3	103.1	104.1	104.8	105.3	105.7	1.0%	5.9
<i>Annual change</i>	0.6	-9.0	5.8	2.3	2.4	0.9	1.0	0.7	0.5	0.4		

Aviation jet fuel use is forecast to complete the explosive phase of its rebound from Covid-era travel restrictions before the end of 2024. Thereafter, structurally increasing demand for long-distance travel, strongly associated with higher GDP in middle-income countries, will remain a key pillar of overall growth. Total jet/kerosene demand will rise by almost 2 mb/d between 2022 and 2028, but a substantial improvement in aircraft fuel efficiencies mean that it will take until 2027 to recover beyond 2019 levels. Similarly, fuel oil and gasoil demand for marine bunkers will continue to gain ground (+300 kb/d) in line with rising global GDP. However, efficiency gains, spurred by progressively tightening International Maritime Organization (IMO) measures to reduce greenhouse gas emissions, will once again temper growth.

On a regional basis, the expansion in global demand will be powered by faster-growing economies in the developing world – especially in Asia – while oil use in advanced countries contracts. Around three-quarters of the 2022-28

increase will come from Asia, with India surpassing China as the main source of growth by 2027. By contrast, oil demand in North America and Europe, where energy transition policies and efficiency gains will be most pronounced, spends most of the forecast period in contractionary mode.

Global oil demand by region (mb/d), 2019-2028

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2022-28	
											Growth Rate	2022-28 Growth
North America	25.0	22.1	23.9	24.6	24.7	24.5	24.3	24.0	23.8	23.5	-0.8%	-1.1
S&C America	6.7	5.8	6.4	6.6	6.7	6.8	6.9	7.0	7.1	7.2	1.5%	0.6
Europe	15.7	13.7	14.5	14.9	14.9	14.8	14.7	14.6	14.5	14.3	-0.6%	-0.5
Africa	4.1	3.8	4.0	4.2	4.3	4.4	4.5	4.6	4.7	4.8	2.0%	0.5
Middle East	8.8	8.1	8.5	9.0	9.2	9.3	9.4	9.6	9.7	9.8	1.3%	0.7
Eurasia	4.3	4.2	4.5	4.6	4.6	4.6	4.6	4.7	4.7	4.7	0.5%	0.1
Asia Pacific	35.9	34.0	35.7	35.8	37.8	38.8	39.7	40.3	40.9	41.3	2.4%	5.5
World	100.7	91.7	97.5	99.8	102.3	103.1	104.1	104.8	105.3	105.7	1.0%	5.9
<i>Annual change</i>	<i>0.6</i>	<i>-9.0</i>	<i>5.8</i>	<i>2.3</i>	<i>2.4</i>	<i>0.9</i>	<i>1.0</i>	<i>0.7</i>	<i>0.5</i>	<i>0.4</i>		

Fundamentals

Global GDP remains under pressure

The global economy returned to pre-Covid-19 levels in early 2021. After a drop of 3.1% in 2020, real world GDP grew by 6.4% in 2021 as countries began to reopen from lockdowns while governments and central banks massively increased fiscal and monetary stimulus. The extraordinary rebound in economic activity gradually dissipated over the course of 2022, as consumer prices soared amid booming aggregate demand and supply chain problems, exacerbated by rallying commodity prices in the wake of Russia's invasion of Ukraine. Combined, these developments eventually forced global central banks to adopt a more hawkish monetary stance from early 2022 onwards.

The US Federal Reserve has increased interest rates by an unprecedented five percentage points between March 2022 and May 2023. This monetary turnaround has begun to weigh heavily on OECD growth, raising recessionary prospects. Added to a gradual reduction in bank lending to households and business, these interest rate hikes are expected to reduce 2023 GDP growth to around 1% for the United States and the eurozone. The downturn in advanced economies renders the global outlook even more dependent on China's post-Covid pandemic reopening being able to maintain its early momentum, which should eventually lift global trade and manufacturing. The bearish outlook translates into below-trend GDP growth of 2.4% and 2.8% in 2023 and 2024, respectively, only recovering in 2025 as OECD economies rebound amid a pivot towards monetary easing. After peaking at 3.7% in 2025, global GDP growth is seen averaging 3.3% in 2026-28.

Real GDP growth assumptions

	2019	2020	2021	2022	2023	2024-28
USA	2.3%	-2.8%	5.9%	2.1%	0.9%	1.7%
Europe	1.8%	-5.8%	5.4%	3.6%	0.7%	1.7%
Asia Pacific	4.4%	-1.3%	6.9%	3.8%	4.1%	4.7%
Japan	-0.4%	-4.3%	2.2%	1.0%	0.6%	1.3%
China	6.0%	2.3%	8.5%	3.0%	5.5%	4.6%
India	4.6%	-6.4%	9.2%	6.9%	4.8%	6.9%
Africa	3.9%	-1.3%	5.7%	3.6%	2.5%	3.3%
World	2.9%	-3.1%	6.4%	3.3%	2.4%	3.3%

Sources: IEA, IMF and Oxford Economics.

End of pandemic marks a shift in demand trends

It bears noting that 2023 marks the last Covid-19 transition year for global oil demand, with China the final major country to lift lockdown restrictions in December 2022. The subsequent surge in mobility that prompted a release of pent-up oil demand appeared to be cresting in mid-2023 and is expected to lose momentum during the remainder of the year, thereby normalising baselines from 2024 onwards. In parallel, global supply-chain constraints and cross-border restrictions that characterised 2020-22 have also abated. Fittingly, the World Health Organization (WHO) declared an end to the Covid-19 pandemic as a global health emergency in May 2023.

On a macroeconomic level, the impact of Covid-19 will be felt for years to come now that the unprecedented monetary and fiscal stimulus prompted by the pandemic is being withdrawn. Although direct Covid-19 fiscal support measures have largely been unwound, the immense spending programmes launched at the height of the pandemic will continue to stretch government finances, as debts undertaken will have to be repaid eventually. This is particularly acute in the current high interest rate environment as central bank liquidity is being withdrawn. The slow-burning credit crunch among retail banks in advanced economies will act as a further drag on economic activity. Emerging markets are especially vulnerable to a deleveraging squeeze, having seen their debt levels and fiscal imbalances rise to dangerous levels, which could undermine medium-term growth.

GDP growth in the United States for 2023 is assumed at a lacklustre 0.9% in our projections, slowing to just 0.4% in 2024 as the country struggles with the aftermath of the US Federal Reserve's interest rate hikes. Amid a job market that remains historically tight and elevated inflation, the risk of a wage-price spiral is real. Fiscal policy is also anticipated to tighten, as budget deficits and debt levels have climbed to uncomfortably high levels. Growth is forecast to recover somewhat, to an average 2% over the 2025-28 period.

China's economy is rebounding after the marked slowdown in 2022, led by soaring mobility and services. China's key challenge will be its ability to maintain economic

momentum beyond the current release of pent-up demand. Amid a continuing manufacturing and trade slump, with muted global growth weighing on exports, this will be heavily dependent on an ongoing recovery in retail spending. However, an uncertain job market, underwater mortgages and a more risk-averse mindset following three years of draconian pandemic controls may stand in the way of a lasting rebound in household spending.

China's other challenges are myriad. Although the real estate sector may have seen the worst of the slump, the large overhang of unsold properties will act as a drag on its recovery, while the escalating US technology war underscores rising geopolitical tensions. China's growth is projected to increase from 3% during lockdown-hit 2022 to slightly over 5% in 2023, before averaging 4.6% in 2024-28.

Indian GDP is projected to expand by 4.8% in 2023, rising to 6.3% in 2024 before recovering to an even stronger 7% in 2025-28. Growth will be buttressed by favourable demographics and an expanding middle class.

There are numerous risks to the forecast, predominantly to the downside. Geopolitical risks remain omnipresent, as China and the West grow apart, with a China/Russia/Middle Eastern axis in the process of developing. These will affect energy supply, trade flows and outright prices. Persistently high inflation could lead to further interest rate increases by central banks, which would compound problems for highly indebted countries, stoke social unrest and stunt the economic recovery in high income countries. New virus mutations could trigger renewed containment measures, limiting mobility and economic activity. Finally, natural disasters and weather-related events affecting economic growth (floods, droughts, wildfires, hurricanes) are rising as the globe continues to warm.

Price scenarios see only modest impact on demand

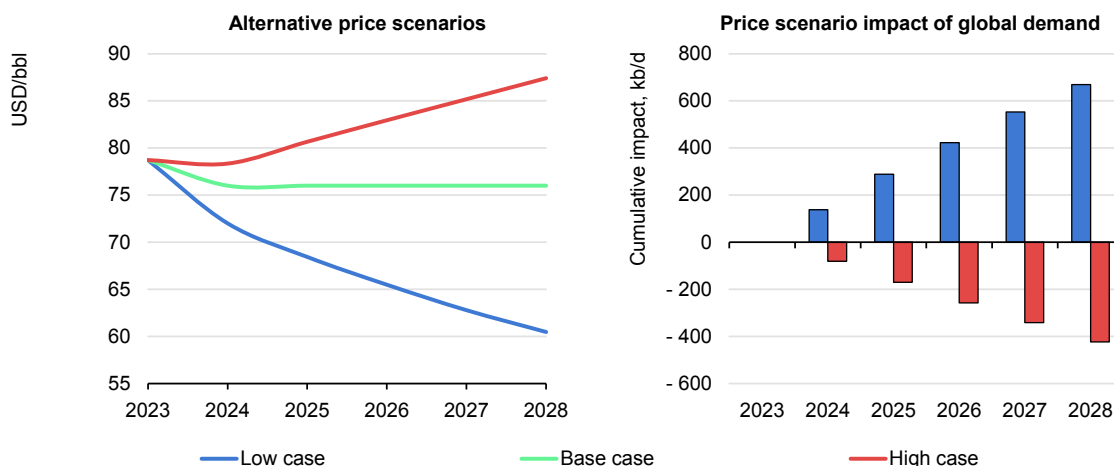
Besides GDP growth rates, assumptions of future oil prices are a key component of demand estimates, with forecasts sensitive to both the absolute price level and intertemporal changes over the outlook. Oil prices used for the modelling input are based on a spot crude price of about USD 76/bbl for North Sea Dated, and we assume this level remains constant in real terms over the forecasting period.

In addition to this base case, the table below shows alternative high- and low-price scenarios:

High-price scenario: Assumes oil prices increase by 2.5% in real terms per annum, in line with their long-term historical pattern.

Low-price scenario: Estimates of future spot prices are based on the ICE Brent forward curve (averaging USD 79/bbl in 2023 slowing to USD 67/bbl in 2028). These are then discounted to real terms.

Impact of alternative oil price forecast scenarios, 2023-2028



IEA. CC BY 4.0.

The high-price scenario would lower 2028 global oil demand by 430 kb/d. However, this would not cause demand to peak earlier. Conversely, the low-price scenario would raise world oil consumption by 670 kb/d at the end of the forecasting period.

Energy transition gathers pace

Policies will reduce road fuel demand and oil use in the power sector

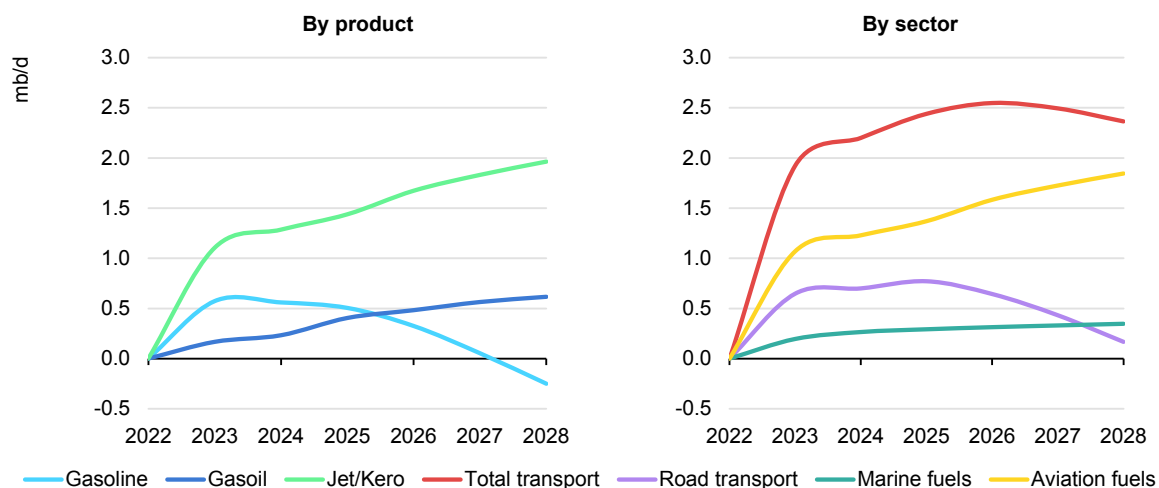
The adoption of tighter efficiency standards by regulators, structural changes to the economy and the ever-accelerating penetration of EVs are expected to powerfully moderate annual growth in oil demand throughout the forecast.

Road transport demand will rapidly progress towards a post-pandemic peak of 45.3 mb/d in 2025, only marginally above the level of 2019, before embarking on a gradual decline. Globally, road transport oil demand will be 460 kb/d below 2019 levels by 2028. To achieve clear peaks in transport and overall demand, with swift subsequent reductions in use, further policy and behavioural changes will be needed.

Gasoline demand will be disproportionately impacted as EVs progressively replace vehicles with internal combustion engines (ICE). About 80% of the 3 mb/d 2022-28 oil demand growth estimated to be displaced by vehicle electrification will be for gasoline. This means that the fuel is likely to exhibit the earliest and most pronounced peak in demand. Usage will never return to 2019 levels and the post-pandemic peak could come as early as 2023. Following a brief plateau, the decline is forecast to accelerate from 2026 onwards, with 2028 demand 900 kb/d below

that of 2019. Total transport demand will plateau in the second half of our forecast period, with its high-water mark expected in 2026 before ebbing gradually as declines in road use outweigh a continued increase in jet and marine fuels consumption.

Cumulative transport fuels demand growth, 2022-2028



IEA. CC BY 4.0.

Efficiency improvements will occur for all fuels, not only road transport fuels, and will have a larger overall impact on oil demand than EVs. Efficiency gains are expected to reduce the growth in oil demand by roughly 790 kb/d per year over the forecast period, for a total of 4.8 mb/d in avoided growth. Total oil demand savings from new EV sales and efficiency improvements over the 2022-28 period will be 7.8 mb/d.

While both fuels will experience large gains over the forecast period, gasoil demand (+620 kb/d) will outperform gasoline use (-250 kb/d) to a considerable extent. In addition to the significance of EVs for gasoline, this is reflective of the relative importance of diesel demand in higher-growth economies.

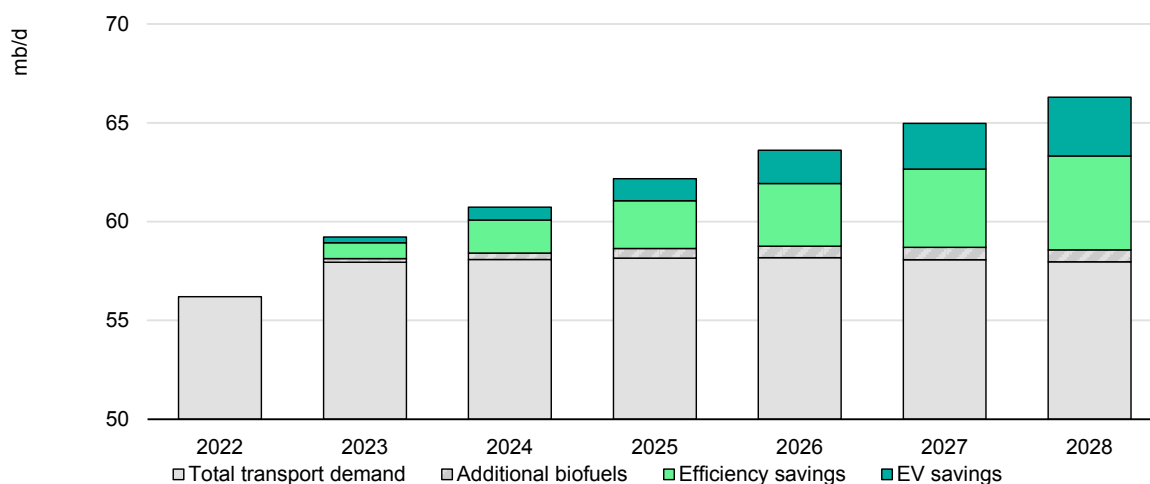
New natural gas and renewable electricity generation capacity will displace fuel oil, gasoil and crude oil consumption in power generation, especially in the Middle East. Several countries in the region, including Saudi Arabia, Kuwait, and Iraq, have ambitious plans to move away from their dependence on oil-fired power plants, which will have a major impact on their domestic demand by 2028.

Lastly, social, political and behavioural changes among consumers will continue to reshape the growth trajectory for oil demand. While significant efforts are already apparent in a number of countries, stronger policies will be required to put oil demand closer to a more sustainable development pathway towards global climate targets.

EVs and efficiency gains curb road use of oil

Road transport fuels, long the backbone of oil demand, will struggle to surpass their pre-crisis peak as energy efficiency improvements and substitution weigh heavily. Efficiency improvements, the transition to electric vehicles and changes in consumer habits will offset part of the impact of economic growth. Additionally, policy changes mean that an increasing share of road fuel demand will be in the form of biofuels, forecast to rise by 600 kb/d by 2028.

New EVs and improved efficiency will avoid 7.8 mb/d of extra oil demand, 2022-2028



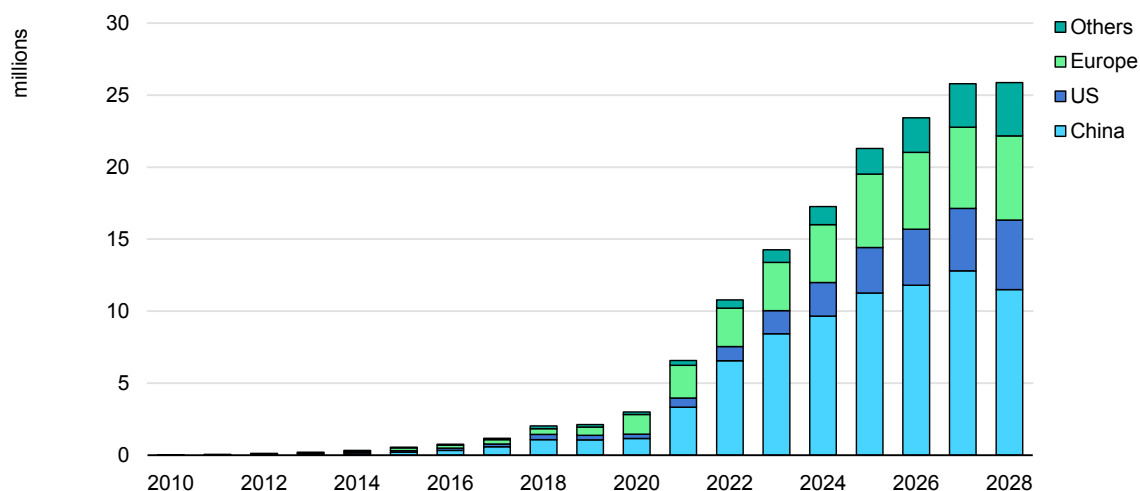
IEA. CC BY 4.0.

EV sales continue to soar

Strong government policy support and a push by the automotive industry to offer more attractive models have led to a rapid increase in sales of electric vehicles. Based on figures from the IEA's [Global Electric Vehicle Outlook 2023](#), EV sales rose from 2 million vehicles in 2018 to 10.8 million in 2022, when one in seven cars sold globally was electric. This trend is set to continue with our projections assuming that by 2028 more than one in four new cars will be an EV, for total sales of 25.9 million.

At the start of 2023, there were around 28 million electric cars on the road worldwide. New sales in 2023-24 are expected to exceed this level and by the end of 2028 more than 155 million EVs will have been sold. This will displace 2.3 mb/d of incremental gasoline use and 630 kb/d of diesel demand during this forecast. More than half of these cars will be sold in China.

Global annual EV sales by country/region, 2010-2028



IEA. CC BY 4.0.

Note: EV sales include battery electric vehicles and plug-in hybrids.

Source: IEA, [Global Electric Vehicle Outlook 2023](#).

Indeed, this precipitous climb has been principally a Chinese phenomenon. There, electric car sales reached 6.6 million in 2022, up six-fold compared with 2019. Due to the Covid-19 crisis, the government extended some subsidies for EVs in 2021 and 2022. While these national incentives are now weakening, this should not stop the continued advance of electric vehicles. New model offerings and local measures in favour of EVs (local subsidies, no city-level purchase limitations) will support sales in the coming years. New sales after 2022 alone will enable China to avoid almost 1 mb/d of gasoline demand growth by 2028.

In Europe, electric car sales rose to 2.7 million in 2022. The surge in EVs entering service was supported by tighter emission standards and purchase subsidies in major markets. Recently adopted EU targets call for all new cars and vans to be zero emissions by 2035. In the United States, EV sales were comparatively small, just shy of 1 million last year, but still three times higher than two years earlier. Strong new tax credits of USD 7 500 per vehicle for consumers as part of the US Inflation Reduction Act (IRA) are set to support this momentum and we expect burgeoning sales of 4.8 million by 2028. The Biden Administration has set a goal of making zero emissions vehicles half of new sales by 2030.

Efficiency gains lead to a significant reduction in road fuel consumption

Efficiency improvements will occur in all transport segments, including road, maritime and aviation. All together, these efficiency gains are expected to reduce growth by roughly 790 kb/d per year over the forecast period, and by 4.8 mb/d in total from 2022 through 2028.

The largest gains will occur in the road transport sector, where ICE vehicles will, despite the surge in EV sales, comprise the majority of vehicles sold throughout the forecast period. Therefore, a continuation of the progress seen in recent years will be essential to constrain demand.

Europe is particularly advanced in terms of environmental regulations. While EVs are key to meeting emission standards, efficiency improvements in ICE vehicles will also contribute. The current EU standard is 95 grams of CO₂ per kilometre (g/km) for new passenger cars and has applied to all new cars since 2021. Under plans adopted in March 2023, vehicular CO₂ emissions would decline by 55% relative to 2021 by 2030. A substantial share of this target will be met by increasing sales of full EVs, but improving efficiency of ICE vehicles and non-plug-in hybrids will also be necessary. Furthermore, the European Union has brought forward proposals to tighten standards for heavy-duty vehicles (HDVs) such as trucks and buses. Notably, these would increase the desired emissions reduction relative to 2019 from 30% to 45%.

In the United States, the Biden Administration raised fuel standards in December 2021, reversing an earlier decision to ease regulations. A March 2022 rule increased industry-wide standards from 2024 onwards, to reach 49 miles per gallon by 2026, with 8% annual improvements in 2024 and 2025, and 10% in 2026. Subsequent proposals, currently under consideration, would target a CO₂ emissions reduction to 73/km by 2028.

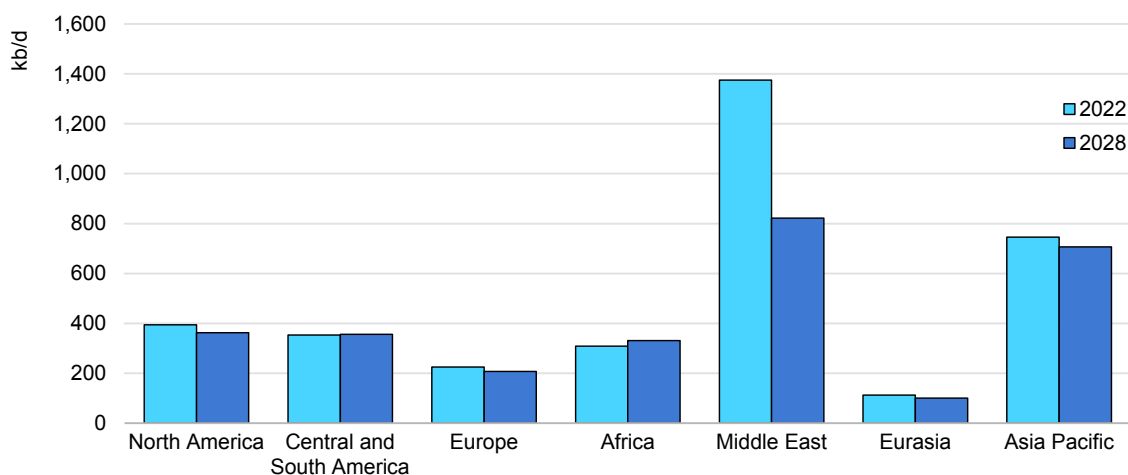
China and India also have ambitious targets. India wants to achieve 110 g CO₂/km for new cars in 2022-23, corresponding to a reduction of 3% per year in oil consumption. Chinese Phase V passenger car fuel consumption standards, published at the end of 2019, lowered fuel use for new vehicles to 4 litres per 100 kilometres (L/100km) by 2025 from 5 L/100km for 2020 under Phase IV. In 2019, Japan approved a tightening of light vehicle standards through 2030, requiring fuel consumption of 3.95 L/100 km by 2030, or an improvement of 32% versus average 2016 levels.

While strong gains in vehicle efficiency have contributed significantly to mitigating road fuel use, these benefits were dampened by the parallel increase in the sales of SUVs. By 2022, SUV sales accounted for 46% of total global car and van sales. In 2011, this stood at about 20%. The growth of SUVs continues to be robust in many countries, including the United States, India and across Europe. In some others, most notably China, the share of SUVs is stagnating, mainly driven by the big rise of smaller battery-powered electric cars.

Renewables and gas to cut oil used in Middle Eastern power generation

Oil use in power generation has steadily declined in recent years, to an estimated 3.5 mb/d in 2022. Unsurprisingly, given its massive hydrocarbon resources, the Middle East has the highest volume of oil used for electricity generation globally, at an estimated 1.4 mb/d in 2022. In the same year, Europe used 220 kb/d, North America 390 kb/d, Latin America 350 kb/d, Asia Pacific 750 kb/d, Africa 310 kb/d and Eurasia 110 kb/d.

Oil use in power generation by region, 2022-2028



IEA. CC BY 4.0.

Several Middle Eastern countries have plans to reduce or eliminate the use of oil in their power sector over the medium term, largely by way of developing natural gas, nuclear, coal and renewable capacities. Countries may struggle to phase out oil entirely due to the pronounced seasonality of electricity demand, which peaks during the summer. A case in point was the extreme mid-2022 heatwave in the Middle East, which stressed power grids across the Gulf region. In another defining characteristic of 2022, the unprecedented surge in volatility in energy prices in the wake of Russia's invasion of Ukraine made for enormous sudden changes in the relative economics of burning natural gas versus oil.

In 2021, Saudi Arabia used 420 kb/d of crude oil, 30 kb/d of gasoil and 290 kb/d of fuel oil in electricity generation. These volumes are comparable to pre-pandemic levels. The country has plans to generate its electricity only from natural gas (50%) and renewables (50%) by 2030, eliminating oil from the power fuel mix. The first of three phases of the Saudi National Renewable Energy Program (NREP) is targeted by the end of 2024 (4.87 GW capacity), generating 15.1 TWh and displacing roughly 70 kb/d of oil, according to Saudi government figures. Saudi

Aramco estimates that substitution by natural gas will eventually displace 500 kb/d of oil demand, mainly in the power sector.

Iraq, too, has ambitious plans that could lead to the displacement of oil in the power sector. In 2020, the country used 140 kb/d of crude oil, 30 kb/d of fuel oil and 15 kb/d of gasoil in power generation. The oil and electricity ministries aim to add 12 GW of renewable power by 2030. Iraq also plans to add 2.5 Bcf/d gas processing capacity by 2027 (in addition to the current 1.5 Bcf/d). The Kurdistan Regional Government (KRG) has started the construction of two large gas pipelines designed to increase the volume of gas available for the power sector.

Kuwait opened its first fixed LNG import facility in mid-2021. The Al Zour LNG terminal is designed to import 22 Mt of LNG per year. Kuwait also plans to develop 3.5 GW of renewable capacity by 2030 and to progressively replace oil-fired capacity with natural gas in the coming years.

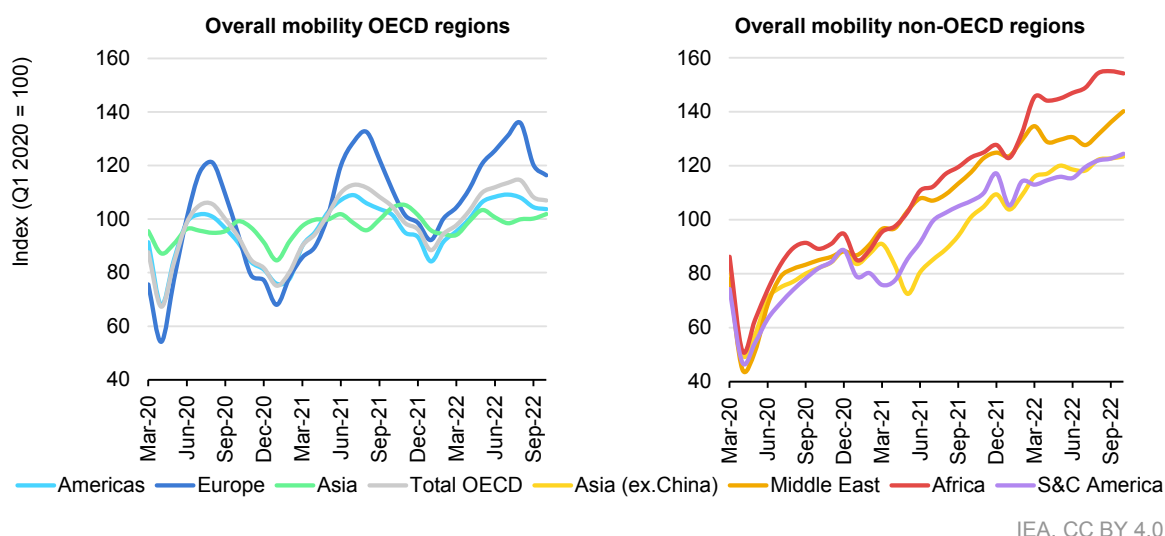
Overall, we project the use of oil in the power sector in the Middle East to fall by 550 kb/d over the forecast period to 820 kb/d in 2028. More than half (280 kb/d) of this decline will be in direct use of crude oil, with the remaining decrease roughly evenly divided between fuel oil and gasoil. Most regions will maintain oil-fired capacity for flexibility to meet peak demand.

Oil demand in the power sector in other regions will record only minor changes. It is projected to increase marginally in Africa, to decline slightly in North America, Europe, Asia Pacific and Eurasia, and to remain largely unchanged in Latin America. Fuel oil and gasoil use in power generation appears to have increased in several Asian and European countries in 2022 due to the high price of natural gas. An unusually warm European 2022-23 winter and weaker prices for competing fuels led to a reversal of the trend during the second half of the year and into 2023.

Covid-era behavioural changes alter mobility trends

Observed through the narrow frame of oil demand, among the most persistent changes wrought by the Covid-19 pandemic will be those impacting patterns of mobility. Overall activity levels have mostly returned to pre-pandemic norms, especially the changes resulting from public health regulations, with mobility measures typically rebounding swiftly once restrictions were removed. Nevertheless, some impacts of Covid-19 disruptions to behaviour are likely to be more permanent and the composition of mobility differs from pre-pandemic trends.

OECD and non-OECD mobility indexes, March 2020 to October 2023



IEA. CC BY 4.0.

Among the more lasting developments is the increasing prevalence of various forms of teleworking and video conferencing at the expense of business travel. Following the onset of the pandemic, the number of people working at home increased dramatically. The International Labour Organization (ILO) estimated that the share of global workers who performed paid work in their homes more than doubled from 8% in 2019 to 17.5% in 2020.

However, this pattern was not evenly distributed across sectors and countries. In large part, this reflects the fact that some jobs – particularly knowledge-intensive service sector jobs – are more easily performed remotely than others. We expect this to result in significant geographical differences in teleworking in the future, with the impact on oil demand largely concentrated in OECD countries.

Working from home remains relatively more common in the United States, where hybrid working has effectively become the new normal. US office occupancy remained around half of pre-pandemic levels in early 2023, compared to about 80% for Europe and 90% for Asia, according to property services firm JLL. Less than half of US companies require employees to be in the office full time. A red-hot job market, with near-record low unemployment, has leveraged employees' bargaining power, while relatively long US commutes compared to other countries make for a greater incentive to work remotely.

This development has caused US work-related mobility to decouple from macroeconomic indicators. Although growth in vehicle miles travelled has lagged national GDP growth for decades, the two moved relatively in tandem in pre-pandemic years, with miles rising 10% between 2012 and 2019, and GDP increasing 17%. Following the pandemic, however, US GDP in 2022 rebounded to 5% above pre-pandemic levels while vehicle miles remained about 1% below

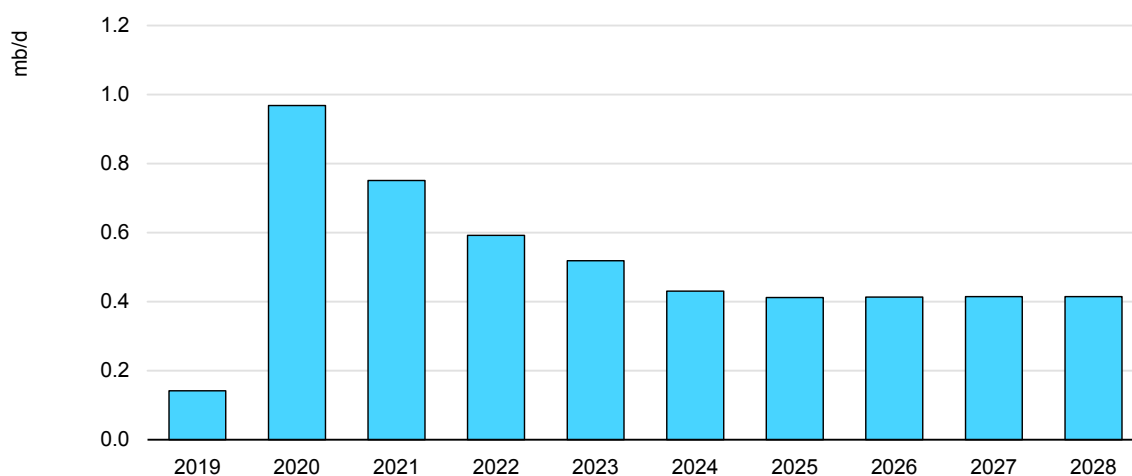
2019 levels. A similar, less pronounced disparity is apparent for total US employment, which has also recovered above 2019 levels.

This slowdown in work-related mobility has stymied gasoline's demand recovery, reinforcing the ongoing downward pull of vehicle efficiencies and the electrification of driving. US gasoline consumption in 2022 averaged 95% of 2019 levels. Conversely, gasoline demand in OECD Europe, where working from home has found less acceptance, has returned to 2019 levels.

A recent analysis on the [Uptake and Inequality of Telework](#) by think tank Bruegel showed an average of 24% among EU workers teleworking in 2021. However, significant differences existed between the level of remote working in member states and between different types of jobs. In general, more highly paid jobs tended to have a higher degree of telework.

We expect that the impact on oil demand of these trends will gradually ease through 2024 but then plateau for the remainder of the forecast period, falling from a peak of around 1 mb/d in 2020 to 400 kb/d over 2025-28. Among those for whom teleworking is a practical option, this would be equivalent to roughly two days per week at home.

Estimated teleworking impact on oil demand, 2019-2028



IEA. CC BY 4.0.

Data from multiple major cities and national governments reveal that in some cases usage rates on public transport have been particularly slow to recover, even as Covid-19 restrictions were relaxed. This was likely driven by health concerns about entering crowded public spaces, as well as by a change in the types of journeys being made.

Public transport's lacklustre recovery occurred amid a general improvement in mobility statistics, implying that activity has shifted towards other forms. Extensive

data are available for transport in London, based on passenger declarations by Transport for London (TfL) and UK government traffic camera information. Bus and metro journeys, having fallen to roughly half of 2019 levels in 2020 and 2021, remained 24% below pre-pandemic levels during 2022, a year not affected by lockdown restrictions. Conversely, journeys by automobile fell less sharply than those by public transport following initial Covid-19 outbreaks, with average 2022 London car traffic settling about 25% above March 2020 levels.

This pattern appears to have been replicated elsewhere. According to German Federal Statistics Office data, while ridership recovered by 29% y-o-y to nearly 10.2 billion, average 2022 rail and bus passenger numbers remained 14% lower than in 2019. Over the same period, long-distance road journeys went up by 2.7%. In a demonstration of the potential for governments to shape these trends, German public transport was heavily subsidised during June-August 2022. In these months, long journeys by rail increased by about 40%.

China is the key exception to this pattern, as public transport use in Chinese cities rebounded to its pre-pandemic level within weeks of the December 2022 reopening, making for a much faster and more complete recovery than cities in major Western countries.

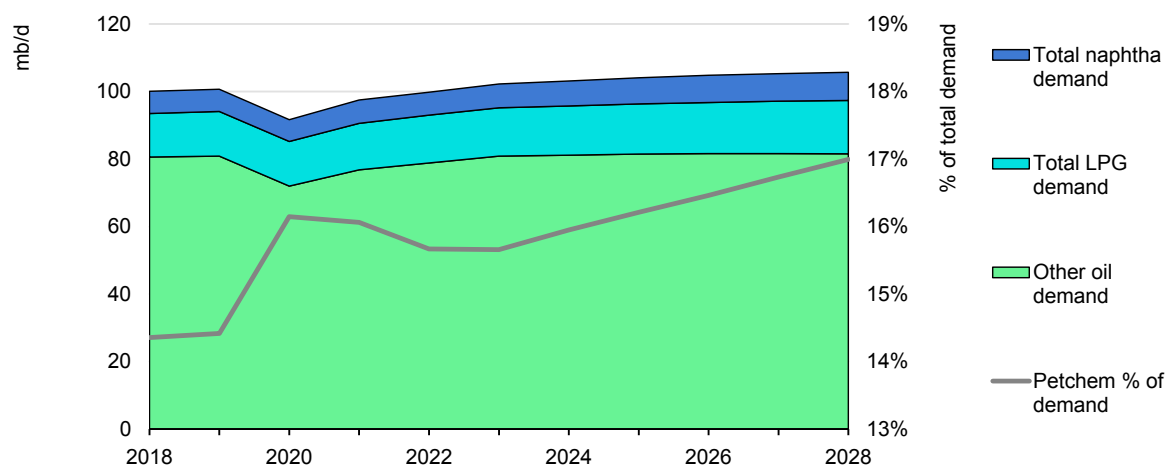
This disparity means that road fuels (in particular gasoline) received exceptional support in cities that usually rely on public transport. However, we expect this to unwind further over the forecast period, contributing to the weaker outlook for road fuel demand.

Petrochemicals power ahead, China takes centre stage

The continued expansion of the petrochemical industry and its consumption of feedstocks provide the single largest contribution to oil demand growth over the forecast period. Chemical feedstocks will account for 2.3 mb/d (+390 kb/d per year) or about 40%, of total oil demand growth from 2022 to 2028.

In contrast to all the other major oil demand sectors, petrochemicals performed strongly throughout the Covid-19 pandemic. Between 2019 and 2022, oil products used as a chemical feedstock for light olefins (ethylene and propylene) and aromatics (benzene, toluene and xylene) grew by about 1 mb/d. Overall oil demand fell by 860 kb/d in the same period.

World oil demand and petrochemical sector contribution



IEA. CC BY 4.0.

Polymers, comprising the largest end use for petrochemicals by volume, are especially concentrated in everyday household consumption. As a result, demand for polymers was comparatively insulated from the impact of public health measures and government policies. Furthermore, the Covid-19 public health crises led to an exceptional rise in demand for plastics in disposable medical items and packaging for increased home deliveries of meals and consumer goods.

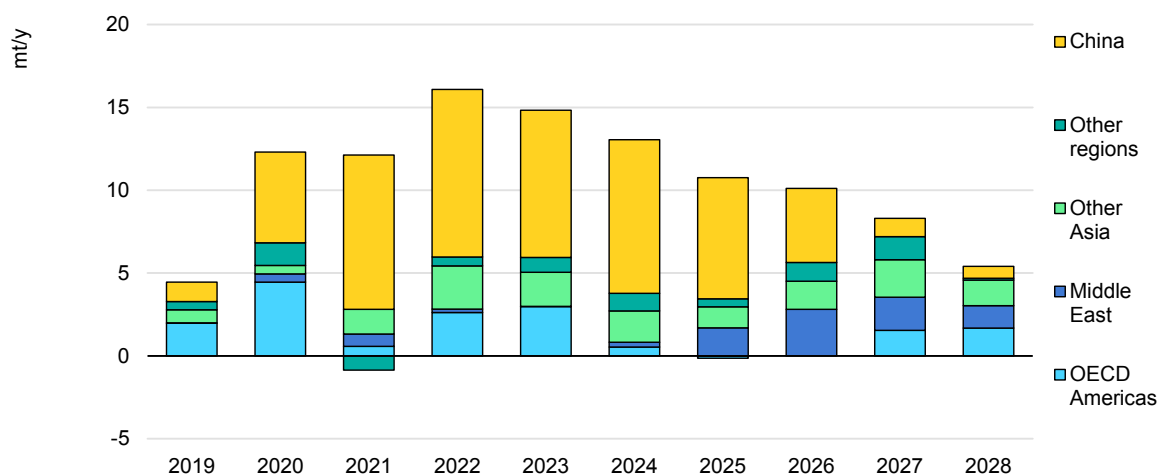
During 2021, feedstock requirements surged at their fastest rate since 2010 (+860 kb/d, 5.9% y-o-y), as manufacturing and construction activity gained momentum and with much of the novel demand of 2020 persisting. An explosive increase in petrochemical capacity, especially in China, helped to accommodate this upsurge in demand. The pace of additions hastened in 2022, with the year setting a record for new olefins capacity at slightly over 16 Mt/yr (+7.5% y-o-y). At the same time, growth in demand for petrochemicals slowed as exceptional use subsided and industrial activity slackened (especially in Europe, where producers suffered from elevated energy costs). Global feedstock requirements grew by a comparatively modest 100 kb/d (+0.7%) during 2022 with the slump in operating rates uneven across different regions. OECD European naphtha consumption collapsed by 13.7% y-o-y, while OECD Asia Oceania saw a fall of 4.6%. By contrast, Chinese naphtha use increased by 15.2% and LPG by 8.9%.

Massive Chinese investments reshaping world markets

New petrochemical plants are heavily concentrated in China, which will account for 51% of all new olefin capacity and 48% of incremental oil-based olefins feedstock consumption during the 2022-28 period. Overall naphtha use is set to rise by 1 mb/d from 2022 by 2028 (170 kb/d per year) and LPG by 530 kb/d (90 kb/d per year), together accounting for 54% of Chinese oil demand growth.

Chinese additions between 2019 and 2025 are set to be larger than the total capacity of existing OECD European and Asia Oceanian petrochemical plants. This will have a major impact on the distribution of petrochemical activity and oil consumption for feedstock throughout our forecast period. China's share of global olefins feedstock demand will grow from 14% in 2019 to almost 26% by 2025 and will remain close to this level to 2028.

Annual olefins oil-based capacity change, (primary output), 2019-2028



Note: Includes steam cracker (ethylene) and propane dehydrogenation (propylene) capacity.

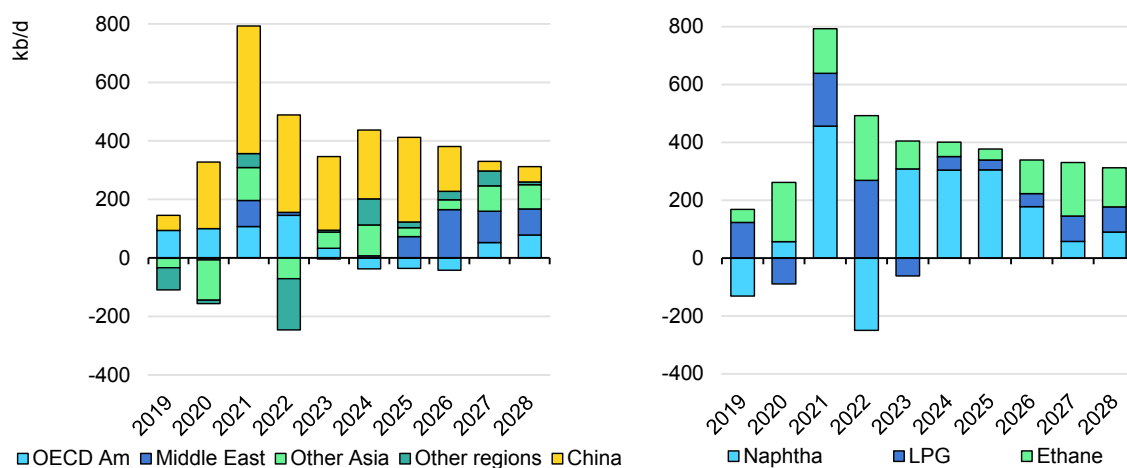
IEA. CC BY 4.0.

Prior to 2020, there was little growth in global naphtha feedstock requirements, with total use declining by 280 kb/d from 2017 to 2020. Almost all growth in olefin feedstock consumption over this period was for ethane from NGL extraction (580 kb/d over the same period). However, most new Chinese capacity is coming in the form of naphtha crackers. These, in addition to a handful of other major naphtha cracker developments, will change the products' fortunes. Overall, 2028 naphtha demand will be 1.7 mb/d above its pre-pandemic level (+190 kb/d per year), driven by higher demand from chemical plants. Ethane use in steam crackers will increase and approach 1 mb/d (110 kb/d per year) over the same period and the volume of (LPG) used in crackers and propane dehydrogenation (PDH) units will climb by 600 kb/d (+70 kb/d per year). This means that the rapid decline in naphtha's share of olefin feedstock ended before the start of the pandemic and will register a modest recovery by the mid-2020s, before edging downwards again, staying close to 45% of the total.

These changes are principally the result of the patterns of investment by chemical producers. While Middle East and US plants based on cost-advantaged ethane were emblematic of the previous investment wave (2014-18), the 2020-24 period features a large number of naphtha crackers, integrated to refineries that are optimised to produce substantial volumes of petrochemical feedstocks. New

ethane-processing units will continue to come into service throughout the forecast period, based on local NGLs availability, especially in locations like the Middle East and the United States, and on imported US cargoes in China and Western Europe.

Annual change in oil-based olefins feedstock use by region and by product, 2019-2028



IEA. CC BY 4.0.

The addition of such a large amount of capacity in just a few years will comfortably outpace growth in end-user demand and lead to a shift in patterns of feedstock consumption. The capacity to produce ethylene from steam cracking will grow by an annual average of 7.8 Mt/yr from 2018 to 2028, while we expect ethylene demand to expand by 4.6 Mt/yr over the same period. Much of this new capacity is substituting for imports of base chemicals and commodity polymers, especially in China, meaning that exporters need to compete for alternative markets. Producers in relatively less cost-advantaged areas, particularly Europe and East Asia excluding China, face increasing pressure requiring cuts in operating rates and raises the spectre of plant closures. Many East Asian producers have either historically exported to China or present attractive targets for displaced exports from other regions. European plants are somewhat older and smaller than in other regions and high energy costs have weakened important segments of downstream demand. They may prove vulnerable to US and Middle Eastern exporters. Petrochemical feedstock consumption began what we expect to be a sustained geographical shift in 2022, with China gaining and most other regions losing share.

Petrochemical feedstock demand will also grow strongly over the forecast period in the Middle East, by an annual average of 70 kb/d, and Eurasia (30 kb/d). Most new plants in these regions will be based on ethane and LPG. In Russia, major new units have been planned, connected to developments in natural gas capacity.

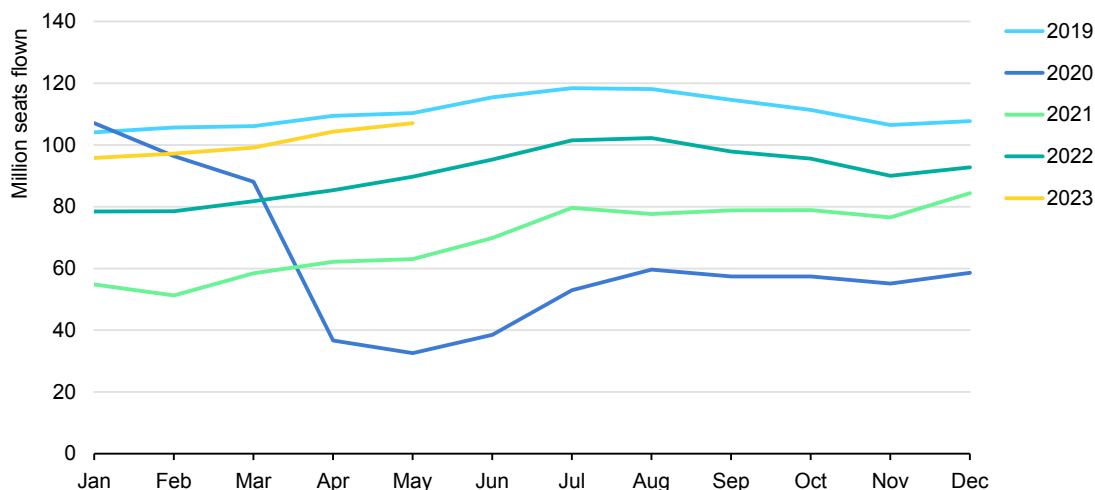
However, these face delays related to uncertainty on project financing and the withdrawal of international technology providers. We assume that only some of expected units will be completed during our forecast period, modestly increasing Russia's share of global feedstock consumption from 2.4% in 2022 to 2.9% in 2028.

Aviation and marine demand growth resumes

Jet fuel provides largest increase in product use by 2028, but only surpasses 2019 levels by 2027

With its profound impact on air travel, the Covid-19 pandemic exerted a heavier toll on jet fuel demand than for any other oil product. Global usage collapsed by 45%, to slightly less than 4 mb/d in 2020 and the recovery from these lows made jet fuel dominate demand gains in 2022 and 2023, and will post the single largest increase by product in the forecast. However, the pace of this bounce is set to slow sharply from 2024 once the resurgence in aviation activity is largely complete and more structural drivers return to the fore. Jet fuel use will go up at an average rate of 150 kb/d a year during 2024-28.

Global air traffic, 2019-2023 (weekly)



IEA. CC BY 4.0.

Source: OAG.

Having stabilised at around half of 2019 capacity flown by 2H20, air traffic staged a robust recovery during 2021, 2022 and the early part of 2023. This rebound appears to be close to completion. The global number of commercial flights now exceeds equivalent 2019 levels, although measures of total seats and miles flown still lag slightly (as smaller aircraft and shorter routes make up a larger share of the total than previously). On average, 2021 jet fuel usage was 63% of 2019 levels.

According to the latest data, this rose to 76% in 2022 and we expect it to be 91% in 2023, with most of the difference being accounted for by improvements in fuel economy since 2019.

Domestic air transportation has recovered faster than international travel, according to [International Air Transport Association](#) (IATA) data. This meant that it rose from 36% of total passenger air traffic in 2019 to 42% by April 2023, having reached 62% in 2021. In April 2023, international revenue passenger kilometres (RPKs) were 16.4% below 2019 levels, while domestic RPKs were up by 2.9%.

The pandemic also played a major role in restructuring the regional distribution of air traffic, which was most constrained where there were the greatest restrictions on travel. As a result, the share of global aviation in the relatively less-impacted Americas rose to 35.2% in April 2023, according to IATA data, compared with 27.5% in 2019. US domestic travel remains steady and flights between the United States and Latin America have increased. Notably, however, there were severe restrictions on international travel to and from China for 2020-22 and domestic flights in the country during the lockdowns of 2022. With restrictions relaxed in late-2022, Chinese domestic flight numbers rapidly returned to 2021 levels and international flights began a more gradual recovery.

International flights involving China and its neighbours now account for the largest incomplete share of the return to 2019 activity. Since China's reopening at the end of 2022, flights to these countries have gradually increased, and we assume that they will return to 2019 levels by 4Q23. This will mark a step change in demand growth from 2024 onwards, with subsequent structural growth highly concentrated in the Asia Pacific region (76% of total 2023-28 jet/kerosene gains) where rising GDP and increasing access to international travel will be sufficient to outweigh improving fuel economy.

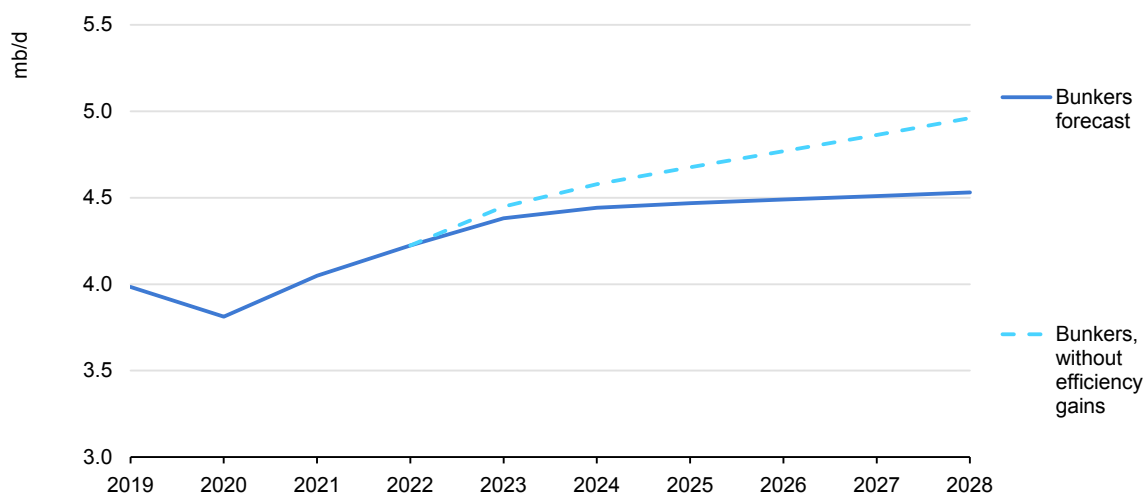
Commercial aircraft now entering service exhibit significantly improved efficiency compared with those they replace. For example, the Airbus 320neo has fuel consumption that is 15% lower than the previous A320 model. Boeing 737 MAX increased their fuel efficiency by 20% and larger planes such as Boeing 787 or Airbus A350 by 25%. Combined with the extent to which the global fleet was renewed over the pandemic years, this means that jet fuel use is unlikely to surpass its 2019 peak until 2027, when demand will exceed 7.2 mb/d. Environmental regulations and commitments, combined with changing consumer behaviour, will also weigh on demand.

Expanding seaborne trade supports marine fuel growth

World bunker fuel consumption is forecast to rise by 300 kb/d by 2028, reaching 4.5 mb/d. Robust growth in trade and seaborne freight will be mitigated by tightening efficiency standards imposed by the IMO.

IMO regulations, designed to reduce carbon dioxide emissions, come into effect in several phases. Phase 1 of the Energy Efficiency Design Index (EEDI), from 2015, required new vessels of the relevant size to produce at least 10% lower CO₂ emissions, relative to the IMO's 2008 baseline. From 2020 Phase 2 increased this to 20% and a 30% reduction will be imposed from the start of 2025 in EEDI Phase 3. Since these rules apply to new vessels, they will take effect gradually as the fleet expands and older vessels are scrapped. Incorporating fleet composition data from the United Nations Conference on Trade and Development (UNCTAD), we forecast that the average gain in fuel efficiency of global shipping could approach 10% during the forecast period, depending on the rate of replacement of older, less-efficient vessels.

International marine bunker demand – impact of efficiency gains, 2022-2028



IEA. CC BY 4.0.

Based on our macroeconomic assumptions and UNCTAD's forecasts, we expect that underlying global demand for seaborne freight will grow by an average of almost 3% per year from 2022 to 2028. This follows a slight increase over the pandemic years (averaging just over 1% per year). In 2020 and 2021, relatively strong demand for moving manufactured goods from exporting regions, especially East Asia, to consumers elsewhere, particularly North America and Europe, and raw materials to manufacturing centres supported global shipping.

A slowdown in trade and changes in the size and composition of the global commercial fleet, combined with the new IMO rules, will limit average marine bunker consumption growth to 1.2% per year from 2022-28 (300 kb/d overall). Without the efficiency improvements mandated by IMO efficiency standards, projected 2028 demand would be more than 400 kb/d higher in 2028.

Demand developments by region

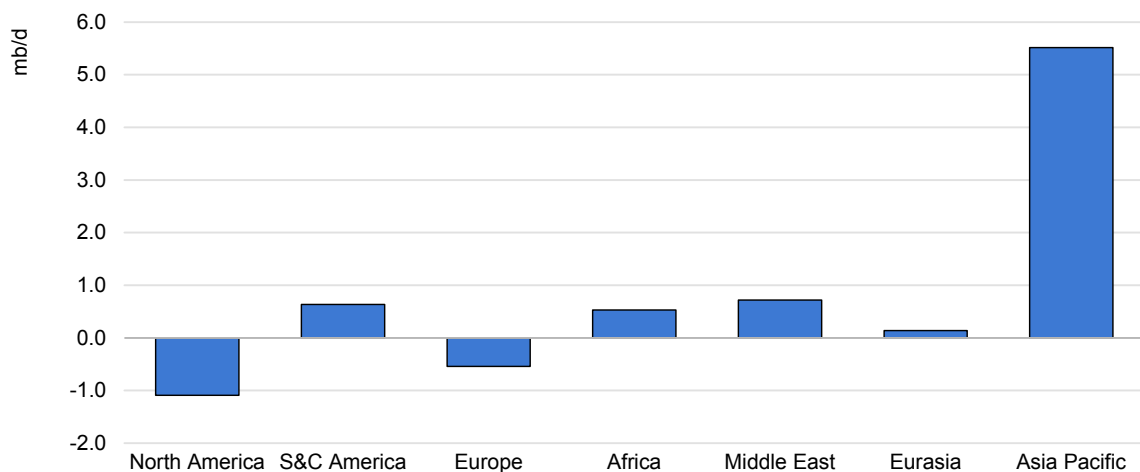
Asia Pacific provides 90% of global demand growth

By far, the largest growth in oil demand will occur in Asia Pacific, amounting to 5.5 mb/d for 2022-28. Regional growth will be supported by increased demand for naphtha and LPG/ethane (+2.2 mb/d), jet/kerosene (+1.3 mb/d) and gasoil (+1.2 mb/d).

Demand in Africa, Eurasia, the Middle East and Latin America will also rise strongly over the forecast period. Combined 2028 oil use in these regions will increase by 1.9 mb/d versus 2022 levels. Petrochemical demand is projected to play a significant role in Middle Eastern growth.

North American demand, by contrast, will plateau in 2023 at 24.7 mb/d, and subsequently decline by 240 kb/d per year on average through 2028. European oil demand, averaging 14.9 mb/d in 2022, will be buttressed by the increase in jet fuel consumption through 2024 before starting an overall decline averaging 120 kb/d annually thereafter. Neither North America nor Europe will return to their 2019 levels.

Global cumulative oil demand growth by region, 2022-2028



IEA. CC BY 4.0.

North American, European oil demand plateaus in 2023-2024, then contracts

Although oil demand rose by a combined 1 mb/d in 2022, growth in Europe and North America will slow to a halt in 2023-24 as higher energy efficiency in the

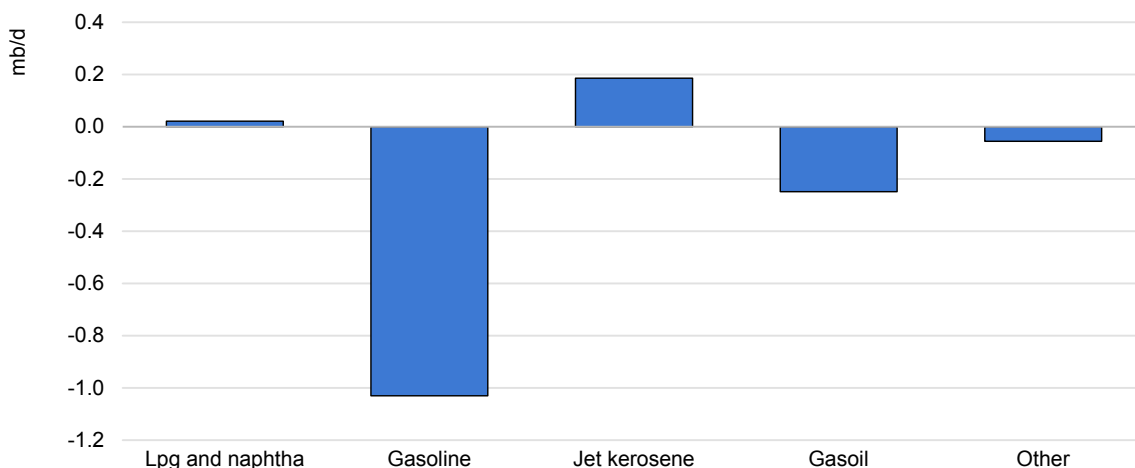
transport sector, penetration of EVs and substitution by other energies curb fuel use. Other factors, such as teleworking and less frequent business travel, will also contribute.

Oil demand by product (mb/d): North America, 2019-2028

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2022-28	
											Growth Rate	2022-28 Growth
LPG/Ethane	3.4	3.5	3.6	3.8	3.8	3.7	3.7	3.7	3.7	3.8	0.1%	0.0
Naphtha	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.7%	0.0
Gasoline	10.9	9.5	10.3	10.3	10.4	10.3	10.1	9.8	9.6	9.3	-1.7%	-1.0
Jet/Kerosene	2.0	1.2	1.5	1.8	1.9	1.9	1.9	2.0	2.0	2.0	1.6%	0.2
Gasoil/Diesel	5.1	4.7	4.9	5.0	5.0	4.9	4.9	4.9	4.8	4.8	-0.8%	-0.2
Residual fuel oil	0.5	0.4	0.5	0.6	0.5	0.5	0.5	0.5	0.5	0.5	-1.7%	-0.1
Other products	2.8	2.6	2.8	2.9	2.9	2.9	2.9	2.9	2.9	2.9	0.2%	0.0
Total products	25.0	22.1	23.9	24.6	24.7	24.5	24.3	24.0	23.8	23.5	-0.8%	-1.1
<i>Annual change</i>	<i>0.0</i>	<i>-2.9</i>	<i>1.8</i>	<i>0.7</i>	<i>0.1</i>	<i>-0.3</i>	<i>-0.2</i>	<i>-0.3</i>	<i>-0.2</i>	<i>-0.2</i>		

North American demand is projected to grow by 100 kb/d in 2023 and subsequently decline. Oil demand will shrink by 230 kb/d per year on average over the 2024-28 period on improved fuel economies in passenger cars supported by government policies. Ethane demand, which grew quickly until 2022, will see this trend resume after 2026 as new capacity comes online. Neither the United States, Canada nor Mexico will see oil demand return to pre-Covid levels. Additionally, demand in each of the three countries reaches a post-pandemic peak in 2023.

North America cumulative oil demand growth by product, 2022-2028



IEA. CC BY 4.0.

Following a projected increase of 50 kb/d in 2023, European oil consumption is expected to decline by an average of 120 kb/d per year from 2024. By 2028, European oil demand will be 1.4 mb/d below its 2019 level. Gasoil use is seen falling from 2022 onwards, while gasoline growth begins to decline from 2023 as rising EV sales and efficiencies undermine demand.

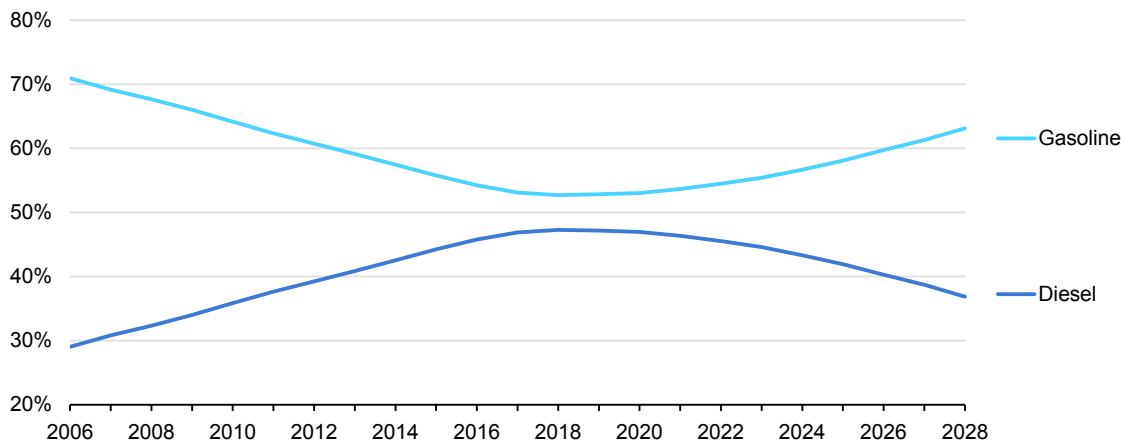
Oil demand by product (mb/d): Europe, 2019-2028

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2022-28 Growth Rate	2022-28 Growth
LPG/Ethane	1.3	1.2	1.2	1.1	1.2	1.2	1.2	1.2	1.2	1.2	1.2%	0.1
Naphtha	1.1	1.1	1.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	-0.3%	0.0
Gasoline	2.3	2.0	2.2	2.3	2.3	2.3	2.2	2.2	2.1	2.1	-1.3%	-0.2
Jet/Kerosene	1.6	0.8	0.9	1.3	1.5	1.5	1.5	1.6	1.6	1.6	3.0%	0.3
Gasoil/Diesel	7.1	6.5	6.8	6.8	6.7	6.5	6.4	6.3	6.2	6.1	-1.9%	-0.7
Residual fuel oil	1.0	0.8	0.9	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0%	0.0
Other products	1.4	1.4	1.3	1.3	1.3	1.3	1.3	1.3	1.4	1.4	0.4%	0.0
Total products	15.7	13.7	14.5	14.9	14.9	14.8	14.7	14.6	14.5	14.3	-0.6%	-0.5
<i>Annual change</i>	<i>0.0</i>	<i>-2.0</i>	<i>0.8</i>	<i>0.4</i>	<i>0.1</i>	<i>-0.1</i>	<i>-0.1</i>	<i>-0.1</i>	<i>-0.1</i>	<i>-0.2</i>		

The drop in gasoil demand is larger than the reduction in gasoline due to efforts to displace heating oil and a shift to gasoline engine cars from diesel.

The share of gasoline cars in total ICE car sales grew from 63% in 2020 to 69% in 2022, while diesel's share went down from 37% to 31%, according to the [European Automobile Manufacturers' Association](#). The total gasoil fleet plateaued at 48% in 2018 and should shrink to 35% by 2028. Jet fuel demand grows through the end of the forecast period, approaching but not attaining pre-Covid levels.

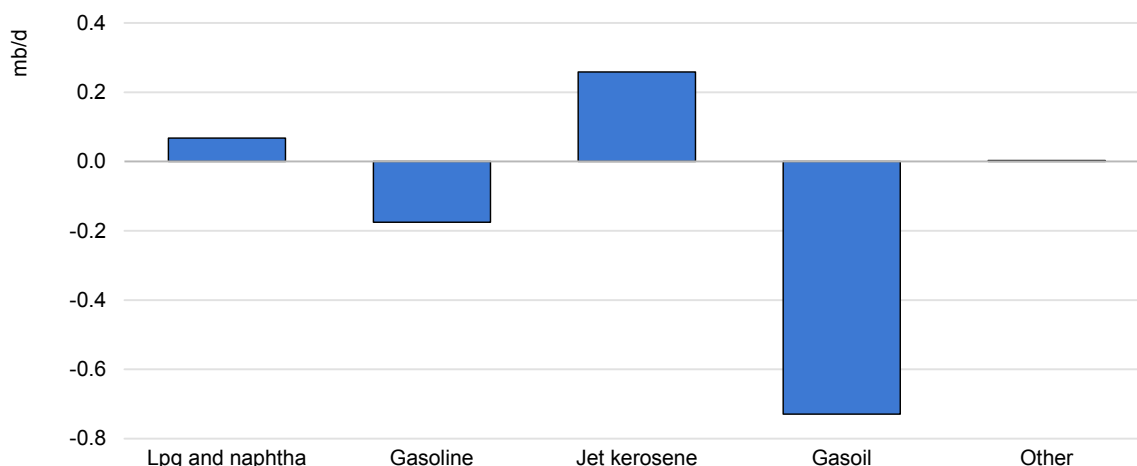
Gasoline versus diesel in European ICE car fleet, 2006-2028



IEA. CC BY 4.0.

In 2028, European and North American oil demand will be 1.4 mb/d and 1.5 mb/d lower than in 2019, respectively.

Europe cumulative oil demand growth by product, 2022-2028



IEA. CC BY 4.0.

Asia and most emerging economies to post strong growth

In Asia Pacific (including OECD Asia Oceania), demand will rise by 5.5 mb/d during 2022-28, representing about 90% of the total world growth. As in other regions, transport fuels lead the gains in the initial stages of the recovery. Overall demand first exceeds its pre-pandemic level in 2023.

Oil demand by product (mb/d): Asia Pacific, 2019-2028

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2022-28	
											Growth Rate	2022-28 Growth
LPG/Ethane	4.4	4.4	4.6	4.9	5.1	5.2	5.4	5.5	5.6	5.7	2.5%	0.8
Naphtha	4.5	4.5	4.8	4.9	5.2	5.5	5.8	6.0	6.1	6.3	4.2%	1.4
Gasoline	7.5	7.0	7.5	7.5	7.8	7.9	8.0	8.0	7.9	7.9	1.0%	0.4
Jet/Kerosene	2.9	1.9	1.8	1.9	2.5	2.8	2.9	3.0	3.1	3.2	9.2%	1.3
Gasoil/Diesel	9.3	8.6	9.0	9.4	9.7	9.9	10.1	10.2	10.4	10.5	2.0%	1.2
Residual fuel oil	2.4	2.4	2.5	2.6	2.7	2.7	2.7	2.7	2.7	2.7	1.0%	0.2
Other products	4.9	5.3	5.4	4.8	4.8	4.8	4.9	4.9	5.0	5.0	0.9%	0.3
Total products	35.9	34.0	35.7	35.8	37.8	38.8	39.7	40.3	40.9	41.3	2.4%	5.5
<i>Annual change</i>	0.5	-1.9	1.7	0.2	2.0	1.0	0.9	0.7	0.5	0.5		

China will continue to account for around one-sixth of world oil demand and half of global oil consumption growth, as its use expands by 2.9 mb/d between 2022 and 2028. However, this increase is heavily front-loaded: after a massive 1.5 mb/d rebound post-lockdowns in 2023, oil demand growth decelerates to roughly 290 kb/d y-o-y on average from 2024 to 2028.

This slowdown corresponds with China's economy proceeding along a path of structurally lower GDP growth as its era of double-digit economic expansion now having conclusively ended. Its present target of 5% per year stands in marked

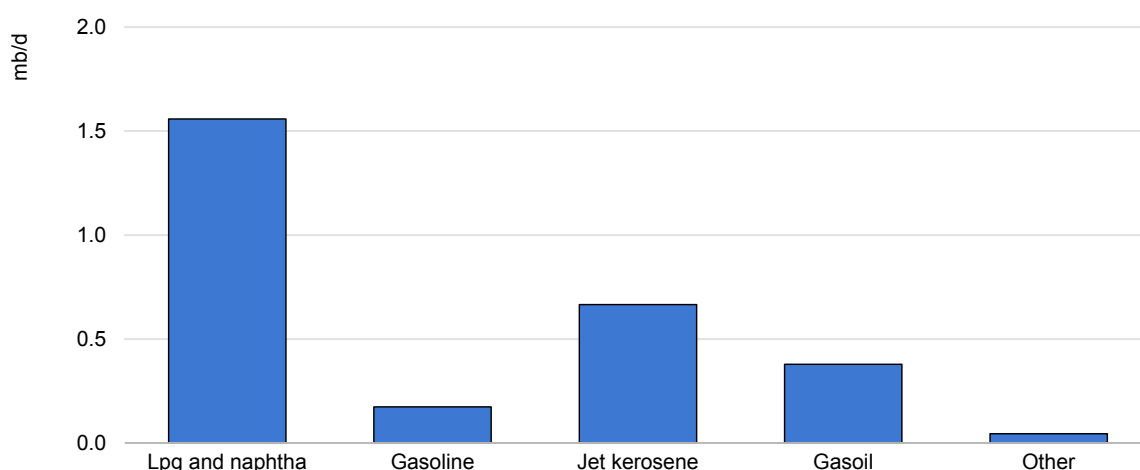
contrast to the average 9% since the country embarked on its shift from a planned to a market economy in 1978. GDP growth is set to decelerate further towards 4% at the end of the forecast period.

Oil demand by product (mb/d): China, 2019-2028

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2022-28	
											Growth Rate	2022-28 Growth
LPG/Ethane	1.8	1.8	1.9	2.1	2.3	2.4	2.5	2.5	2.6	2.6	3.8%	0.5
Naphtha	1.4	1.5	1.6	1.8	2.1	2.3	2.6	2.8	2.8	2.8	7.8%	1.0
Gasoline	3.4	3.2	3.5	3.4	3.7	3.7	3.7	3.6	3.6	3.5	0.8%	0.2
Jet/Kerosene	0.9	0.8	0.8	0.6	0.9	1.0	1.1	1.1	1.2	1.2	13.9%	0.7
Gasoil/Diesel	3.2	3.0	3.2	3.3	3.6	3.6	3.7	3.7	3.7	3.7	1.8%	0.4
Residual fuel oil	0.4	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6	1.2%	0.0
Other products	3.0	3.5	3.5	2.9	2.9	2.9	2.9	2.9	3.0	3.0	0.6%	0.1
Total products	14.1	14.3	15.1	14.7	16.1	16.6	17.0	17.3	17.5	17.6	3.1%	2.9
<i>Annual change</i>	<i>0.5</i>	<i>0.1</i>	<i>0.8</i>	<i>-0.4</i>	<i>1.5</i>	<i>0.5</i>	<i>0.4</i>	<i>0.3</i>	<i>0.1</i>	<i>0.1</i>		

Demographics are at the heart of this downturn. China's population declined in 2022 after decades of slowing birth rates. This development shrank the vast labour pool underlying the low-cost manufacturing model that fuelled the 1990-2010 economic boom. Propelled by debt-fuelled infrastructure investment, the country is still coming to terms with the era's legacy of overleveraged corporations and local governments, misallocated capital, and a massive property slump.

China cumulative oil demand growth by product, 2022-2028



IEA. CC BY 4.0.

Beijing's attempts to pivot from an economic model driven by construction and manufacturing to one led by services emerged in 2023 as consumption of the retail-oriented fuels gasoline and jet/kerosene benefits from rebounding mobility. By contrast, gasoil use is depressed by a global manufacturing slump. In addition, the policy shift is reflected in changes in the demand product mix over the entire forecast period. Gasoil, linked to industrial use, will see its share drop by two

percentage points to 21% between 2022 and 2028, while retail-driven jet/kerosene will rise by three points to 7%. Conversely, gasoline's share will fall by 3% to 20% as vehicle electrification outweighs the 2023 post-lockdown release of pent-up travel demand.

Lastly, the petrochemical sector will see the largest relative increase, as LPG/naphtha's share rises by four percentage points to 31%. The sector benefits from a policy prioritisation of economic self-sufficiency amid escalating geopolitical tensions, with China aiming to reduce its reliance on polymer imports by greatly expanding its petrochemical capacity.

Oil demand by product (mb/d): India, 2019-2028

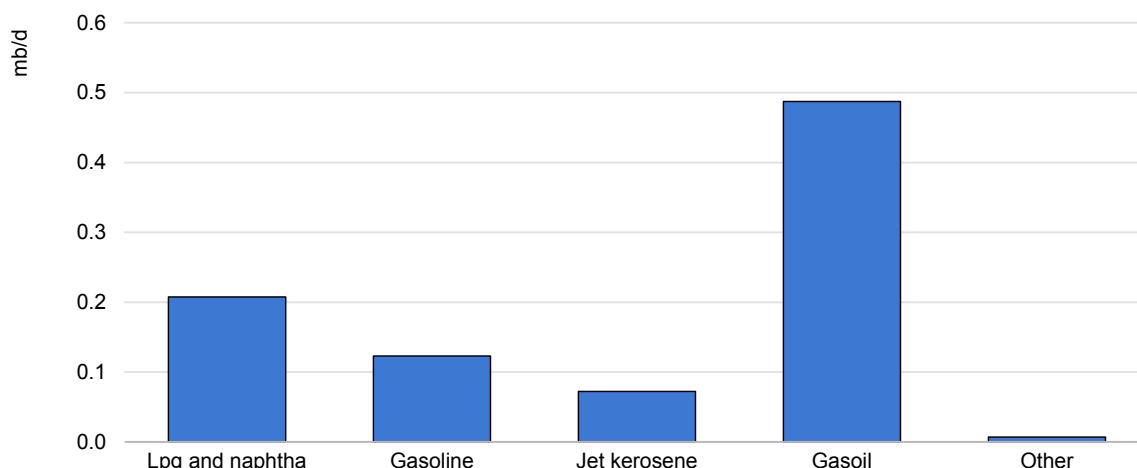
	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2022-28	
											Growth Rate	2022-28 Growth
LPG/Ethane	0.8	0.9	0.9	0.9	0.9	1.0	1.0	1.0	1.0	1.0	2.1%	0.1
Naphtha	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4	4.3%	0.1
Gasoline	0.7	0.7	0.8	0.9	0.9	0.9	1.0	1.0	1.0	1.0	2.2%	0.1
Jet/Kerosene	0.2	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	6.3%	0.1
Gasoil/Diesel	1.6	1.5	1.5	1.7	1.8	1.9	1.9	2.0	2.1	2.2	4.3%	0.5
Residual fuel oil	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.6%	0.0
Other products	1.1	1.0	1.0	1.1	1.1	1.2	1.2	1.2	1.2	1.3	1.6%	0.1
Total products	5.0	4.6	4.9	5.3	5.5	5.6	5.8	6.0	6.1	6.3	3.0%	1.0
<i>Annual change</i>	<i>0.0</i>	<i>-0.4</i>	<i>0.3</i>	<i>0.4</i>	<i>0.2</i>	<i>0.2</i>	<i>0.2</i>	<i>0.1</i>	<i>0.2</i>	<i>0.2</i>		

India is set to overtake China in terms of global y-o-y oil demand growth in 2027. The fastest-growing economy in the world, with GDP growth averaging 6.9% for 2024-2028, is aided by benign demographics. India surpassed China to become the world's most populous country in 2023. Although its rate of expansion has been slowing for decades, population growth will likely not peak until 2065.

Further propelled by trends such as urbanisation, industrialisation, and the emergence of a wealthier middle-class keen for mobility and tourism, Indian oil demand will grow by more than 1 mb/d between 2022 and 2028. Gasoil, the main fuel by far, will see its share of the product mix climb from 32% to 35% over the forecast period.

Activity and trade in the rest of Southeast Asia are set to benefit from India's upbeat economic prospects. Malaysia and Indonesia, key Indian trading partners, are seeing similar increases in oil consumption to India's, of about 20% between 2022 and 2028.

India cumulative oil demand growth by product, 2022-2028



IEA. CC BY 4.0.

Growth will remain muted in Central and South America amid slowing economic activity, with Brazil, where annual demand growth decelerates from around 70 kb/d in 2022-24 to 20 kb/d in 2028 a case in point. GDP growth in Brazil, responsible for almost half of Latin American oil demand, will recover somewhat from anaemic levels in 2023 towards 2% at the end of the forecasting period. Still, the country's economic performance is relatively lacklustre, mirroring the entire region, especially in comparison to Africa and Asia. Low productivity and high unemployment make for a subdued economic outlook, while elevated inflation and strained public finances limit the scope for monetary or fiscal stimulus. We project total Central and South America demand to be 640 kb/d above 2022 levels by 2028.

Oil demand by product (mb/d): Central and South America, 2019-2028

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2022-28	
											Growth Rate	2022-28 Growth
LPG/Ethane	0.6	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	1.6%	0.1
Naphtha	0.2	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1%	0.0
Gasoline	2.0	1.7	1.9	2.0	2.0	2.0	2.1	2.1	2.1	2.1	1.5%	0.2
Jet/Kerosene	0.3	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	4.1%	0.1
Gasoil/Diesel	2.3	2.1	2.3	2.4	2.4	2.5	2.5	2.5	2.6	2.6	1.4%	0.2
Residual fuel oil	0.5	0.4	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.6	1.9%	0.1
Other products	0.7	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	1.0%	0.0
Total products	6.7	5.8	6.4	6.6	6.7	6.8	6.9	7.0	7.1	7.2	1.5%	0.6
<i>Annual change</i>	<i>0.0</i>	<i>-0.9</i>	<i>0.6</i>	<i>0.2</i>	<i>0.1</i>	<i>0.1</i>	<i>0.1</i>	<i>0.1</i>	<i>0.1</i>	<i>0.1</i>		

African oil demand in 2028 will be 530 kb/d higher than in 2022 as GDP growth, buttressed by the continent's rapidly expanding population, exceeds 3% on average over the forecast period. This results in steady gains in road transport fuels. Africa's oil use is heavily skewed towards gasoil (making up 40% of total consumption) as use of diesel generators remains widespread amid limited access to reliable electricity grids. Among the refined products, LPG will lead

consumption growth at 4.7% per year. Urbanisation underpins this robust increase of 150 kb/d over the 2022-28 period, largely due to more widespread use of propane and butane in cooking at the expense of traditional biomass. This switch is aided by government policies that incentivise the use of LPG, a clean cooking fuel.

Oil demand by product (mb/d): Africa, 2019-2028

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2022-28 Growth Rate	2022-28 Growth
LPG/Ethane	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.6	4.7%	0.1
Naphtha	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6%	0.0
Gasoline	1.2	1.1	1.2	1.2	1.2	1.2	1.2	1.2	1.3	1.3	1.1%	0.1
Jet/Kerosene	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	4.2%	0.1
Gasoil/Diesel	1.7	1.5	1.6	1.7	1.7	1.7	1.7	1.8	1.8	1.8	1.6%	0.2
Residual fuel oil	0.3	0.2	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	2.0%	0.0
Other products	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	1.5%	0.0
Total products	4.1	3.8	4.0	4.2	4.3	4.4	4.5	4.6	4.7	4.8	2.0%	0.5
<i>Annual change</i>	<i>0.0</i>	<i>-0.4</i>	<i>0.3</i>	<i>0.2</i>	<i>0.1</i>	<i>0.1</i>	<i>0.1</i>	<i>0.1</i>	<i>0.1</i>	<i>0.1</i>		

Petrochemicals drive growth in the Middle East and Eurasia

Oil demand in the Middle East will benefit from growth in the petrochemical sector, with LPG/ethane and naphtha use increasing by 600 kb/d versus 2022 levels. Gasoline demand is also projected to post strong gains of 170 kb/d over the period, reflecting the region's expanding population and comparably limited fuel efficiency gains.

However, we expect overall consumption to be partially offset by plans to switch to natural gas and renewables in the power sector, which will affect direct crude burn, gasoil, and fuel oil use. Middle Eastern demand is forecast to increase by 720 kb/d in 2028 versus 2022 levels.

Oil demand by product (mb/d): Middle East, 2019-2028

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2022-28 Growth Rate	2022-28 Growth
LPG/Ethane	2.2	2.2	2.2	2.2	2.3	2.3	2.4	2.5	2.6	2.7	3.4%	0.5
Naphtha	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	4.8%	0.1
Gasoline	1.7	1.5	1.6	1.7	1.8	1.8	1.8	1.9	1.9	1.9	1.5%	0.2
Jet/Kerosene	0.6	0.3	0.3	0.5	0.5	0.5	0.6	0.6	0.6	0.6	3.3%	0.1
Gasoil/Diesel	1.7	1.5	1.6	1.7	1.7	1.7	1.8	1.8	1.8	1.8	1.1%	0.1
Residual fuel oil	1.3	1.2	1.3	1.4	1.4	1.4	1.4	1.4	1.3	1.3	-0.6%	-0.1
Other products	1.1	1.1	1.1	1.2	1.2	1.2	1.2	1.1	1.0	1.0	-3.2%	-0.2
Total products	8.8	8.1	8.5	9.0	9.2	9.3	9.4	9.6	9.7	9.8	1.3%	0.7
<i>Annual change</i>	<i>0.0</i>	<i>-0.8</i>	<i>0.4</i>	<i>0.6</i>	<i>0.2</i>	<i>0.1</i>	<i>0.1</i>	<i>0.2</i>	<i>0.1</i>	<i>0.1</i>		

Finally, Eurasian oil use is expected to finish the forecast period 140 kb/d above 2022, with petrochemicals being the main driver of growth. This will occur despite a contraction in Russia, where 2028 demand will be about 3% below 2022's level.

The country's GDP growth averages well below 1% between 2024-28, with economic progress suffering in the face of sanctions and major petrochemical projects on hold.

Oil demand by product (mb/d): Eurasia, 2019-2028

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2022-28		
											Growth Rate	2022-28 Growth	
LPG/Ethane	0.8	0.9	0.9	1.0	0.9	1.0	1.0	1.0	1.0	1.1	1.1	1.6%	0.1
Naphtha	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	4.0%	0.1
Gasoline	1.0	1.0	1.1	1.1	1.1	1.1	1.1	1.2	1.2	1.2	1.2	1.1%	0.1
Jet/Kerosene	0.3	0.2	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	-1.1%	0.0
Gasoil/Diesel	1.2	1.1	1.2	1.3	1.3	1.3	1.2	1.2	1.2	1.2	1.2	-1.0%	-0.1
Residual fuel oil	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1%	0.0
Other products	0.6	0.6	0.7	0.7	0.6	0.6	0.6	0.6	0.7	0.7	0.7	-0.2%	0.0
Total products	4.3	4.2	4.5	4.6	4.6	4.6	4.6	4.7	4.7	4.7	4.7	0.5%	0.1
<i>Annual change</i>	<i>0.0</i>	<i>-0.1</i>	<i>0.3</i>	<i>0.1</i>	<i>0.0</i>	<i>0.0</i>	<i>0.0</i>	<i>0.1</i>	<i>0.1</i>	<i>0.0</i>			

Supply

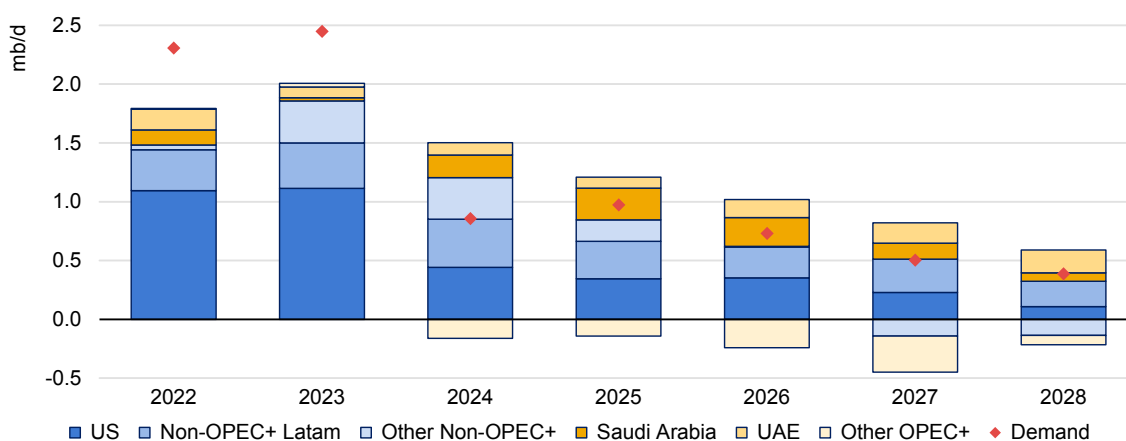
Global summary

Capacity building eases as energy transition accelerates

An expansion in global oil production capacity, dominated by the United States and other producers in the Americas, is set to moderate progressively over the medium term. However, the gains still keep up with the slower pace of projected demand growth over the 2023-28 forecast period. The world's total supply capacity is forecast to post a net increase of 5.9 mb/d to 111 mb/d by 2028, but a marked slowdown in US additions sees overall global capacity growth easing annually from an average 1.9 mb/d in 2022-23 to just 300 kb/d by the end of the forecast.

The broad deceleration in production capacity building largely reflects the global pivot towards cleaner energy and a corresponding weaker demand outlook. This creates a spare capacity cushion of an average 4.1 mb/d, concentrated in Saudi Arabia and the UAE, which should help ensure that world markets are adequately supplied throughout the medium term.

Global oil supply capacity and demand forecast, year-on-year change, 2022-2028



IEA. CC BY 4.0.

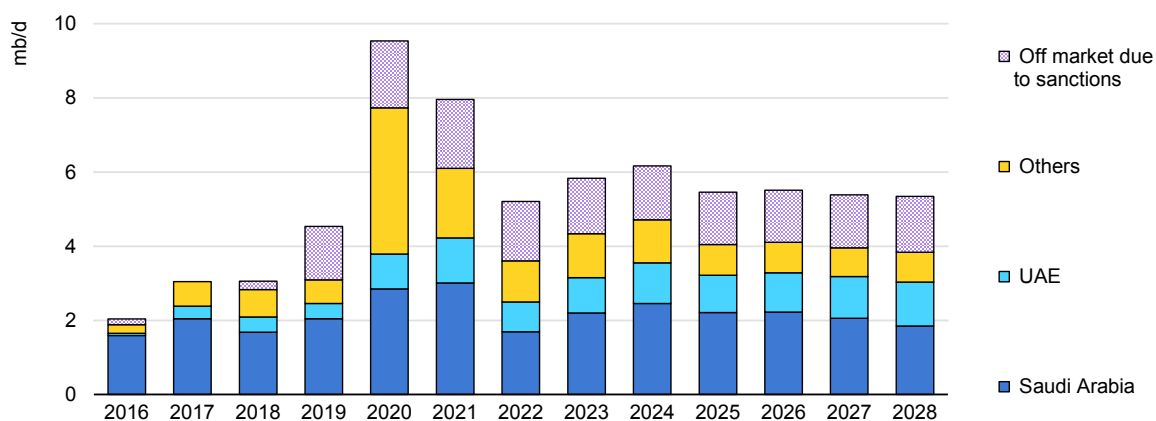
Note: Assumes Iran and Russia remain under sanctions.

Producers outside the OPEC+ alliance (non-OPEC+) dominate medium-term capacity expansion plans, with a net 5.1 mb/d supply boost, or 86% of the total increase. The United States alone accounts for half the non-OPEC+ growth, while Brazil and Guyana contribute an additional 1.9 mb/d in Latin America.

Saudi Arabia and the UAE lead the OPEC+ capacity building effort, while African and Asian members struggle with continuing declines. These Middle East heavyweights are boosting capacity now in anticipation of higher long-term demand for their barrels. Overall capacity from the 23 members in the OPEC+ alliance rises by 800 kb/d, which leaves a spare capacity cushion of at least 3.8 mb/d.

The outlook for Russia is clouded by the current geopolitical situation, but we expect capacity to fall as sanctions limit its ability to export, forcing some production to be shut in. Longer term, the departure of Western companies in the wake of Russia’s invasion of Ukraine may also curb capacity growth due to project delays stemming from a lack of technology and equipment.

OPEC+ spare crude oil production capacity



IEA. CC BY 4.0.

Note: Assumes Iran and Russia remain under sanctions. Russia added from 2022 onwards.

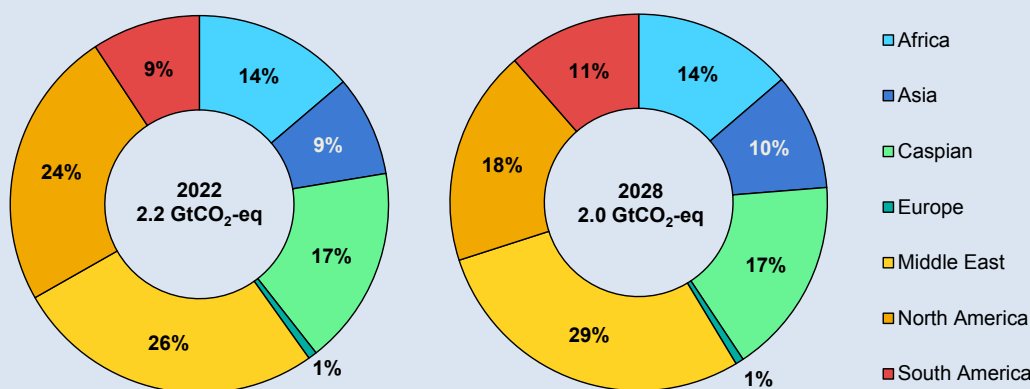
As for investment, global upstream capital expenditures is set to rise by USD 54 billion to USD 528 billion in 2023, the highest since 2015. Industry investment in giant projects has slowed sharply amid the shift towards a lower carbon future. Our analysis shows companies are targeting smaller, short-cycle projects and select oil field developments in the Americas and Middle East. These expansion plans tend to be lower cost and low-carbon projects with shorter payback periods as companies aim to avert the potential for stranded assets amid increased environmental, social and governance (ESG) pressures and expanding climate initiatives. Global upstream oil Scope 1 and 2 carbon emissions are forecast to drop 11% from 2022 to 2028, while emissions intensity falls by 15% given currently Stated Policies Scenario (STEPS) and where growth occurs.

How green is the growth?

Oil and gas operations currently account for 15% of the world’s energy-related emissions and the industry is under pressure to play a bigger role in energy transitions. Less than 5% of oil and gas production has 2030 targets that align with the IEA’s NZE Scenario, according to a new IEA report, [Emissions from Oil and Gas Operations in Net Zero Transitions](#).

Over our six-year forecast, the world’s oil production is expected to grow by 5.8 mb/d while the Scope 1 and 2 emissions intensity of global upstream oil operations is set to fall by around 15%, leading to an absolute reduction in emissions of 11%.

Regional upstream oil production Scope 1 and 2 emissions in 2022 and 2028



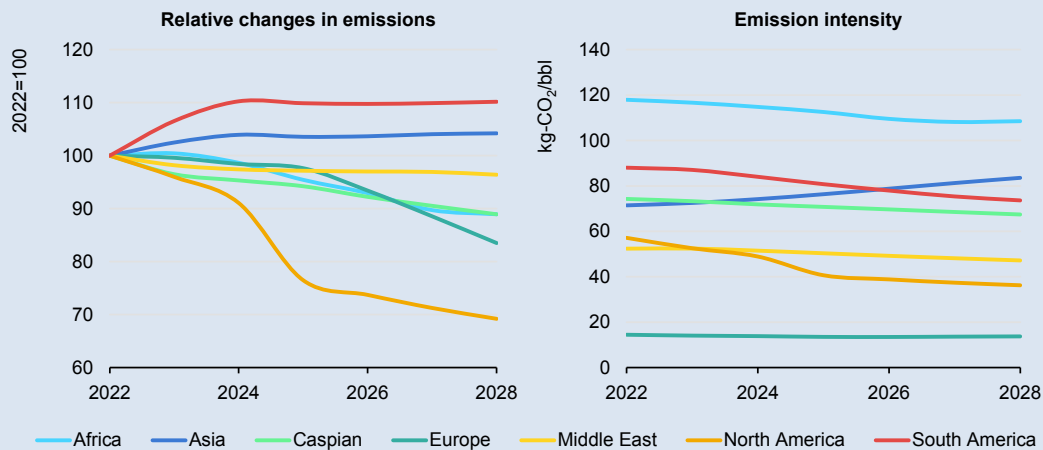
IEA. CC BY 4.0

The United States, the world’s top oil producer, also accounts for the greatest share of emissions from oil operations. Last year it accounted for 16% of global Scope 1 and 2 upstream emissions and 19% of supply. The Biden Administration has put climate action at the top of its agenda with the US Inflation Reduction Act (IRA) and is enforcing policies to mitigate methane emissions, reduce flaring and increase the use of carbon capture, utilisation and storage (CCUS). As a result, we estimate that US upstream oil emissions will drop 40% even as production grows by 13% over the forecast period, mainly through reductions in methane emissions.

The Middle East, home to 33% of the world’s current supply and 26% of upstream oil emissions, is forecast to produce 7% more oil in 2028 while generating 4% less emissions. While showing signs of progress, some of the region’s producers such as Iran, Iraq and Qatar have more room to improve than others. In the UAE, the Abu Dhabi National Oil Co (Adnoc) has already committed to a methane intensity of 0.15% by 2025 and to reduce its greenhouse gas (GHG) intensity by 25% by 2030. Saudi Aramco has an extensive leak detection and repair (LDAR)

programme that has kept its methane emissions among the lowest in the industry and has a master gas capture system that has led to very high flaring efficiencies.

North America leads in upstream oil Scope 1 and 2 emissions reductions



IEA. CC BY 4.0

Tackling Scope 1 and 2 emissions from oil and gas operations is one of the most viable and lowest cost options to reduce total GHG emissions to 2030. Curbing methane emissions from upstream operations represents one of the best opportunities given the large scope for cost-effective abatement through policies aimed at LDAR and stricter equipment design. Limiting non-emergency flaring and electrifying operations can also play large roles in reducing emissions.

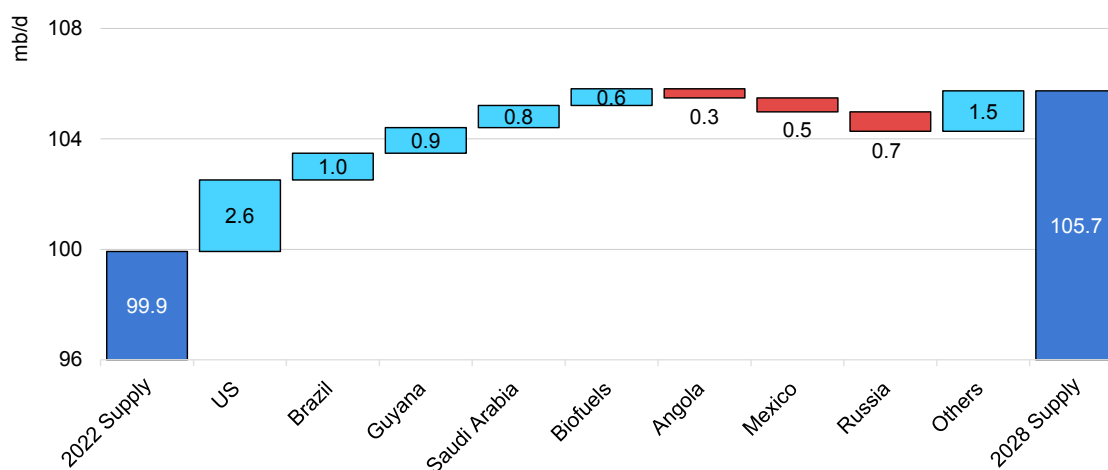
The exact path of emissions reductions will depend on policy decisions and industry responsiveness. Yet, the decarbonisation of oil and gas operations is needed and must be part of energy transitions. The industry also needs to adopt a consistent approach to monitor, report and verify emissions from its activities based on robust measurements to build public confidence in actions being taken.

Global oil supply growth concentrated in the Americas

The outlook for actual supply growth, as opposed to capacity, shows the United States, along with Brazil and Guyana, dominating gains, accounting for 80% of the increase over the forecast period. To match our projected oil demand growth over the next six years, an increase of 5.8 mb/d would be required for supply to reach 105.7 mb/d by 2028. Under this forecast, the United States alone provides nearly 45% of the total rise while the Middle East accounts for just over 40%. Collectively, OPEC+ contributes 12% of the growth as declines from Russia and African members temper gains from Middle East countries.

Driven by the United States and other countries in the Americas, world oil production will overtake pre-Covid-19 levels this year and continue its upward trajectory in the medium term. The United States, Brazil and Canada are all forecast to pump at unprecedented rates this year and the trio is expected to set fresh records through 2028. Qatar hits its highest ever output towards the end of the medium-term period. Saudi Arabia and the UAE, constrained for now by OPEC+ quota cuts that came into effect from November 2022 and voluntary curbs from May 2023 that are due to run through 2024, are expected to produce at historical highs in the later years of the forecast. Russia, under the weight of sanctions, posts the biggest loss over the six-year period, while underinvestment leads to notable declines in Mexico and Angola.

Oil supply changes for select countries from 2022-2028



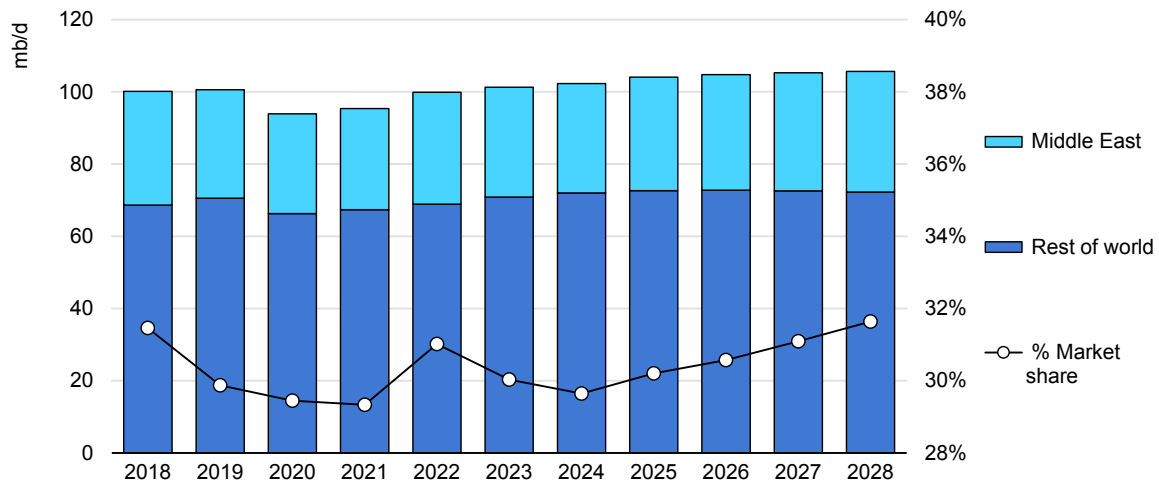
IEA. CC BY 4.0.

Note: Assumes Russia and Iran remain under sanctions.

Supply in 2023 is forecast to rise by 1.4 mb/d to reach a record-high annual average of 101.3 mb/d. But that is a sharp slowdown from growth of 4.5 mb/d in 2022, which was dominated by the OPEC+ alliance as it phased out historic 2020 cutbacks. By 2028, the supply expansion edges down to just 390 kb/d – in line with a deceleration in oil demand due to continued progress in energy efficiency and the uptake of electric vehicles.

The slowdown in US growth will enable producers from the Middle East – led by Saudi Arabia, Iraq and the UAE – to add barrels to meet demand growth. As a result, market share from the region rises to 32% in 2028 from 30% in 2023. Given current investment and market trends, the Middle East's share of world oil production looks set to increase over the longer term.

Middle East regains market share over the medium term



IEA. CC BY 4.0.

Note: Assumes Russia and Iran remain under sanctions.

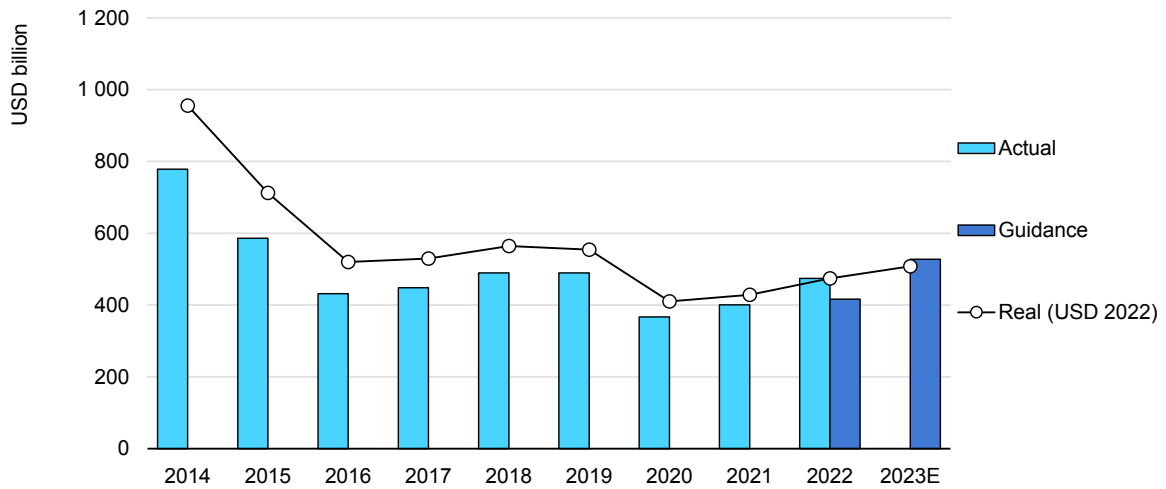
Investment and exploration

Global spending recalibrates as demand growth slows

Global upstream oil and gas investment, upended by Covid-19 and lingering uncertainty due to the acceleration of energy transitions, is set to increase by around 11% in 2023 to an estimated USD 528 billion, compared with USD 401 billion in 2021 and USD 474 billion in 2022 (see the IEA's [2023 World Energy Investment report](#)).

Upstream investment plans, in real terms, are 47% below 2014. Years of efficiency gains, cost controls and capital discipline, punctuated by measures taken during the pandemic-induced balance sheet crisis, have reduced lifting costs and wellhead breakeven prices. However, tightening monetary policy and an ongoing labour shortage, higher rig rates and material costs are challenging these hard-won gains with increasing cost pressures. The IEA Global Upstream Cost Index rose 22% in 2022 compared with 2020, and the IEA US Shale Cost Index surged 38%. However, global and US development costs remain 15% and 5% lower than the highs of 2014, respectively.

Global oil and gas upstream capital spending

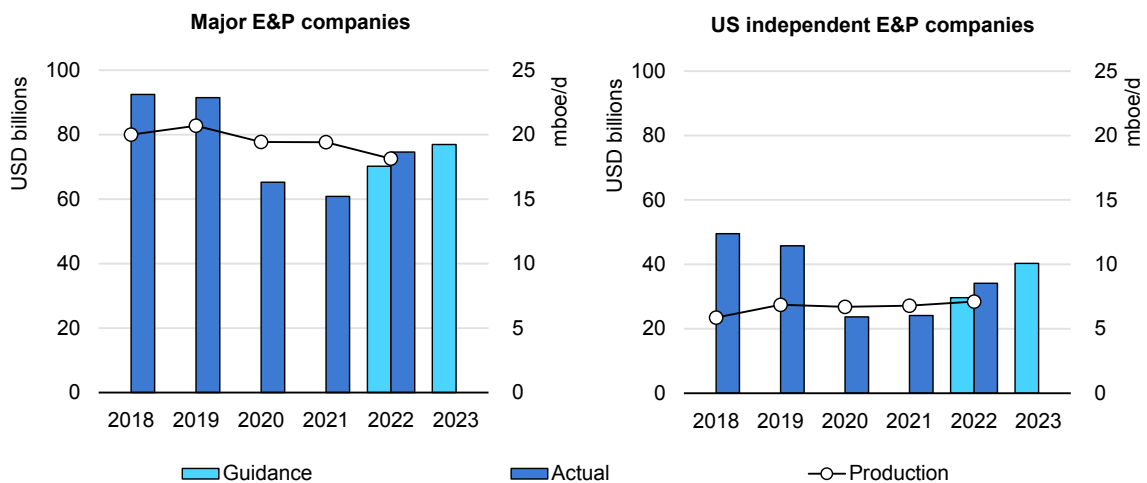


IEA. CC BY 4. 0.

Source: IEA analysis based on company reports.

National oil companies (NOCs) invested 14% more in 2022, overtaking the 2019 level, driven primarily by capacity building efforts in Saudi Arabia and the UAE. Saudi Aramco raised its upstream spending by about 24% to USD 29 billion and plans further increases to boost its crude oil capacity to 13 mb/d by 2027. The UAE’s Adnoc plans to spend USD 150 billion over the next five years.

Oil and gas capital spending by selected companies



IEA. CC BY 4. 0.

Source: IEA analysis based on company reports. Major companies include BP, Chevron, Conoco Phillips, Eni, ExxonMobil, Shell and TotalEnergies. US independent companies include 18 selected companies.

While the absolute level of spend in the Middle East has recovered to previous highs, most of the upstream investment increases in 2022 were for light tight oil

(LTO), with a select group of US independent exploration and production (E&P) companies raising Capex by about 40%. US independents are expected to spend more in 2023 but continued capital discipline and investor-orientated policies will keep their Capex below 2019 levels.

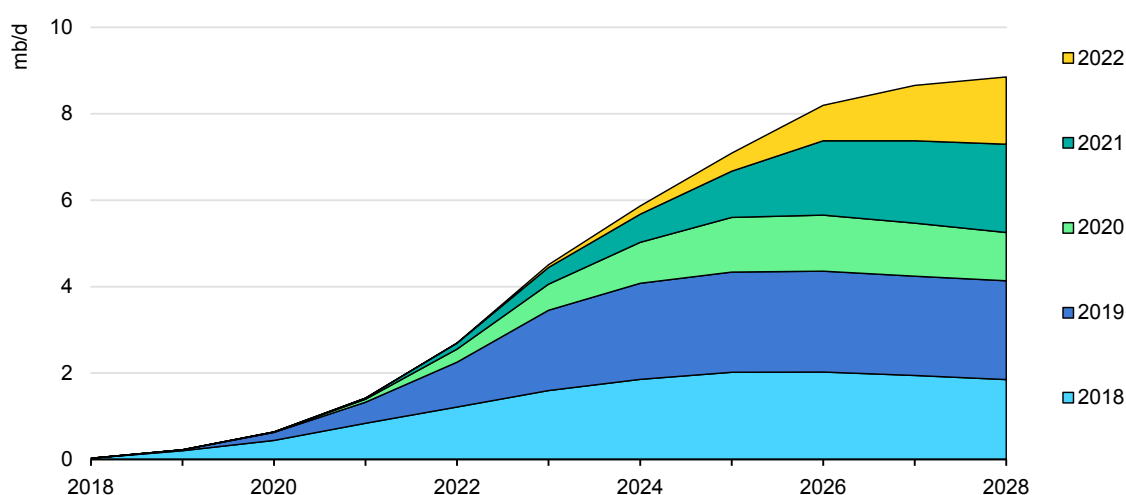
Upstream capital expenditures from the majors, which includes BP, Chevron, Conoco Phillips, Eni, ExxonMobil, Shell and TotalEnergies, climbed by USD 14 billion in 2022 after posting declines in 2020-21. Project delays and increased capital efficiencies drove the lower-than-expected spending by the peer group in the previous year. Capex guidance for 2023 indicates continued modest increases with similar corporate allocations between segments (broadly speaking, as upstream, downstream and new energies).

Conventional discoveries slow as exploration bifurcates

In 2022, improvements in oil market conditions led to the sanctioning of projects that are expected to add 1.6 mb/d to global production by 2028. Brazil accounts for 20% of the sanctioned volumes, while the United States and Guyana each contribute 14% and Saudi Arabia provides 12%.

The Brazilian gains come primarily from Mero and Búzios, two large multi-phase projects eventually comprised of 15 floating production storage and offloading vessels (FPSOs) between them. In Guyana, the ExxonMobil-led project will commission four new FPSOs adding close to 800 kb/d of output. Projects in the deepwater Gulf of Mexico (GoM) and the Pikka project in Alaska support the US gains.

Conventional production additions by sanction year



IEA. CC BY 4.0.

Note: Expected production by year based on sanctioned projects.

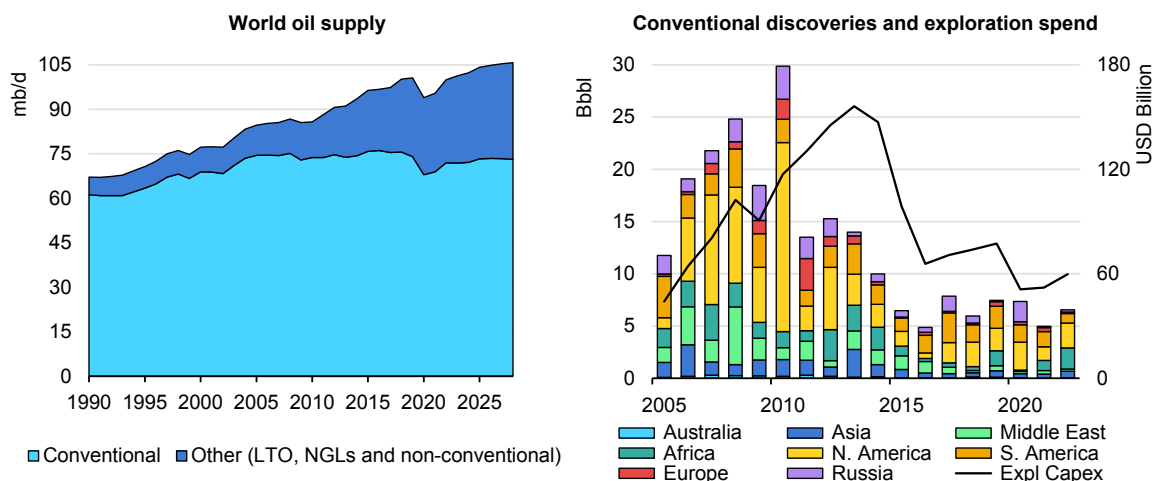
Source: IEA analysis based on Rystad Energy UCube data.

The investment cuts affected exploration spend more acutely than other business segments. As a result, conventional oil discoveries in 2021 fell to their lowest since 2016, with less than 5 billion barrels found – nearly matching a 50-year low and half the annual average seen over the previous decade, according to Rystad Energy. In 2022, discoveries recovered marginally, to 6 billion barrels, but are still a far cry from historical averages.

The effects of lower exploration spend on global supply output have been muted over the past decade as the growth of non-conventional production – accounting for 130% of the world’s total growth over the period – more than offsets declines in conventional oil production.

Moving forward, it is unclear how long the shale patch can bolster growth. As observed in 2022, US LTO’s price responsiveness was relatively muted compared to the last decade (see box, “Shale growth at risk from lower prices, higher costs”). Additionally, new reserve additions in shale have slowed considerably from a massive 10-year average reserve replacement ratio (RRR) of 1580% in the 2000s to the latest five-year average RRR of 33%, leading to inventory questions in key basins. We do not see this changing over the medium term as shale loses its swing producer status.

Conventional discoveries have slowed markedly over the last decade



IEA. CC BY 4.0.

Source: IEA analysis based on Rystad Energy UCube data.

Global conventional oil supply peaked in 2016 as shale production moved apace. The global five-year (2018-22) RRR for oil is 50% having steadily declined from almost 100% a decade ago. Conventional resource discoveries from exploration have averaged 7.5 billion barrels a year for the last decade, far short of the approximately 27 billion barrels of conventional supply last year. This decline has

been due to lower exploration budgets and reduced risk profiles. The decline in resource additions has spared no region over the last decade.

In the coming years we expect exploration spending to be divided between high-impact wells in hot spots and infrastructure-led exploration (ILX). High activity regions currently include Namibia, Suriname and Guyana while ILX locations are in more established areas like US GoM, the North Sea and China.

ExxonMobil announced seven discoveries in 2021 and nine in 2022 in Guyana. In neighbouring Suriname, TotalEnergies and APA Corporation struck commercial volumes in Block 58 at Sapakara South in 2021 and Krabdagu in 2022. Petrobras will lead in Brazil's frontier regions, including the northern Equatorial Margin in the coming years, attempting to build on their success seen in the Santos Basin. Parts of western Africa have also garnered renewed interest after Eni's Baleine success offshore Cote d'Ivoire in 2021 and the massive multibillion barrels discoveries off the coast of Namibia by Shell and TotalEnergies last year.

Infrastructure-led exploration efforts tend to be shorter-cycle and do not need to be as large as standalone projects to proceed. BP's recent Gulf of Mexico Argos tieback to Mad Dog 2 and Equinor's Fenja project in the Norwegian Sea are examples of successful ILX projects that have utilised existing infrastructure to reduce the cost and carbon footprint of bringing new resources online.

OPEC+ supply

Middle East drives modest OPEC+ increase

OPEC+ oil supply, including condensates and natural gas liquids (NGLs), is forecast to grow by just 690 kb/d over the six-year period, with the Middle East, led by Saudi Arabia, along with Kazakhstan more than offsetting losses largely from Russia, Mexico and Angola. This assumes that from 2025, supply from core Gulf producers rises or falls proportionally in line with the call on OPEC crude oil. Together with Russia, these Middle East countries form the backbone of the OPEC+ alliance that provides around half the world's supply of oil.

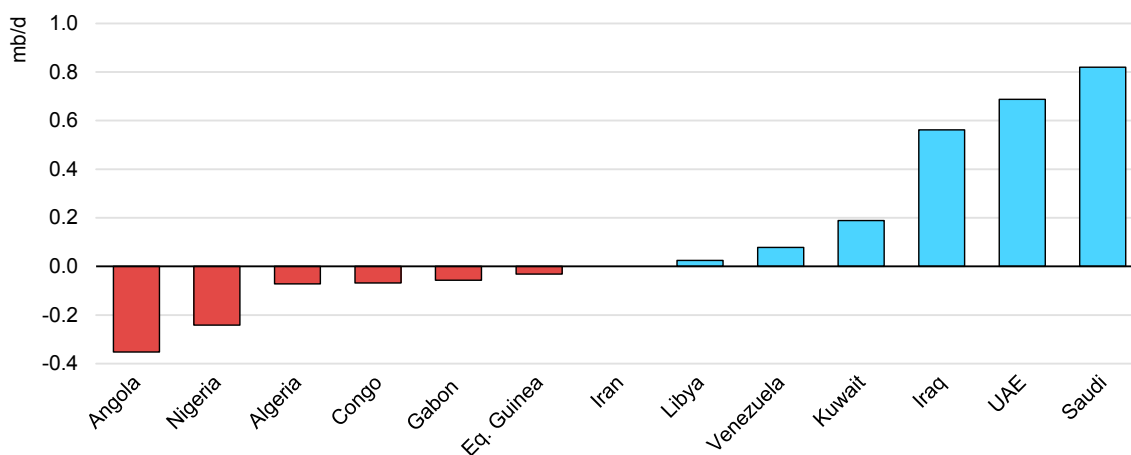
In 2022, the bloc's output of total oil, including condensates and NGLs, soared by 3.1 mb/d to an average 52.1 mb/d as it phased out record 2020 cuts. This year could see a decline of 470 kb/d, with Russia – under the weight of sanctions – and Middle East producers, restricted by extra OPEC+ cuts that are due to run through 2024, all pumping less. The 23-member alliance agreed to reduce supply in late 2022 to support the market as the economic outlook worsened, pressuring prices. Output dropped further in May 2023 after a new round of voluntary cuts announced by select countries in April took effect. In early June, the bloc extended its output reduction along with voluntary cuts through 2024.

Growth from the bloc is expected to return from 2025 onwards – albeit at a relatively modest average rate as the call on OPEC crude rises by 1.1 mb/d over the 2025-28 period due to slowing demand and a deceleration in non-OPEC+ output. Saudi Arabia, the UAE and Iraq will deliver most of the extra barrels as spending on projects beyond the Middle East falters. These core Gulf producers may have to sustain supply at or near-record rates to make up for ongoing declines from African and Asian members of the bloc as well as Russia. Outside of the Middle East, Kazakhstan is also expected to scale record highs.

Saudi, UAE drive gains in capacity and supply

Saudi Arabia could pump at or near record-smashing rates during much of the six-year forecast by making use of its spare capacity. This year, the extra OPEC+ cuts announced in early April (as well as its additional 1 mb/d reduction for July) are expected to slow the Kingdom’s crude oil production to 10 mb/d, 480 kb/d below an all-time high reached in 2022. From 2025 onwards, Saudi supply is forecast to rise steadily (when adjusted for the call on OPEC crude) and reach an unprecedented annual rate of 11.2 mb/d in 2028. A gradual expansion of its crude oil production capacity allows Riyadh to sustain a spare cushion of roughly 2 mb/d.

OPEC crude oil production capacity change 2023-2028



IEA. CC BY 4.0.

Note: Assumes Iran remains under sanctions.

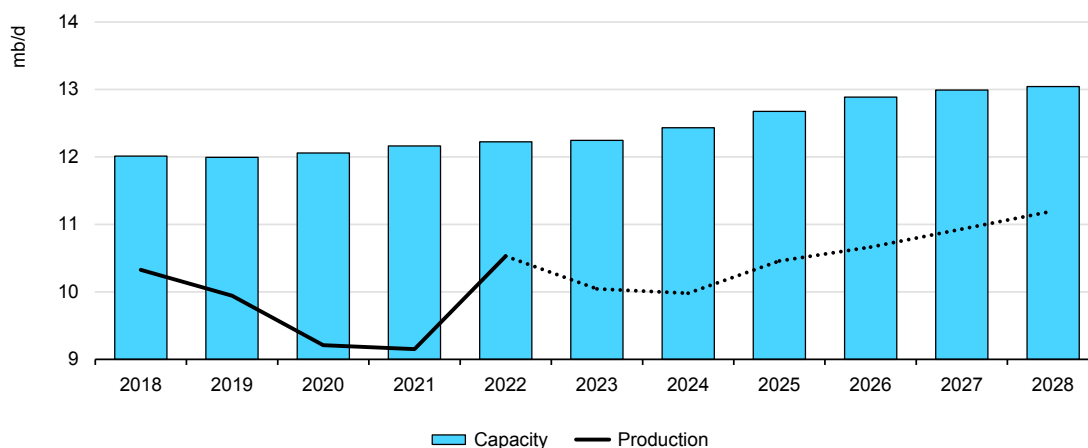
Saudi Aramco is striving to raise capacity by 1 mb/d to reach 13 mb/d in 2027 by focusing on its giant offshore fields. To underpin that effort, Aramco expects to boost total capital expenditure to between USD 45 billion and USD 55 billion in 2023 (compared to USD 38 billion in 2022) and increase it further over the next several years. Nearly 60% of capital expenditure is earmarked for the upstream.

Riyadh’s current production capacity is estimated at 12.2 mb/d, including the Neutral Zone, which has been restored to about 500 kb/d. Before Neutral Zone production was halted in 2015, the offshore (mainly al-Khafji) and onshore (mostly Wafra) fields were pumping at around that rate.

The Kingdom’s first material capacity boost in more than a decade is forecast to come online gradually starting from 2024-25, thanks to higher cost projects at the offshore oil fields of Marjan and Berri (a combined 550 kb/d) and Zuluf (around 600 kb/d). These projects will offset field declines elsewhere as well contribute to the build in capacity to 13 mb/d. Beyond the forecast period, the offshore Safaniyah field is expected to expand by 700 kb/d.

Saudi Aramco has meanwhile pledged to achieve net zero emissions by 2050 as part of the Kingdom’s stated aim to reach that goal on a national basis by 2060. Its neighbour the UAE has also announced plans to meet its net zero emissions target by 2050.

Saudi Arabia estimated crude oil production and capacity



IEA. CC BY 4.0.

Note: Production projection adjusted for call on OPEC crude.

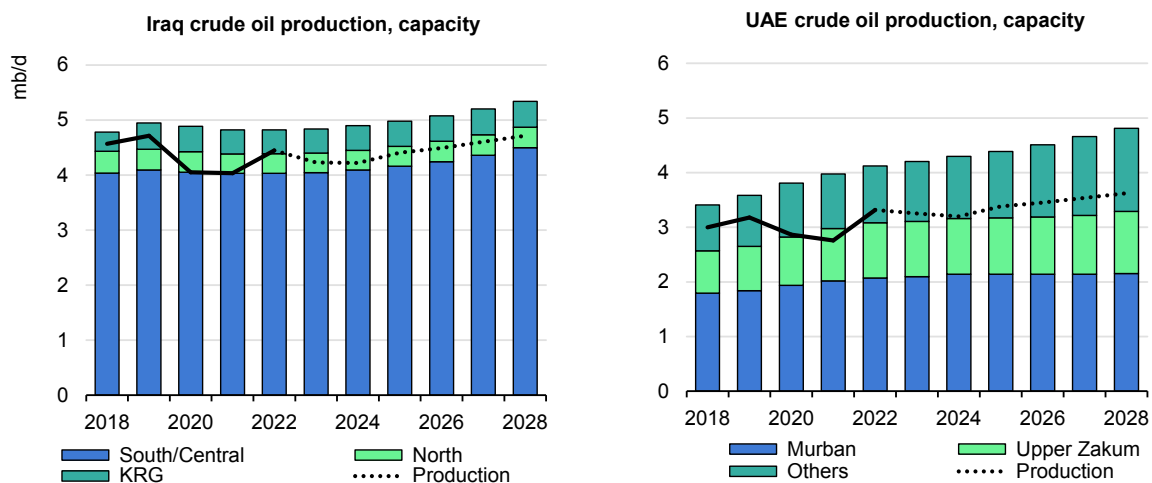
The **UAE** has been aggressively raising crude capacity in recent years and looks on track to provide a 690 kb/d increase over the six-year period. Annual average crude output in 2022 hit an all-time high of 3.3 mb/d and, after easing this year and next along with new OPEC+ cuts, rises to record-breaking levels later in the forecast. Production could reach 3.6 mb/d by 2028, leaving the UAE with 1.2 mb/d of spare capacity.

Its relatively low-cost resource base and secure operating environment have bolstered the UAE’s expansion effort, which has an official target of 5 mb/d by 2027. To support the effort, it plans to increase capital spending for 2023-27 to

USD 150 billion from USD 127 billion for 2022-26. We estimate current capacity at 4.2 mb/d and see it growing to 4.8 mb/d in 2028. Offshore oil fields are core to the build-up. Capacity at the Exxon-operated Upper Zakum field, one of the world’s largest, reached 1 mb/d in 2021 – three years ahead of schedule. Further growth is planned over the forecast period.

To that end, Adnoc has awarded contracts to Schlumberger, Adnoc Drilling and Halliburton to boost Upper Zakum as well as the Satrah al-Razboot fields. The UAE-based National Petroleum Construction Corp is set to develop a much smaller offshore block, which is expected to pump first oil in 2023. The block is made up of the Belbazem, Umm al-Salsal and Umm al-Dholou fields and is expected to produce 45 kb/d.

Iraq, UAE help drive OPEC+ supply gains



IEA. CC BY 4.0.

Note: Production assumption adjusted for call on OPEC crude.

For its onshore sector, which produces flagship Murban crude, Adnoc plans to invest to sustain capacity at the 650 kb/d Bu Hasa, its largest onshore oil field. It will also raise capacity at the Al Nouf oil field to 175 kb/d by 2024 from 160 kb/d now. To support gains, Adnoc has carried out onshore and offshore licensing rounds. It awarded exploration rights for onshore Block 3 to Occidental Petroleum. For the offshore, it granted Block 5 to a consortium of four Pakistani companies, Block 3 to Eni and Thailand’s PTTEP and Block 4 to Cosmo.

Iraq is poised to deliver capacity growth of 560 kb/d to reach nearly 5.3 mb/d in 2028. As for actual supply, the country during 2022 pumped an annual rate of 4.4 mb/d. This year, it is expected to produce 4.2 mb/d, which would leave it with roughly 500 kb/d of spare crude oil capacity.

Production capacity has been constrained in the short term by infrastructure bottlenecks at its southern terminals. Baghdad says export capacity in the Gulf will eventually rise by around 200 kb/d to 3.45 mb/d after finishing the installation of new pumps. Iraq is also striving to bring a fifth single point mooring buoy into operation, which could add at least 500 kb/d to southern export capacity.

While there are many above-ground challenges that can frustrate project execution, Iraq is straddling some of the world's most vast and lowest cost resources. The southern oil hub of Basrah, where international oil companies (IOCs) are managing mega projects, will provide most of the capacity gains over the medium term. BP, Eni, ExxonMobil and Lukoil currently manage a combined 3 mb/d at Rumaila, Zubair, West Qurna-1 and West Qurna-2, respectively.

TotalEnergies also has a USD 27 billion energy project on the drawing board. The company finally struck an agreement in 2023 with Baghdad on its long-delayed scheme to construct four separate oil, gas and renewables projects with initial investment of USD 10 billion. The Iraqi government has now agreed to take a smaller 30% stake in the project. TotalEnergies will hold 45% and QatarEnergy 25%. The first phase includes a project to inject 5 mb/d of treated seawater into core southern oil fields to sustain pressure. TotalEnergies will also raise output at the Ratawi oil field from 85 kb/d to 210 kb/d and build a large solar power plant. Additionally, the company will build a processing plant for gas produced at West Qurna-2, Majnoon, Ratawi, Tuba and Luhais.

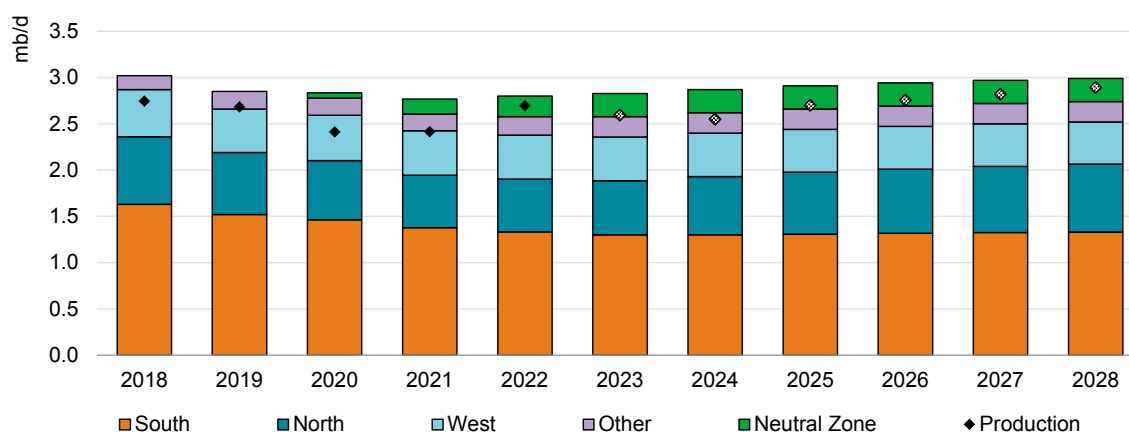
At West Qurna-1 (capacity of 500 kb/d), Indonesia's state Pertamina has doubled its stake to 20% by acquiring a 10% share from ExxonMobil. Discussions are still underway for the sale of Exxon's remaining 22.7% share in the southern field to Iraq's Basrah Oil Co. In 2013, Exxon sold almost half its share to China National Petroleum Corp, which currently holds 32.7%. Capacity at the field is expected to rise towards 700 kb/d over the next several years on the back of a drilling contract signed with Schlumberger.

At West Qurna-2, Lukoil has reportedly lifted capacity by 80 kb/d to 480 kb/d following the completion of 47 new wells. At the 300 kb/d Missan field cluster of Buzurgan, Abu Gharib and Fakka, a project to upgrade an oil and gas separation unit at Abu Gharib is underway. Baghdad also plans to boost output at Majnoon, now pumping roughly 130 kb/d, to 450 kb/d over the next several years.

The northern Kirkuk oil fields and the capacity that is controlled by the KRG are expected to contribute only marginal growth over the forecast period. There are plans to raise Kirkuk's capacity to 1 mb/d from roughly 500 kb/d. However, efforts to boost output have been frustrated by the long-running feud between Baghdad and the KRG over control of land and oil. Shipments along the Iraq-Türkiye pipeline to the Turkish Mediterranean terminal of Ceyhan have been halted since the end of March 2023, forcing the shut-in of the KRG's production.

Of the core Gulf producers, **Kuwait** is expected to see a relatively modest increase in capacity. Annual average crude oil production in 2022 rose 280 kb/d to 2.7 mb/d after OPEC+ cuts were unwound, leaving it with virtually no spare capacity. Over the six-year forecast period, we project a 190 kb/d rise in capacity to 3 mb/d.

Kuwait estimated crude oil production and capacity, 2018-2028



IEA. CC BY 4.0.

Note: Other is primarily light oil.

Kuwaiti capacity had been slipping since 2018 due to ongoing field declines, falling 250 kb/d to roughly 2.8 mb/d in 2021. It has since been hovering around that level but we project a slight increase starting next year as the country plans for an ambitious drilling programme and more infrastructure investment.

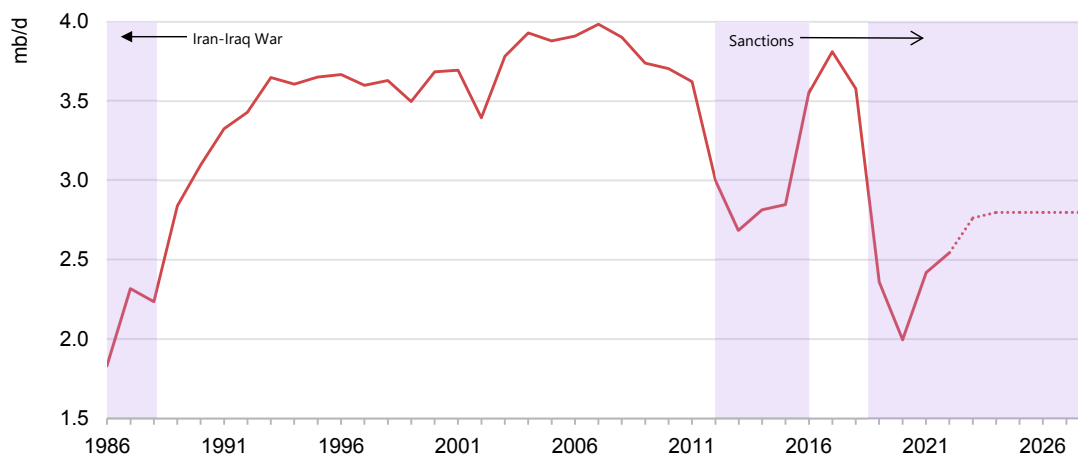
We expect a modest increase in Neutral Zone capacity (250 kb/d for Kuwait) to help offset further declines in the south at the giant Burgan oil field, which has suffered the steepest losses. Although Covid-19 set back a number of expansion projects, a 100 kb/d crude oil gathering centre started up in 2021 along with new facilities to handle 60 kb/d of Lower Fars Heavy Oil.

Kuwait is meanwhile targeting a 500 kb/d capacity expansion over the next several years thanks to an annual drilling programme of 500 wells, construction of two gathering centres as well as water injection facilities and other infrastructure that are now underway. However, that capacity goal is likely to prove optimistic. Reviving and developing Kuwait's ageing and complex oil fields (as well as those of the Neutral Zone) will require substantial investments to underpin the drilling effort along with more expensive enhanced oil recovery technology.

Iran supply edges up, but sanctions stymie capacity growth

Iran remains a wildcard for world oil markets. If it is released from sanctions, production could ramp up gradually by roughly 900 kb/d to reach capacity of 3.8 mb/d. Talks to revive the 2015 Iran nuclear deal, which would ease sanctions, have been on ice since September 2022. However, reports recently have emerged suggesting the potential for some sanctions relief for Tehran.

Iran crude oil production, 1986-2028



IEA. CC BY 4.0.

Note: Assumes sanctions remain throughout the forecast period.

Despite tough financial restrictions, Iran managed to increase crude oil output by about 130 kb/d in 2022 to an average 2.5 mb/d. Tehran appears to be keeping up brisk oil sales to China that have been running at an estimated 1 mb/d since the third quarter of last year. Before the former US administration withdrew from the Joint Comprehensive Plan of Action nuclear deal (JCPOA) in 2018, exports of Iranian oil, including condensates, had been running above 2 mb/d. Higher exports and domestic throughput have pushed Iranian crude production up to around 2.9 mb/d in May 2023 and we have held that level throughout the remainder of the forecast period.

We believe Iran is still able to maintain its sprawling oil network, enabling it to ramp up relatively swiftly if and when sanctions are eased. Lower wellhead production most likely led the National Iranian Oil Co to shut in wells at its high-cost offshore fields and perform maintenance at its mature oil fields. Shutting in output can be helpful for ageing oil fields as it will allow pressure to rebuild and make it easier for operations to restart.

As for capacity building, Iran's efforts in this respect have largely stalled given the obstacles posed by the collapse of exports since the end of 2018 and the lack of foreign investment due to sanctions. The previous round of international sanctions had already left the oil sector in urgent need of foreign cash and technology, particularly in enhanced oil recovery methods to sustain and raise output at older oil fields. But Tehran is looking to the core West Karun oil fields of North and South Azadegan, Yaran and Yadavaran to drive future growth with a 1 mb/d boost. Undeterred by sanctions, Iran expects in 2023 to double capacity to 320 kb/d at its southern Azadegan field, which straddles the border with Iraq.

OPEC crude oil production capacity (mb/d)

	2022	2023	2024	2025	2026	2027	2028	2022-28
Algeria	1.0	1.0	1.0	1.0	1.0	1.0	0.9	-0.1
Angola	1.2	1.1	1.0	1.0	0.9	0.9	0.8	-0.4
Congo	0.3	0.3	0.3	0.3	0.2	0.2	0.2	-0.1
Equatorial Guinea	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0
Gabon	0.2	0.2	0.2	0.2	0.2	0.1	0.1	-0.1
Iran	3.8	3.8	3.8	3.8	3.8	3.8	3.8	0.0
Iraq	4.7	4.7	4.8	4.9	5.0	5.1	5.3	0.6
Kuwait	2.8	2.8	2.9	2.9	2.9	3.0	3.0	0.2
Libya	1.2	1.2	1.2	1.2	1.2	1.2	1.2	0.0
Nigeria	1.4	1.3	1.3	1.2	1.2	1.2	1.1	-0.2
Saudi Arabia	12.2	12.2	12.4	12.7	12.9	13.0	13.0	0.8
UAE	4.1	4.2	4.3	4.4	4.5	4.7	4.8	0.7
Venezuela	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.1
Total OPEC	33.7	33.9	34.1	34.4	34.8	35.0	35.3	1.5
<i>Annual Change</i>	<i>0.1</i>	<i>0.1</i>	<i>0.2</i>	<i>0.3</i>	<i>0.4</i>	<i>0.2</i>	<i>0.3</i>	

Oil output in **Oman**, including condensates and NGLs, is projected to hold relatively steady over the forecast period at just shy of 1.1 mb/d. The ongoing development of offshore fields and those offered in its 2021 bid round are expected to help sustain crude oil production capacity. To attract upstream investment, Oman has offered three onshore blocks for oil and gas exploration in its latest licensing round. Another round for offshore blocks is due to be announced later this year. The sultanate has also set a 2050 net zero target and is striving to ramp up domestic renewable hydrogen production (see the [IEA's Renewable Hydrogen from Oman: A Producer Economy in Transition](#) report).

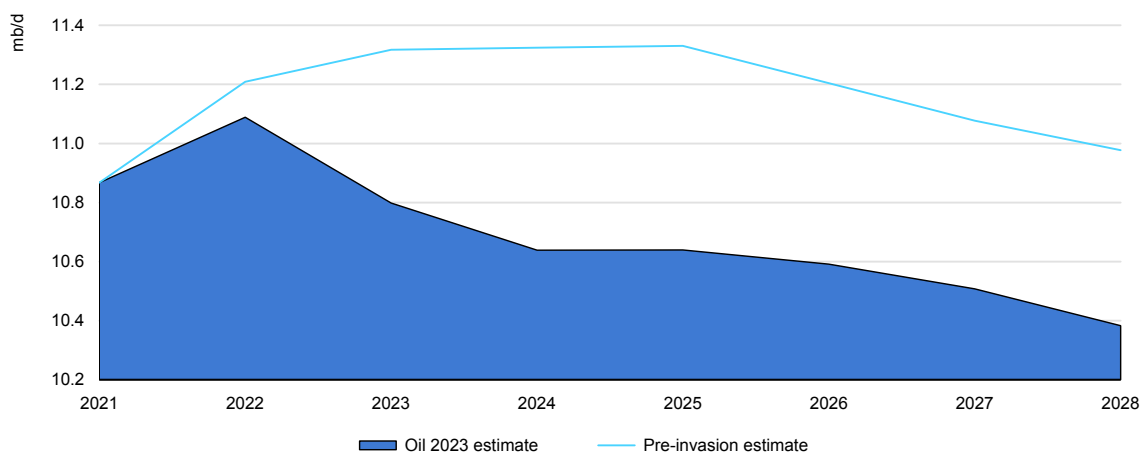
Russian growth story stalls due to Ukraine invasion

Prior to its invasion of Ukraine, **Russia's** total oil production was expected to rise by 100 kb/d to reach 11.3 mb/d in 2025, before tapering lower. But now our supply forecast is trending around 600 kb/d below that pre-war estimate. In 2022, total oil supply rose by a modest 220 kb/d to 11.1 mb/d. And this year, despite sanctions, Russian oil supply has held up remarkably well. Crude and product exports have

been re-directed to new markets as deep price discounts attract traders willing to risk handling the barrels. At the same time, drilling is being ramped up in the western Siberian oil hub. As a result, we expect total oil supply to fall by just 290 kb/d y-o-y to 10.8 mb/d. Our 2023-24 estimate takes account of Moscow's self-declared cut of 500 kb/d that extends from March through the end of 2024.

The world's third-largest oil producer after the United States and Saudi Arabia, Russia admits that finding new markets will be a challenge and that upstream projects may be delayed as some domestic producers struggle to secure equipment and financing and as Western investors and lenders have mostly quit the country. We are assuming that supply will ease further through 2028, with a net decrease of 710 kb/d for the six-year forecast period. Moscow's ability to self-finance its oil industry operations and its access to Chinese equipment and services may stave off a far steeper decline. But a toughening of western financial measures imposed on Russia could also result in a sharper downtrend.

Russia estimated total oil supply, 2021-2028



IEA. CC BY 4.0.

Note: Assumes sanctions remain throughout the forecast period.

Russia's largest oil producers had planned a significant increase in investment aimed at bolstering output, but now those plans appear to be on ice. Moscow had been looking increasingly to its huge resources in the Arctic to provide growth to support production as its mature fields are depleting. Tapping those hard to recover reserves will require significant and more costly efforts compared to conventional fields. And in the current environment, it is unclear whether Rosneft's Vostok Oil mega project, a crucial source of Arctic growth, will be able to achieve its development targets. The hope was that the project would ramp up towards 600 kb/d in 2024. Rosneft, the country's top producer, says the project is still on track and that it has started drilling at the development's Payakha field. Although

the pre-invasion aim was to boost output to more than 1.5 mb/d, this looks increasingly difficult to achieve in the medium term.

Production in neighbouring **Kazakhstan** and **Azerbaijan** eased last year due to operational constraints and various outages. But regional supplies will be supported by the further expansion of Tengiz in Kazakhstan and the start-up of the BP-led Azeri Central East platform.

In Kazakhstan, total oil output edged down to 1.8 mb/d in 2022 but is expected to rise to a record 2.1 mb/d in 2025 and hover around that level through the end of the forecast. The Chevron-led consortium that operates Tengiz has started early flows from a USD 45 billion project to boost output to 850 kb/d and support growth in the years ahead. The so-called Tengiz Future Growth Project-Wellhead Pressure Management Project is nearing completion. Tengiz, the country's largest oil field, pumped an average 635 kb/d in 2022. At the giant Kashagan oil field, output is due to reach around 450 kb/d from 2025 onwards. The field is now producing roughly 400 kb/d.

Kazakhstan is meanwhile working with international oil companies to raise spending in renewables to help it through the energy transition. State-owned Kazmunaigas has vowed to reduce its carbon emissions by 15% by 2031 and has awarded solar and wind development schemes to foreign companies.

Azeri total oil supply slipped in 2022 to 670 kb/d and is forecast to hover around that level throughout the forecast. Although output has been declining for years, BP is on track to deliver oil from the USD 6 billion Azeri Chirag-Guneshli (ACG) expansion project next year. Operator BP expects to produce an extra 100 kb/d from the Azeri Central East platform. After reaching an annual average peak of roughly 840 kb/d in 2009, ACG pumped 390 kb/d in 2022.

African OPEC+ to suffer further losses

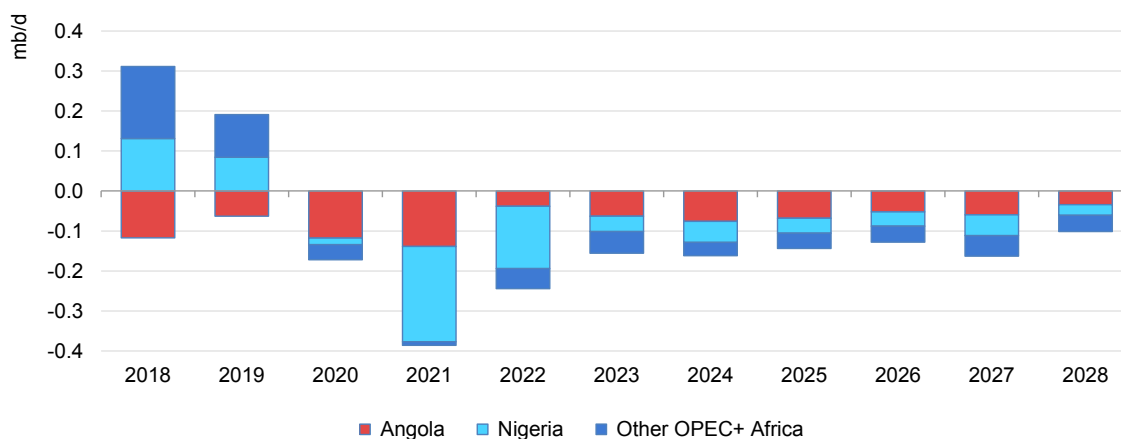
Apart from Libya, African OPEC+ members are expected to suffer significant losses over the six-year period as producers fail to lure enough investment to halt declines.

Nigeria briefly lost its rank as Africa's top crude oil producer in 2022 as output sank to 40-year lows. It has since reclaimed the top slot after major export streams recovered and stabilised. We expect to see a short-lived rebound, with chronic underinvestment and sabotage continuing to take a toll on capacity and production. Crude oil output tumbled to 1.1 mb/d in 2022 and capacity is expected to decline from 1.4 mb/d in 2022 to 1.1 mb/d in 2028.

Nigerian oil officials have repeatedly set, and missed, targets for the country to overcome production issues. Operators have been urged to reopen wells as

quickly as they can. And finally, major crude streams are showing some signs of recovery, although the extent of the rebound remains to be seen. Crude oil production of Bonny Light has recovered to around 100 kb/d compared to just 50 kb/d in 2022. Forcados is also showing more promise: output in early 2023 was around 200 kb/d – up from an average 150 kb/d in 2022. Qua Iboe output has been fairly steady at around 150 kb/d.

OPEC+ Africa crude oil production capacity (y-o-y change)



IEA. CC BY 4.0.

Note: Other OPEC+ Africa producers are Libya, Algeria, Equatorial Guinea, Gabon, Congo, Sudan and South Sudan.

The battle to reverse declines and repair ageing infrastructure underscores the chronic underinvestment in Nigeria's crucial oil sector. A poor regulatory framework and sabotage of oil facilities are deterring needed spending. Additionally, new discoveries in other African countries are offering viable alternatives to investors whose decisions now incorporate emissions intensity and faster returns as critical metrics.

For many, the future of the Nigerian oil industry hinges on the success of the Petroleum Industry Act to spur new investment. The new law has established regulatory bodies both in the upstream and downstream sectors and the incorporation of NNPC Limited. The law also offers improved fiscal terms to investors that the government believes will attract substantial new spending. However, recent signals from international oil companies do not look promising. Shell and ExxonMobil, for instance, have announced divestment plans. TotalEnergies is reportedly seeking to sell its 12.5% stake in deep water OML 118, which includes the Bonga field. Output from the block is expected to rise whenever the Shell-operated Bonga Southwest project finally gets off the drawing board.

On a brighter note, the 32 kb/d Ikike oil field, operated by TotalEnergies, came online last year. It is one of three projects alongside Owowo and Preowei that TotalEnergies has on its books.

Plagued by operational and technical issues at its high-cost deepwater oil fields, **Angola's** crude oil capacity is expected to fall by 350 kb/d to 820 kb/d by 2028. The 2021-22 start-up of a number of fields has helped to stem some of the near-term declines. Crude oil production was broadly steady y-o-y at about 1.1 mb/d in 2022, but that is down from a peak of 1.8 mb/d in 2015. TotalEnergies's Zinia Phase 2 project in Block 17 reached a peak of 40 kb/d last year. The deepwater project will feed into Pazflor exports. Output from Eni's 10 kb/d Cuica and 15 kb/d Cabaca North fields will be routed to the Olombendo FPSO in the eastern hub of Block 15/06. Eni also started up the Ndungu field on the west of the block in 2022. More short-term lift could be provided from ExxonMobil's discovery at the offshore Bavuca South-1 well, part of the Block 15 redevelopment plan, which is expected to deliver 40 kb/d.

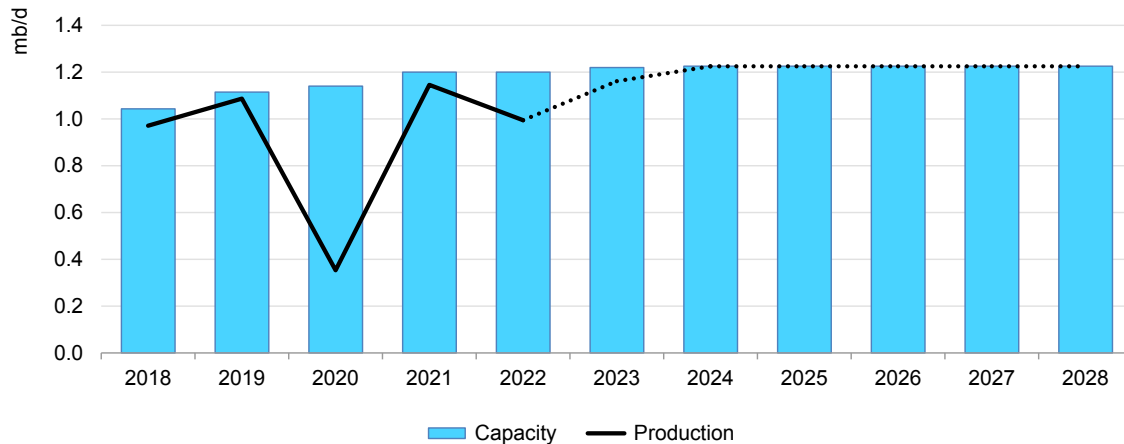
TotalEnergies meanwhile signed a heads-of-agreement in 2023 that paves the way for a long-awaited final investment decision to develop the offshore Cameia and Golfinho fields on Blocks 20 and 21. If given the go-ahead, the project would produce oil for the first time from the deepwater part of the Kwanza basin with initial production of around 70 kboe/d.

A prolonged period of civil unrest in 2022 led to a 150 kb/d annual drop in **Libyan** crude production to 995 kb/d. But by mid-2023, output had recovered to about 1.15 mb/d. As for capacity, we expect levels to hold broadly steady at around 1.2 mb/d over the six-year period. This of course depends on political stability and investment to fund infrastructure repairs.

To at least sustain current levels, Libya must rely on the southwestern el-Sharara oil field, the country's largest, which is pumping around full capacity of 300 kb/d. The nearby Elephant field can produce up to 80 kb/d. In the east, the Abu Attifel and Zueitina oil fields can each contribute around 70 kb/d. Other oil fields in the east operated by Arabian Gulf Oil Co (Agoco) and Sirte Oil Co can produce around 200 kb/d and 80 kb/d, respectively. The offshore Bouri and al-Jurf fields add 80 kb/d between them. Located in the northeast Sirte Basin, the Waha Oil Co, with current capacity of roughly 400 kb/d, is also key to further growth.

Libya's energy network has been battered by civil war, militant attacks and a lack of maintenance. A further boost in production will require rehabilitation of a number of fields in the eastern Sirte Basin, replacement of damaged storage tanks at the eastern Ras Lanuf and Es Sider terminals and repair of major pipelines.

Libya estimated crude oil production and capacity



IEA. CC BY 4.0.

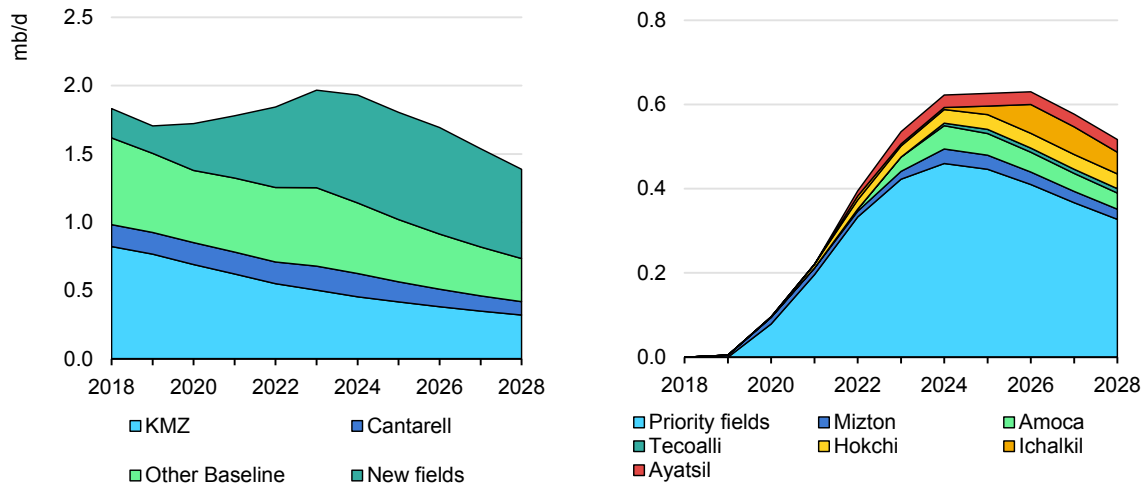
Note: Production assumption adjusted for call on OPEC crude.

There is also some hope that IOCs will seek to invest in its relatively low-cost production. TotalEnergies has said it is prepared to develop the Waha concessions – especially to boost the North Gialo field to 100 kb/d and restore 40 kb/d of output at the Mabruk oil field after it was targeted by Islamic State in 2016. Tatneft, which signed four production service agreements with the Libyan National Oil Corp in the Ghadames and Sirte basins, has restarted seismic exploration in Block 4/82 in the al Hamada area.

Mexico outlook deteriorates; Venezuela stems losses

After Russia, **Mexico** posts the largest loss among OPEC+ producers, dropping 500 kb/d to 1.5 mb/d. Its long-term oil production decline shows a brief respite in 2022-23 as the Quesqui field ramps up in earnest. The sector has had its ups and downs since the pandemic when Pemex severely curtailed planned investments. Fleetwood Energy's Ichalkil-Pokoch project has been operating continuously since start up and Eni's Area 1 has shown steady increases in volumes since the Miamte FPSO was put into service in 2022. Additionally, recent large discoveries by Eni and Wintershall Dea have added to those successes. To stymie declines in later years, commissioning the Zama and Trion fields will be crucial. Equinor's country exit and Shell's string of dry holes have raised doubts about Mexico's long-term growth prospects.

Mexico total production and contribution by new fields



IEA. CC BY 4.0.

Venezuela appears to have finally stemmed a long-running decline, with crude oil production rising for a second straight year to reach 700 kb/d in 2022 (+90 kb/d y-o-y). That is still 70% down on 2016, when it stood at nearly 2.5 mb/d. Further modest gains could be in store this year. The US at the end of 2022 loosened sanctions on Caracas following the resumption of talks between President Nicolas Maduro and opposition parties, allowing Chevron to restart operations at four joint ventures where it is a minority partner: PetroPiar, Petroindependencia, PetroBoscan and PetroIndependiente.

Washington imposed sanctions in 2019 on Venezuela that banned most activity by US firms in the country and halted the import of the country's oil into the United States. Under the new US Treasury licence, Chevron's joint ventures with Petroleos de Venezuela (PDVSA) can produce oil (including importing diluent) and the US company can lift that oil as repayment for investments it has made in Venezuelan assets. But near-term production upside is expected to be limited due to long-overdue maintenance and modest operational improvements.

As a result, we have only slightly increased our crude oil capacity estimate to 840 kb/d through the remainder of the forecast, although a turnaround in the political situation would provide the opportunity to rebuild the energy sector. Any recovery in production would require replacing lost professional skills and investment capital now and for the longer term.

PDVSA is meanwhile aiming to boost output by reopening wells and carrying out maintenance in its vast Orinoco Belt. Upgraders managed by foreign joint venture partners in the heavy oil belt have malfunctioned due to lack of maintenance and difficulty sourcing equipment, poor security and corruption. TotalEnergies and Equinor have divested their shares in the Petrocedeno joint venture due to its high

carbon intensity. The transfer of their respective 30% and 10% shares in Petrocedeno to a unit of PDVSA will give the state 100% control. The project includes the Junin oil field in the Orinoco Belt and a 200 kb/d upgrader that blends the extra-heavy crude into lighter crude, which PDVSA has restarted.

Non-OPEC+ supply

Non-OPEC+ supply grows in tandem with demand

The Americas drive a 5.1 mb/d increase in non-OPEC+ volumes over the six-year forecast period. US growth continues to be led by light tight oil developments, specifically in the Permian Basin. Guyana, powered by the ExxonMobil-led Liza project, is emerging as a substantial producer, and explorers continue to find new resources in its territorial waters. Farther south, Brazil ramps up production, with IOCs adding barrels and Petrobras commissioning half of the new FPSOs in the world. The Vaca Muerta shale play in Argentina has large upside potential and infrastructure is being put in place to ease takeaway capacity constraints.

Total Non-OPEC+ supply (mb/d)

	2022	2023	2024	2025	2026	2027	2028	2022-28
OECD	27.3	28.5	29.0	29.4	29.6	29.7	29.7	2.4
OECD Americas	23.6	24.8	25.3	25.7	26.1	26.4	26.6	3.0
OECD Europe	3.2	3.2	3.2	3.3	3.1	2.9	2.7	-0.4
OECD Asia Oceania	0.5	0.5	0.5	0.4	0.4	0.4	0.4	-0.1
Non-OECD	15.3	15.7	16.1	16.4	16.7	17.0	17.1	1.9
FSU	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.0
Europe	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0
China	4.2	4.3	4.3	4.3	4.2	4.1	4.0	-0.2
Other Asia	2.0	2.0	1.9	1.9	1.8	1.7	1.7	-0.4
Non-OECD Americas	5.6	6.0	6.4	6.8	7.0	7.3	7.5	1.9
Middle East	1.9	1.9	1.9	1.9	2.1	2.2	2.2	0.3
Africa	1.1	1.1	1.1	1.2	1.3	1.3	1.4	0.3
Non-OPEC+ Oil	42.5	44.2	45.1	45.9	46.4	46.7	46.8	4.3
Processing Gains	2.3	2.4	2.4	2.5	2.5	2.5	2.5	0.2
Global Biofuels	2.9	3.1	3.3	3.4	3.4	3.5	3.6	0.6
Total-Non-OPEC+	47.8	49.7	50.9	51.7	52.3	52.7	52.9	5.1
<i>Annual Change</i>	<i>1.5</i>	<i>1.9</i>	<i>1.2</i>	<i>0.8</i>	<i>0.6</i>	<i>0.4</i>	<i>0.2</i>	

Other parts of the non-OPEC+ world do not look quite as promising. The North Sea is on the front line of the energy transition with secure, stable and low-emission oil production and faces some of the greatest opposition to hydrocarbon extraction. A decade-long decline in Asia Pacific oil production continues as companies pivot towards gas developments. Other countries in South America are attempting to attract much needed capital to the upstream, but it is too early to

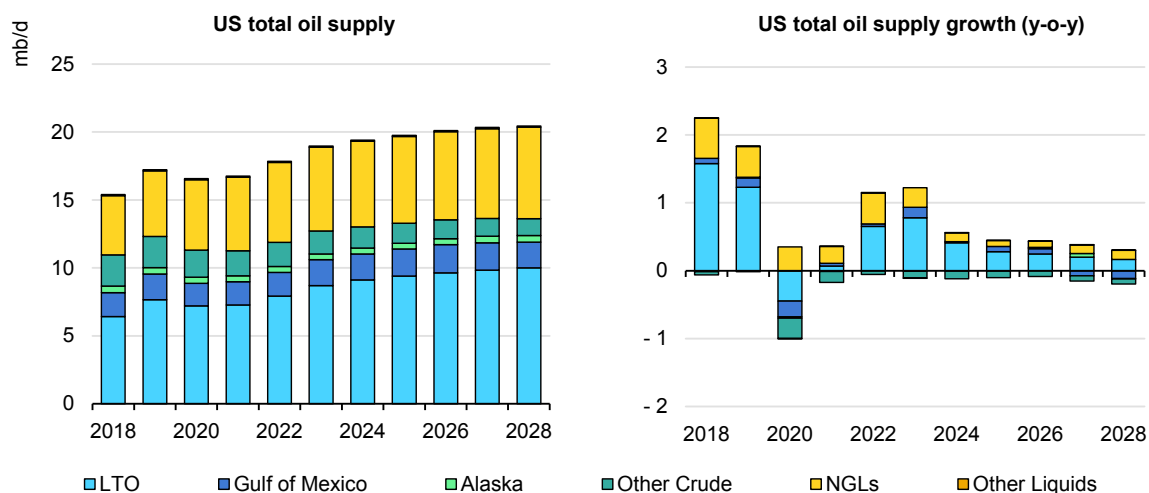
determine if they will be successful. Africa sees some countries produce their first barrels while others deal with legal, security, or Covid-19 related delays and disruptions.

US shale matures to a higher return, lower growth trajectory

A post Covid-19 recovery in **US** oil production was solidified in 2022 with production up 1.1 mb/d y-o-y. Total oil supply is expected to increase by a further 1.1 mb/d on average in 2023 to reach an all-time high of 19 mb/d. However, the pace of expansion markedly slows from 2024 onwards as producers navigate the energy transition and US LTO companies struggle with higher costs, increasing decline rates and lower output from new wells drilled.

Despite climate action, concerns of underinvestment and a sharp slowdown in LTO, the United States is still the largest contributor to medium-term supply growth at 2.6 mb/d by 2028, of which 1.7 mb/d is crude oil. NGL production is forecast to rise by 860 kb/d to 6.7 mb/d, led by higher ethane exports, as US LTO continues to grow and natural gas production shifts to more liquids-rich plays.

US growth expectations moderated by shifting investment strategies



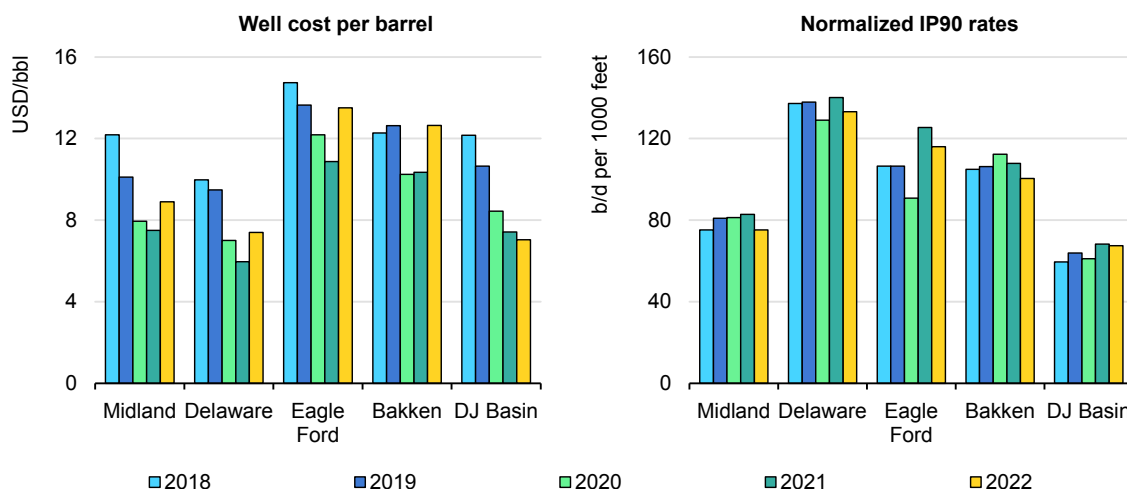
IEA. CC BY 4.0.

US crude oil production grows to 13.6 mb/d in 2028, setting new record highs through 2027. The increase is led by LTO, primarily from the Permian Basin. The shale patch has matured financially to a lower growth trajectory as it focuses on disciplined investing, de-leveraging and returning cash to shareholders. Reinvestment rates of 40-60% are expected over the medium term, compared with more than 160% from 2015-17. Publicly listed companies will likely continue

to prioritise shareholder returns, look to increase efficiencies through acquisitions and limit organic production growth.

US LTO production grows 2.1 mb/d from 2022 to 2028, to 10 mb/d, while conventional US onshore output is expected to decline by 550 kb/d over the same timeframe. Overall shale averages just shy of a 4% per annum growth rate, with the Permian Basin providing 80%. Gains are front-loaded as 780 kb/d of additions this year slow to just 170 kb/d in 2028.

Productivity increases have plateaued or reversed in key LTO basins



IEA. CC BY 4.0.

Notes: Well cost per barrel determined by dividing the median well costs by the median estimated ultimate recoveries. Normalised IP90 rates are median flow rates taken 90-days after a well is put on production normalised by the median lateral length.

Source: IEA analysis based on data from Rystad Energy ShaleWellCube.

Investment rates have continued to recover but may never return to pre-Covid levels as improvements in productivity had, in aggregate, been leading to lower recovery costs from 2016 until 2022. Although that may be little consolation for drillers today as they feel the pinch of high spec rig day rates that have increased over 50% in the last year, continued tightness of hydraulic fracking equipment (frack spreads) and persistent labour issues, as well as reduced well flow rates.

Furthermore, those investment dollars will target cost- and carbon-advantaged barrels as companies focus on reducing the carbon intensity to meet ESG pressures. For oil and gas executives, the question today may not be climate change per se, but in maintaining investor confidence that they can adapt their business models to the impending changes. An acceleration of decarbonisation efforts through capital redeployment, acquisitions and strategic partnerships is expected over the forecast period.

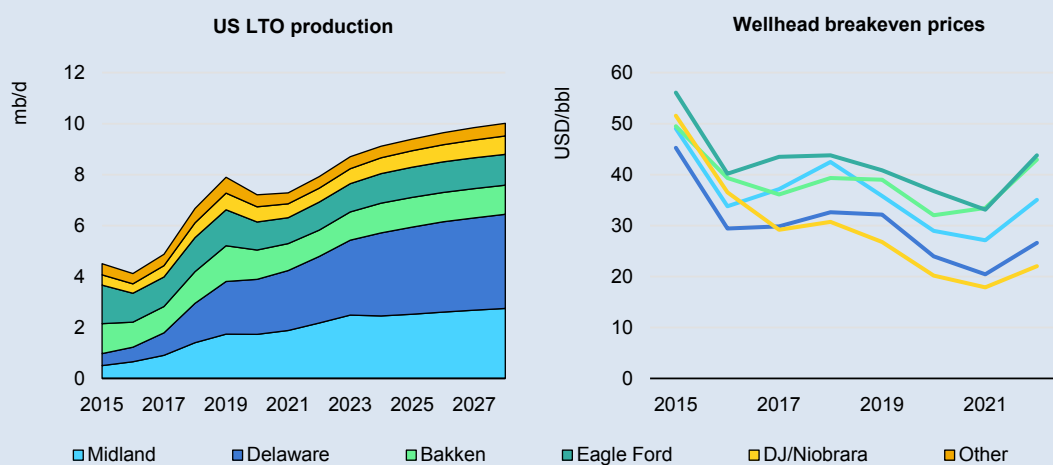
Shale growth at risk from lower prices, higher costs

The reaction of shale production to different prices is critical to markets as it has been a swing producer alongside OPEC+ in balancing markets over the last eight years. Yet, the responsiveness of the US shale industry vis-à-vis pricing has changed in the wake of the Covid-19 pandemic (see [November 2021 Oil Market Report](#)).

This was especially true in the summer of 2022 when prices surged but activity levels continued along their same trajectory. Equipment availability, lower reinvestment rates, productivity challenges and increased costs have squeezed the industry’s ability to respond and skewed risks to the downside.

While West Texas Intermediate (WTI) at USD 75/bbl is still sufficient to cover operating expenses even for the lowest quartile of operators in the Permian Basin, for many companies it is very close to threshold pricing for drilling new wells. After almost consistently falling since 2015, wellhead breakeven prices rose last year and are, so far, on track to log a second year of increases. Wellhead breakeven prices for shale in key basins are, on average, USD 14/bbl lower than half-cycle breakeven costs.

Base case US LTO production and wellhead breakeven prices



IEA. CC BY 4.0.

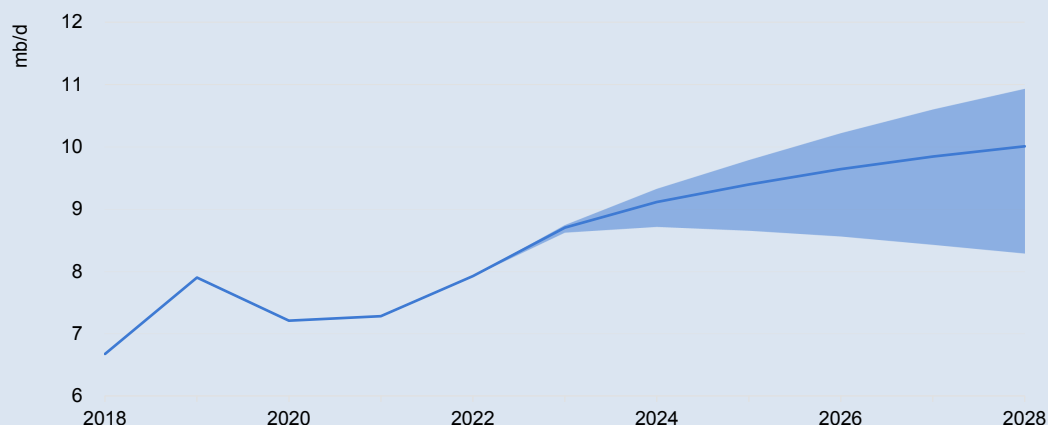
Source: IEA analysis based on data from Rystad Energy ShaleWellCube.

For modelling purposes, this report assumes that 30% of production is more responsive to forward strip pricing with the other 70% less price responsive due to hedging programmes, long-term corporate planning or other factors. That, coupled with production efficiency and multi-year correlations of completion activity to margins, forms the basis of our forecast.

In our base case, LTO output is expected to increase by 2.1 mb/d to around 10 mb/d in 2028. Should prices approach triple digits on a sustained basis or, conversely, stay below the threshold for drilling new wells, producers and oilfield

service companies are expected to respond accordingly. Our high-price sensitivity case estimates that an incremental 920 kb/d of production could come online by 2028, whereas, in our low-price sensitivity – essentially following the forward curve – we would expect roughly 1.7 mb/d of downside potential from our base case.

US LTO production with high and low-price sensitivities



IEA. CC BY 4.0.

Notes: Oil prices used for the base case are based on a spot crude price of about USD 76/bbl for North Sea Dated, and we assume this level remains constant in real terms over the forecasting period. High-price scenario: Assumes oil prices increase by 2.5% in real terms per annum, in line with their long-term historical pattern. Low-price scenario: Estimates of future spot prices are based on the ICE Brent forward curve (averaging USD 79/bbl in 2023 slowing to USD 67/bbl in 2028). These are then discounted to real terms.

In the US Gulf of Mexico, supply is expected to rise by 140 kb/d between 2022 and 2028, to 1.9 mb/d. Production peaks in 2026 at 2.1 mb/d after nine major new projects come online. These include 360 kb/d of capacity from four projects that started up in 2022 and 2023, and another 350 kb/d of projects being commissioned in 2024 and 2025. After 2025, production will begin to decline unless additional projects reach a financial investment decision (FID) in the very near term.

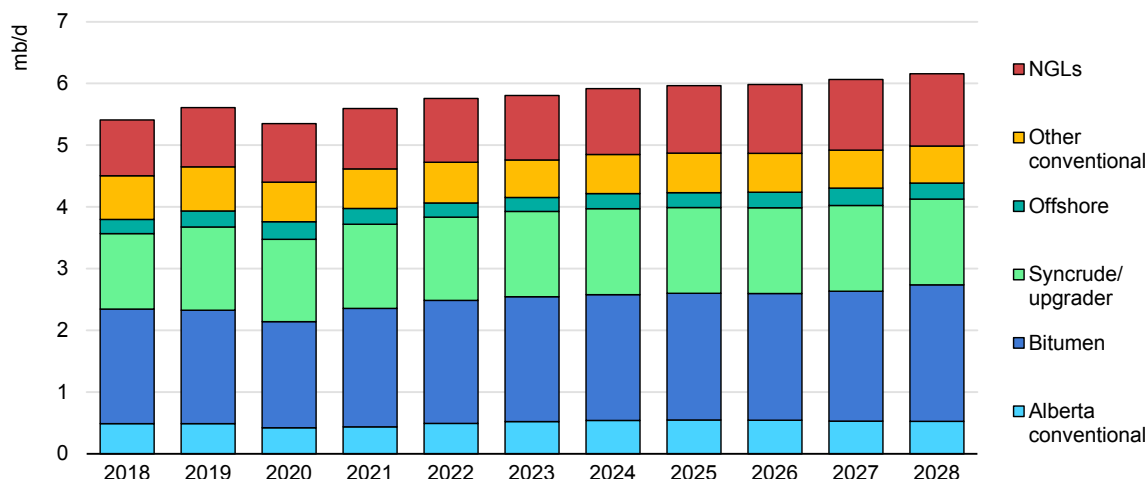
The results from the federal US Gulf of Mexico Lease Sale 259 (29 March 2023) achieved the highest gross receipts since 2019 and confirm that companies are interested in maintaining a footprint in the GoM after this current wave of projects. Of the blocks bid on, close to two-thirds are within 40 km of an existing hub – indicating a desire for a faster time cycle and lower costs of development utilising existing infrastructure.

Canadian oil sands rise despite risk of higher carbon tax

Canadian production continues to recover from its 2020 slump. Optimisation and debottlenecking of operations at oil sands projects will add incremental barrels,

but new capital projects are limited in number and scope by the scars of the pandemic, expectations of carbon tax increases and, like their US counterparts, calls by investors to return cash. By 2028, supply will be just shy of 6.2 mb/d, 400 kb/d more than in 2022.

Canadian oil supply by product, 2018-2028



IEA. CC BY 4.0.

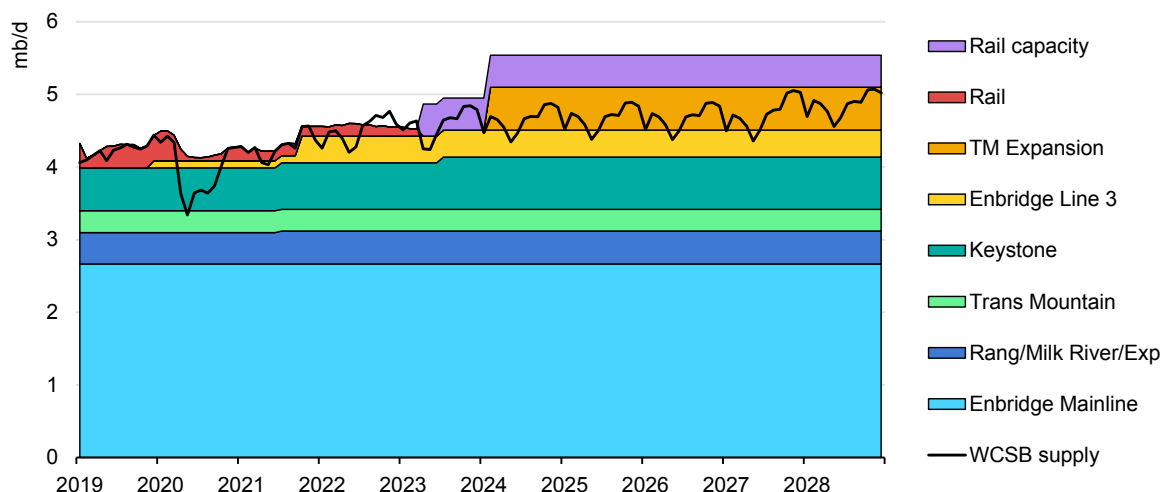
Canadian offshore output is set to grow by a marginal 30 kb/d to 260 kb/d by 2028 as the current renewed interest in the province does little more than offset base decline. The Suncor-led Terra Nova FPSO is expected to start in early 2024, targeting 70 million incremental barrels of oil. The Cenovus-led West White Rose project received FID last year and is slated to bring up to 80 kb/d to the market starting in 2026 – extending the life of the asset by over a decade. Additionally, Equinor and BP continue to study the 700 million barrel Bay du Nord project, having awarded front-end engineering and design (FEED) contracts earlier this year and working towards FID over the next few years, with a potential start date of 2030.

Takeaway capacity is projected to increase for the Western Canadian Sedimentary Basin as the Trans Mountain Expansion (TMX) pipeline is expected to start up in early 2024, provided financing constraints are resolved. The TMX pipeline, already 80% contracted, will nearly triple the capacity of the 1 150 km pipeline to over 890 kb/d of Pacific Coast exports.

Expected increases in Canada’s carbon tax will reduce growth in supply as operators assess higher investment costs. The proposed carbon tax could jump from around USD 30/tonne currently to approximately USD 135/tonne by 2030. The Royal Bank of Canada estimates the industry will need to spend USD 10.5 billion annually until 2050 to reach net zero emissions while the

Canadian Association of Petroleum Producers believes it will need to spend closer to USD 75 billion in total to achieve the goal. The size and range of these numbers highlights the challenge and uncertainty involved in reaching net zero.

Western Canadian Sedimentary Basin takeaway capacity



IEA. CC BY 4.0.

Sources: IEA analysis based on data from Enverus and company statements, [Canada Energy Regulator](#) (2023) (accessed 2 June 2023).

Brazil, Guyana, Argentina underpin Latin America growth

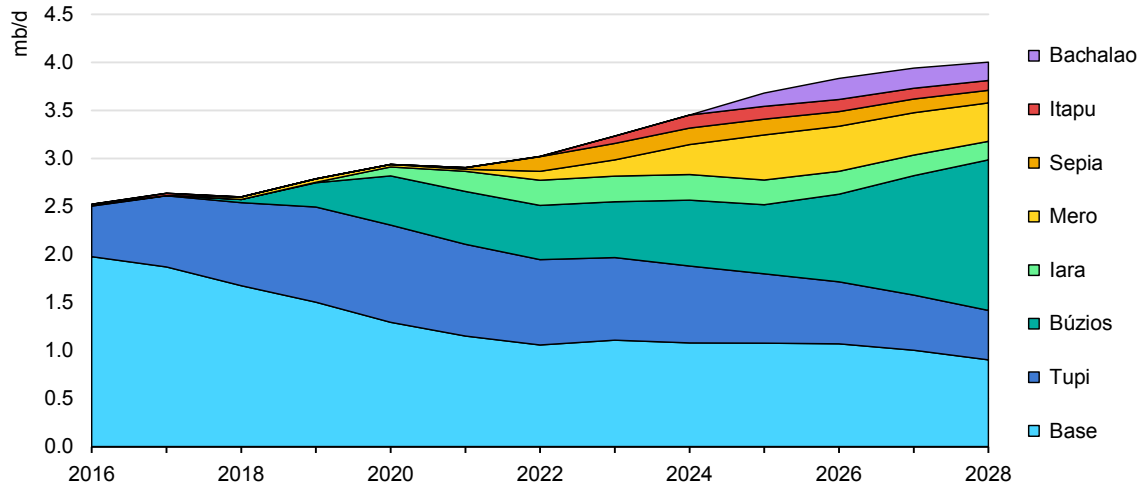
Total oil supply in non-OPEC+ Latin America grows 1.9 mb/d to 7.5 mb/d by 2028 as low-cost resources tapped in Brazilian offshore pre-salt reservoirs, the Stabroek block in offshore Guyana and the Neuquén Basin in Argentina's offset declines from the rest of the region.

Brazilian supply rises 970 kb/d by 2028, with Petrobras expected to contribute more than 70% of the increase. Other gains will come from TotalEnergies, Shell, Equinor, China National Offshore Oil Corporation (CNOOC) and China National Petroleum Corporation (CNPC) as IOCs and other NOCs expand their footprint in Brazil's prolific offshore. The Santos Basin currently produces 70% of Brazil's crude and is where the major projects and expansions are slated to occur over the forecast period. With a base production decline rate of between 10-15% per year, any significant project delays or operational issues could put Brazil's projected growth at risk.

Mero and Búzios are two large multi-phase projects that will total a combined 15 FPSOs by 2028, including five already in service. Including these FPSOs, Petrobras plans on bringing online 15 new FPSOs between 2022 and 2027, with three additional pre-FID FPSOs totalling 360 kb/d of capacity possible but not

included in this forecast. This represents approximately half of the world's FPSOs put in operation over this timeframe.

Búzios and Mero drive Brazilian growth through the decade

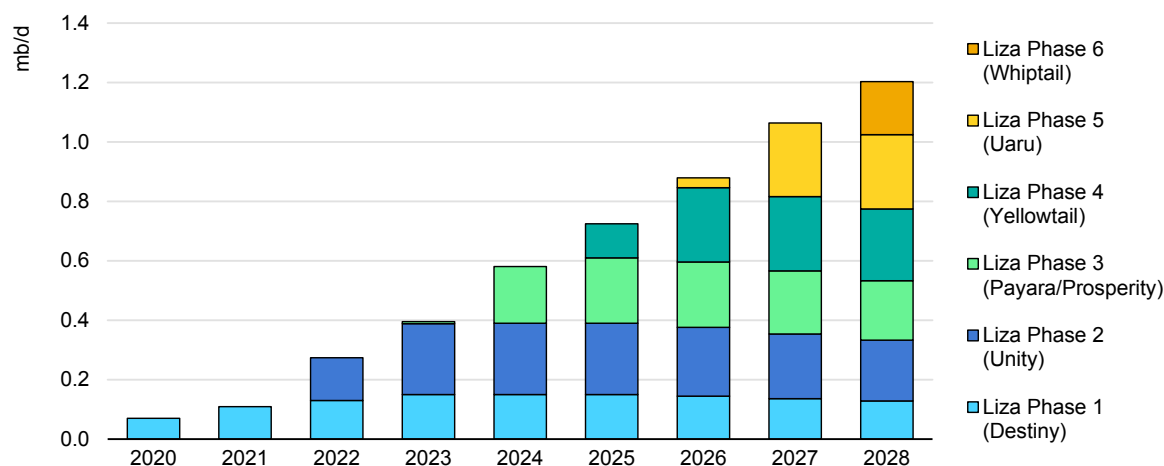


IEA. CC BY 4.0.

Argentina's main shale patch, Vaca Muerta in the Neuquén Basin, roared back to life in 2021 and 2022 after a Covid-19 induced pause in activity. Total feet drilled for exploitation wells rose 128% in 2021, led by state-owned Yacimientos Petrolíferos Fiscales (YPF) and BP-backed Pan American, and exports were up 45% on the year. In 2022, total feet drilled increase by 15% and is on track for another 20% gain in 2023. Exports will continue to grow this year with the completion of the Trans-Andean pipeline revamp, providing a Pacific loading terminal for Argentinian crude, and a capacity increase on the existing line to Puerto Rosales on the Atlantic coast. LTO production more than doubles to 610 kb/d over our forecast period, driving Argentina's total oil production to record highs of just over 1 mb/d in 2028.

Guyana will post explosive growth of almost 1 mb/d over the forecast period. The ExxonMobil-led consortium continues to make discoveries in the Stabroek Block where current estimates peg recoverable oil equivalent resources at over 11 billion barrels and discussions of a seventh phase have begun. Oil started flowing in 2019 from the 120 kb/d Liza Phase 1 development. The second phase, Liza Unity, started up in February 2022 while the third phase, Payara, is planned for 4Q23. Three more phases are planned for over the next six years, bringing total capacity to approximately 1.2 mb/d.

Guyana growth driven by recent discoveries in the Stabroek block



IEA. CC BY 4.0.

Notes: Phase 3, 4 and 5 sanctioned. Phase 6 currently in front-end engineering and design (FEED).

By contrast, supply is expected to decline in the rest of Latin America, with investment cuts and a lack of new projects taking their toll on the region's industry. **Peru** and **Ecuador** announced plans to boost investments in exploration and production over the next five years but the roadmap to increased volumes remains unclear. The new government in **Colombia** has changed direction and halted new exploration licences.

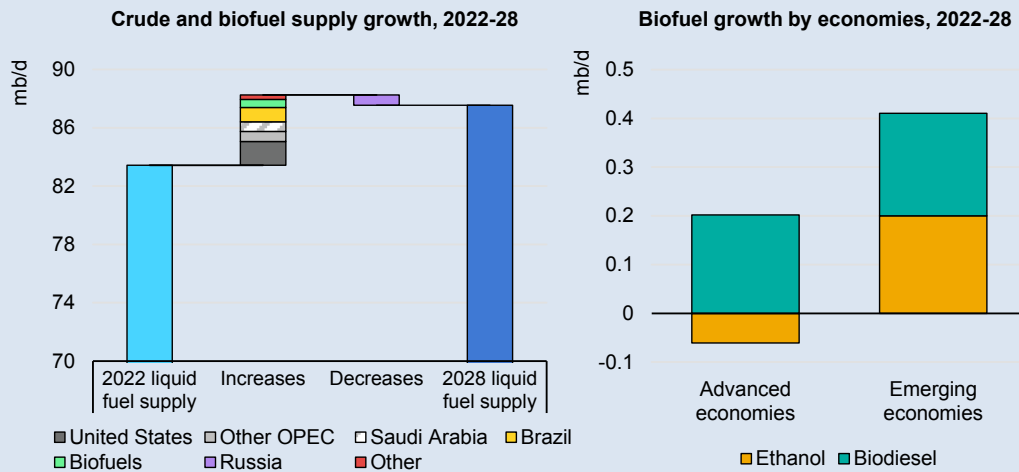
Biofuels to provide 10% of new liquid fuel supply growth to 2028

Biofuels production expands nearly 600 kb/d from 2022 to 2028, led higher by significant growth from emerging economies. Brazil, Indonesia and India combined account for 70% of the increase as each country pursues domestic blending targets. Policies aimed at reducing greenhouse gas emissions drive growth in the United States, Europe and Canada.

Ethanol and biodiesel supply increase by 30% in emerging economies from 2022 to 2028, primarily to support rising domestic demand in response to policies designed to reduce oil imports and GHG emissions while using domestic feedstocks such as sugar, corn and palm oil. Growing demand for liquid transport fuels also buoys biofuel production.

India is ramping up output to meet its 20% ethanol blending target by 2025, supported by guaranteed pricing and incentives for new ethanol facilities. In Indonesia, production expands to meet a 35% biodiesel blending goal, up from 30% in 2022 while Brazil is aiming for 15% for 2026. Brazil also champions ethanol

with an existing 27% blending target, tax breaks and RenovaBio – a carbon intensity reduction scheme. Indonesia, Brazil and India are all considering additional biofuel policies that provide considerable upside potential to growth.



IEA. CC BY 4.0.

Notes: Biofuels forecast from the IEA's 2023 [Renewables Market Update](#). Biodiesel includes renewable diesel, biodiesel and biojet fuel. Liquid fuel supply includes crude and liquid biofuels.

Greenhouse gas reduction targets also fuel biofuel demand growth in advanced economies, even as slowing transport fuel demand over the forecast period temper the overall increase. Renewable diesel and biojet fuel dominate new supply since it can be produced with low GHG intensity, often from residues, and blended with few modifications. In ethanol's case many jurisdictions do not have compatible infrastructure, such as pumps, to support higher blending levels. Static blending levels, combined with declining gasoline demand in advanced economies, leads to a slight decline in ethanol demand from 2022 to 2028.

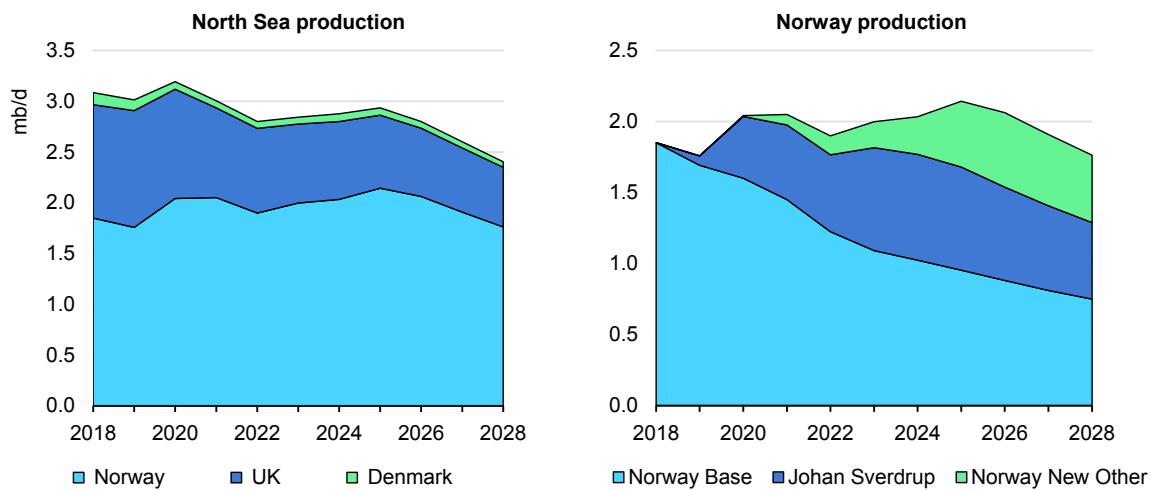
Policies in the United States, Canada and the European Union drive new demand. In the United States, the Inflation Reduction Act adds an estimated USD 9.6 billion [through 2031](#) in the form of tax credits and loans, in addition to the existing federal Renewable Fuel Standard Program and state level policies aimed at reducing GHGs and boosting use of renewables. [Canada's Clean Fuel Regulations](#), which sets annual greenhouse gas intensity reduction targets in the transport sector from 2023, in concert with provincial biofuel policies underpin demand growth.

In the European Union, member states continue to advance policies to meet the EU's Renewable Energy Directive target of 14% renewable energy in transport by 2030. This target will likely double, pending the outcome of [ongoing negotiations](#). However, this does not imply a doubling of biofuel demand since some biofuels are double counted and other pathways such as electric vehicles also count towards the total.

North Sea at frontline of the energy transition

The North Sea disappointed in 2022 on weak drilling activity, project delays and heavy maintenance. There is little to suggest a strong turnaround in the medium term, particularly in the United Kingdom where volumes are expected to drop 6% per year to a 45-year low of 590 kb/d by 2028. The situation in Norway is less dire; steep declines in base production mean new flows from major projects such as Johan Sverdrup Phase 2, Martin Linge and Johan Castberg will lead to a slight boost, peaking in 2025, before Norwegian output continues its downward march. Total North Sea production is forecast to decline by 400 kb/d to 2.4 mb/d from 2022 to 2028.

Investments in Norway delay but do not offset North Sea decline



IEA. CC BY 4.0.

Net zero ambitions of governments and major financial institutions could have strong implications for the North Sea – already home to some of the lowest emissions intensities in the world – where private equity’s footprint has continued to grow, reducing the major’s dominance. As such, North Sea producers are stepping up efforts to reduce the carbon intensity of their operations by electrifying upstream facilities to improve their longevity and remain attractive investment prospects.

The future of the North Sea oil industry has come under increased scrutiny in recent years. Volatile regional energy costs and Russia’s invasion of Ukraine have highlighted the importance of securing reliable energy supplies. Conversely, activists have been quick to point out the potential inconsistencies of governments encouraging, and banks participating in, further investment in fossil fuels while pursuing climate goals.

Despite mixed messages, the UK and Norwegian governments are broadly supportive of an industry that directly or indirectly provides 130 000 and 200 000 local jobs, respectively, and healthy tax revenues. While price action and profits during 2022 stoked conversations over windfall taxes, the jump in consumer prices also underscored the risks of limiting indigenous production and being dependent on energy imports.

Norway's production is expected to grow through 2025 as more than eight new developments have recently started or will start up before then, including the large Johan Sverdrup and Johan Castberg projects. With base declines north of 10%, supply of 1.8 mb/d in 2028 is 140 kb/d lower than 2022 with Johan Sverdrup accounting for almost one-third of Norwegian output in 2028.

Some modest **UK** supply gains will come from Shell's Penguin and Neptune's Seagull projects, with both expected online in 2023 and produce a combined 75 kb/d. Furthermore, BP is targeting improved production at the so far disappointing Clair Ridge project. However, these are not sufficient to offset years of weak investment, and with few projects sanctioned (or even pre-FID), output looks set to fall by 250 kb/d by 2028.

Asia Pacific oil is out of favour; non-OPEC+ Mideast expands

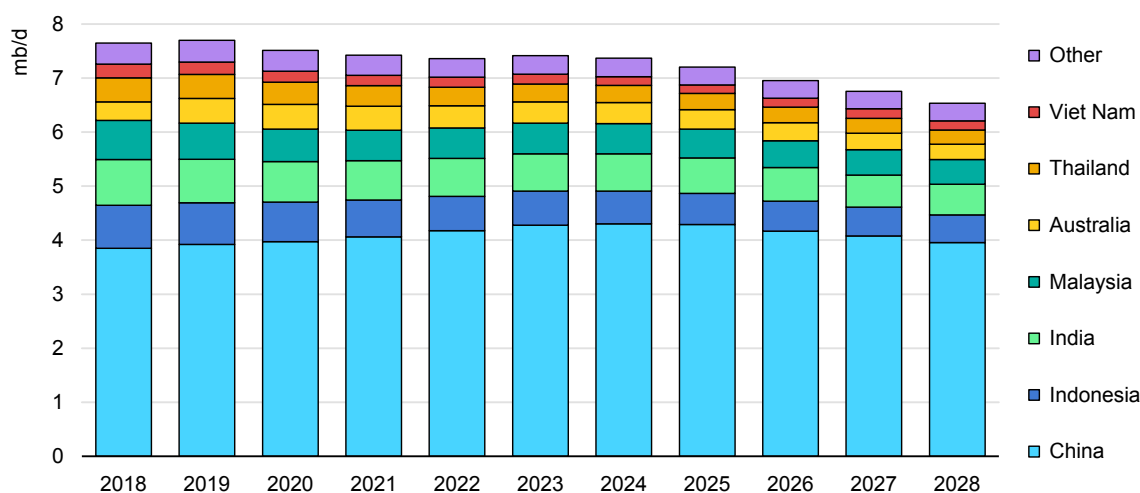
Non-OPEC+ Asia Pacific oil production continues to falter, with ageing oil fields, Western company exits and investments increasingly geared towards natural gas. Volumes, already down by close to 900 kb/d over the last decade, will fall a further 830 kb/d by 2028. China, Australia, India, Indonesia and Thailand all post large losses, totalling a combined 690 kb/d by the end of the forecast period.

Chinese companies have stepped up their efforts and increased investments to stem production declines, with supply relatively flat since 2016. The 14th Five-Year Plan (2021-25), initially released in March 2021, lays out ambitious energy and climate goals for China that prioritises energy security, coal and natural gas developments. While CNOOC continues to develop offshore fields and coal-to-liquids throughput is forecast to double over the medium term, these efforts will only partially offset natural decline. As a result, oil production in China is set to fall by 220 kb/d to 4 mb/d in 2028.

Australian supply is forecast to fall 30% to 280 kb/d by 2028 – driven by declines in the Greater Enfield development and in condensates from the Northwest Shelf. The recent approvals by Australian regulators of Santos' Dorado development have greatly increased the probability of a final investment decision on the project. If Santos approves the 100 kb/d Dorado development in 2023, production could potentially come online by 2026.

The other medium-sized producers – **Indonesia, Thailand and India** – all continue along managed decline trajectories with no major projects in the queue to turn around their faltering production. Output in Indonesia and Thailand has consistently fallen since 2016 and is forecast to slip by a further 120 kb/d and 80 kb/d, respectively, to 510 kb/d and 260 kb/d by 2028. India stymies its decline in 2024 as the KG-DWN 98/2 Northern Area project ramps up, but volumes slide 140 kb/d to 560 kb/d by the end of the forecast period.

Asian oil supply by country, 2018-2028



IEA. CC BY 4.0.

Meanwhile, **Qatari** oil supply is set to grow by 360 kb/d over the forecast period as it further develops associated condensates from the massive North Field. Its total oil production is due to rise to a record 2.1 mb/d in 2027 and climb higher still in 2028. The country's 48 million tonnes per year (Mt/yr) LNG expansion, with estimated investment of up to USD 50 billion, will be carried out in two phases: first the 32 Mt/yr North Field East (NFE) followed by the 16 Mt/yr North Field South (NFS). The two schemes combined are expected to raise LNG capacity from 77 Mt/yr to 126 Mt/yr and increase the volume of NGLs by 2027-28.

QatarEnergy has so far awarded a combined 26.25% in NFE to TotalEnergies (6.25%), ExxonMobil (6.25%), Shell (6.25%), Eni (3.125%), ConocoPhillips (3.125%) and Sinopec (1.25%). NFS was awarded to TotalEnergies (9.375%), Shell (9.375%) and ConocoPhillips (6.25%). NFE and NFS are expected to start up in 2026 and 2028, respectively. NFE will have four trains that are due to produce some 260 kb/d of condensate, 130 kb/d (11 000 t/d) of LPG and 70 kb/d (4 000 t/d) of ethane. NFS will have two trains that are slated to produce 130 kb/d of condensate along with LPG. Qatar's crude production of around 600 kb/d is expected to hold broadly steady over the next six years.

Africa: Two steps forward, one step back

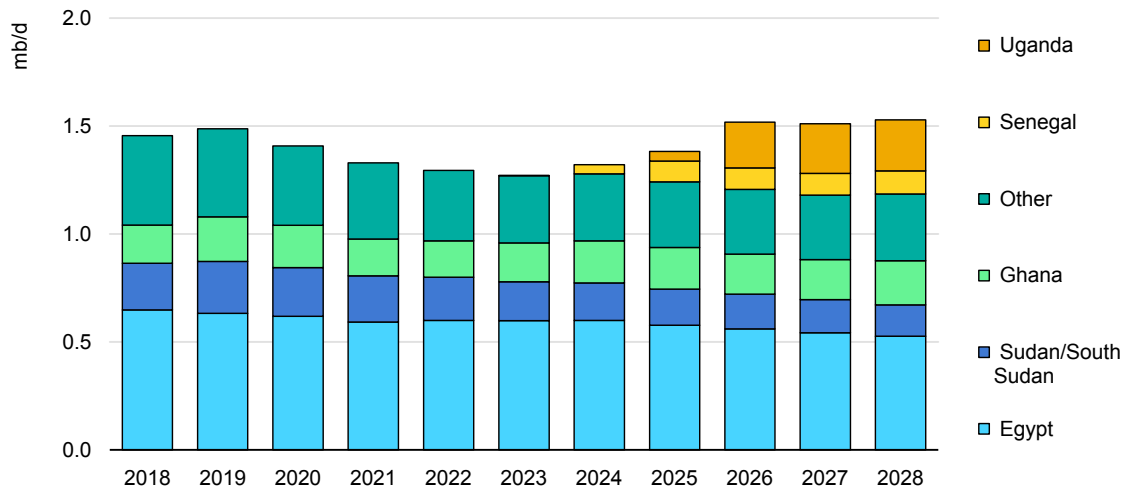
Non-OPEC+ African supply is set to steadily increase through the forecast period as projects ramp up in Ghana and Cote d'Ivoire, while Senegal and Uganda also join the producer's club. Recent mega discoveries in Namibia have brought a sense of optimism to the region after years of delays catalysed by the Covid-19 pandemic.

Senegal remains on track to become an oil producer in 2023 when Woodside's 100 kb/d Sangomar FPSO is commissioned. Additionally, Eni's Baleine project in **Cote d'Ivoire** is targeting first oil in 2023 with a large expansion yet to be sanctioned set for the later years of this forecast. Baleine will be Africa's first net zero oil and gas development (Scope 1 and Scope 2). It is a pioneering step for the industry to FID a major capital project with a full life cycle net zero intent. In **Ghana**, Mahogany-Teak-Akasa (MTAB) comes online in 2024 and adds 30 kb/d to Ghana's current output, with total production reaching 200 kb/d by 2028.

TotalEnergies and its partner CNOOC approved the USD 7 billion **Ugandan** Lake Albert development in late 2021, which had been repeatedly delayed due to financing issues and the lingering impact of the pandemic. First oil will come in 2025 and flows from the project's Tilenga and Kingfisher fields are expected to eventually reach 230 kb/d. TotalEnergies, along with Shell and QatarEnergy, are all large stakeholders in the recent Orange Basin mega discoveries off the coast of **Namibia**. While no development plans have been submitted to exploit the resource base, these fields could catapult Namibia as a producer along a similar path as Guyana from the end of the decade.

However, other African projects, such as Tullow's South Lokichar in **Kenya** and Aker Energy's Pecan in **Ghana**, remained in pre-FID status after years of delays due to legal disputes, protests and Covid-19. At the time of writing, field development plans had been submitted for both projects to their respective regulatory agencies. South Lokichar could add 120 kb/d from 2026 if sanctioned this year as FEED has been completed on a new 800 km export pipeline for the field. Yet that looks less likely with the recent exit of Tullow's non-operating partners from the project. Ghana's Pecan is estimated to have 100 kb/d of capacity, representing a 50% increase over our current forecast should development proceed.

Africa oil production by country, 2018-2028



IEA. CC BY 4.0.

Egyptian output has continued to slide but higher oil prices, renegotiated production sharing contracts, and further bid rounds have led firms such as APA Corporation and Eni to boost investment. As a result, APA Corporation anticipates that their gross oil output will increase at an annual growth rate of 5-10% through 2025, helping mitigate Egypt’s decline but not reversing it. Furthermore, Cairn and Cheiron are in the process of taking over Shell’s Western Desert acreage and state they plan higher spending and production.

Refining

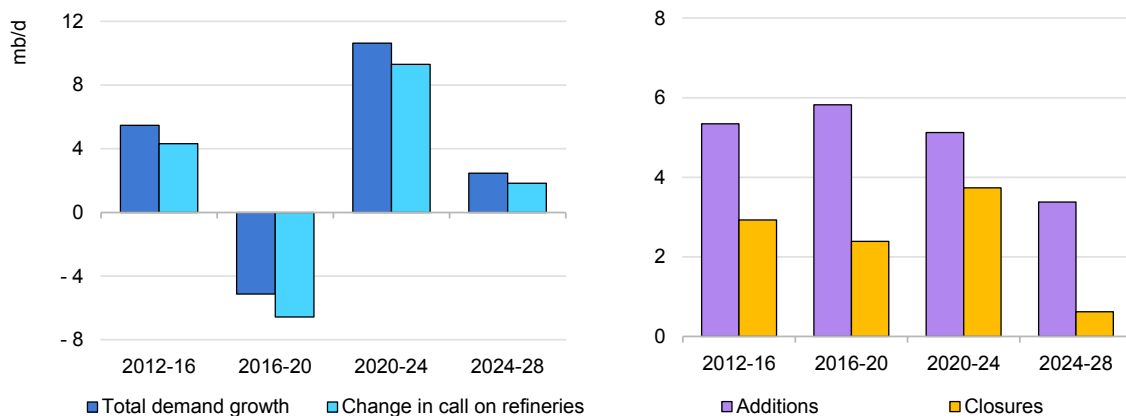
Global summary

Refining sector on cusp of third transformational shift

The refining industry faces its third step change in nearly as many years with an imminent peak in demand for road transportation fuels amid surging EV sales compounded by exceptionally strong jet fuel growth over the 2022-28 forecast period. This will challenge refiners to deliver a vital structural shift towards middle distillate product yields and petrochemical feedstocks. This fundamental change in refining dynamics follows quickly on the heels of the negative demand shock caused by the Covid-19 pandemic followed by the sanctions-related oil supply dislocations from Russia’s war in Ukraine.

Global refining capacity is expected to expand by a net 4.4 mb/d in our six-year outlook to 2028. Growth East of Suez dominates the big picture with China providing the largest increase, even as the next few years sees a brief revival in refinery expansions in the Atlantic Basin. New refinery additions will far outpace oil demand growth, with spare capacity estimated at 8 mb/d in 2028.

Slowing demand growth raises risk of further refining industry closures



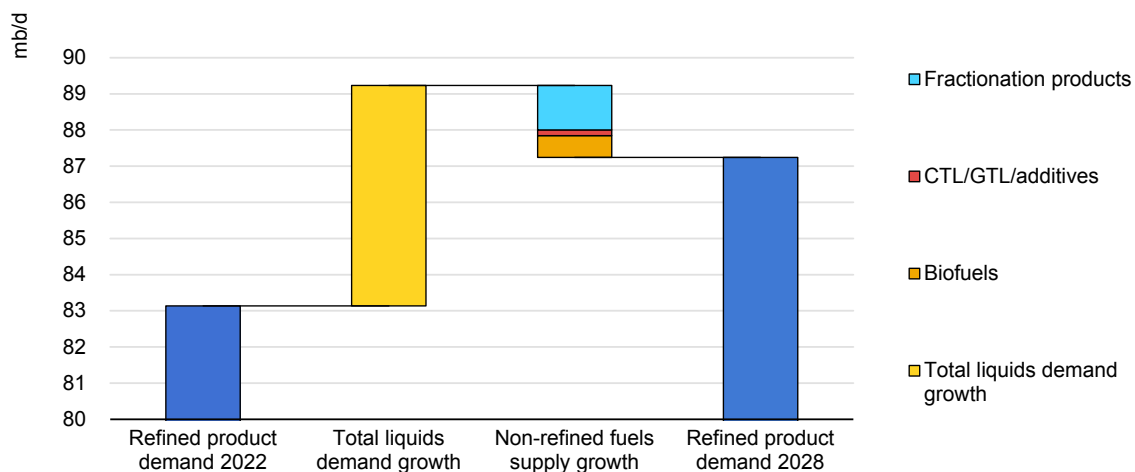
IEA. CC BY 4.0.

While nameplate capacity appears more than ample during our outlook, China’s internal policies aimed at reducing emissions from its refining sector could lead to continued volatility in product export volumes and yet again upend global supply flows and margins in the medium term. China now has the greatest share of

installed capacity in the world, after overtaking the United States in 2022, and will remain the largest holder of spare refining capacity over the medium term. Crucially, our forecast for product balances is heavily dependent on higher Chinese product exports, especially for diesel.

China’s dominance of spare refining capacity and the looming peak in transportation fuel consumption will require refiners to deftly manage their operations to sustain the profitability of their assets and meet oil demand in their markets. They will also need to adjust to a changing crude oil slate amid slower growth in US light tight oil (LTO) and the potential for OPEC+ producers to reduce exports of heavier crudes. Those refineries most exposed to these changes face the renewed risk of closure.

Refined product demand growth curtailed by competing sources of supply



IEA. CC BY 4.0.

Notes: Liquids demand growth is net of direct crude use. CTL/GTL are coal-to-liquids and gas-to-liquids, respectively

Efficiency gains and surging EV sales will impact gasoline demand more than diesel. Increased naphtha consumption will partly offset the projected decline in gasoline. But, despite shifting supplies towards the petrochemical sector, the overhang in light ends supply will prove challenging for refiners. While global diesel demand growth slows toward the end of the forecast period, persistent gains in jet fuel demand will offset this trend and tighten middle distillate balances. As such, refiners will need to significantly ramp up refinery yields towards middle distillate production.

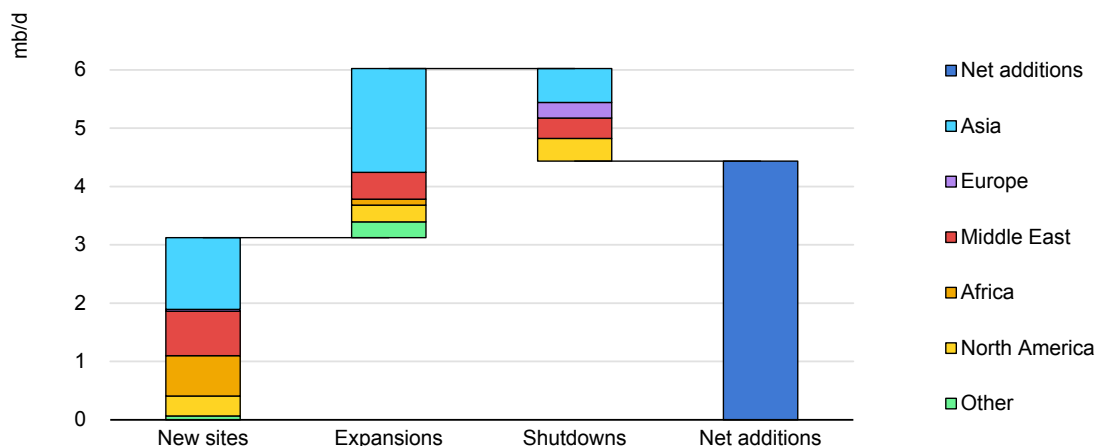
Refining capacity

East of Suez refining capacity migration accelerates

More than 6 mb/d of new crude distillation capacity is scheduled to be completed over the forecast period. At the same time, 1.6 mb/d of capacity is slated to shut, leaving a 4.4 mb/d net increase. East of Suez dominates the outlook, though the Atlantic Basin will see modest increases early in our forecast. A number of additional projects are in the planning phase, but we have excluded those that appear to lack the sufficient financial, organisational, or governmental support needed to be operational by 2028.

Approximately 3.9 mb/d of crude distillation capacity was closed in 2020-22, more than double the prevailing five-year average rate and well ahead of historical trends. The latest round of shutdowns following the Covid demand shock in 2020-21 are now largely complete and gross additions outpace closures by a healthy margin for the next three years.

Asia dominates 2022-2028 capacity expansions as Atlantic Basin closures diminish



IEA. CC BY 4.0.

Nevertheless, a further rationalisation of refinery capacity may be necessary in OECD Europe and OECD Americas. Both regions see a decline in demand for gasoline and road diesel before the end of the forecast. Furthermore, refiners in Europe are disadvantaged by inflated natural gas and electricity prices and stringent environmental policies, in particular the Emissions Trading System (ETS).

Gross refinery capacity expansions eclipse overall demand growth, and even more so the call on refined products, after allowing for higher biofuels and NGL supply. New sites lead the increase in additions, with greenfield projects totalling

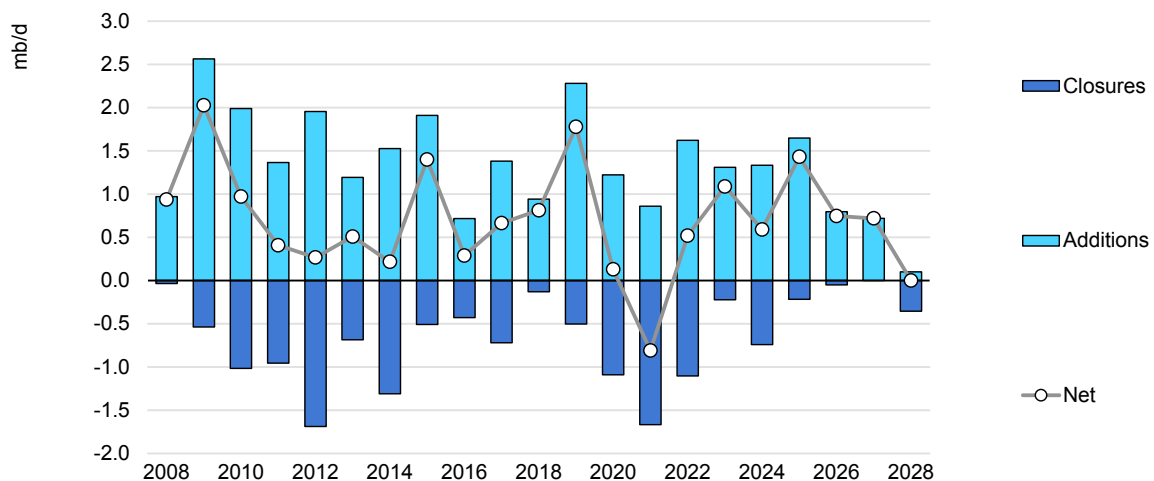
3.1 mb/d, including 2 mb/d from five mega refineries. At the same time, expansions to existing refineries will add 2.9 mb/d to capacity.

Regional refinery capacity and utilisation 2022-2028

	2022	2028	Change	2022	2028	Change	2022	2028
	Total capacity (mb/d)			Refinery throughput (mb/d)			Utilisation rates	
US	17.7	17.6	-0.1	15.9	15.2	-0.8	90%	86%
Other North America	3.4	3.8	0.3	2.6	2.8	0.2	74%	73%
Europe	14.6	14.3	-0.2	12.2	11.4	-0.8	84%	80%
FSU	9.1	9.2	0.2	6.5	6.3	-0.2	72%	68%
China	18.2	19.7	1.5	13.7	16.5	2.9	75%	84%
India	5.2	6.2	1.0	5.1	6.2	1.1	98%	100%
Other Asia	14.6	14.5	-0.1	11.0	11.0	0.0	76%	76%
Middle East	10.5	11.4	0.9	8.5	9.8	1.3	80%	86%
Latin America	6.1	6.3	0.2	3.6	3.7	0.1	58%	58%
Africa	3.2	4.0	0.8	1.8	2.4	0.6	55%	60%
World	102.6	107.1	4.5	80.8	85.2	4.4	79%	80%
Atlantic Basin	54.2	55.3	1.1	42.4	41.5	-0.9	78%	75%
East of Suez	48.4	51.7	3.3	38.4	43.7	5.3	79%	84%

Net refinery capacity additions will average 740 kb/d per year over the period, on par with historical averages. Only announced refinery closures are included within our estimates. Approximately 70% of the 6 mb/d of new capacity is located East of Suez. China is expected to be the single largest contributor with India and the Middle East tied in second place.

After the first fall in 30 years in 2021, refining capacity growth rebounds

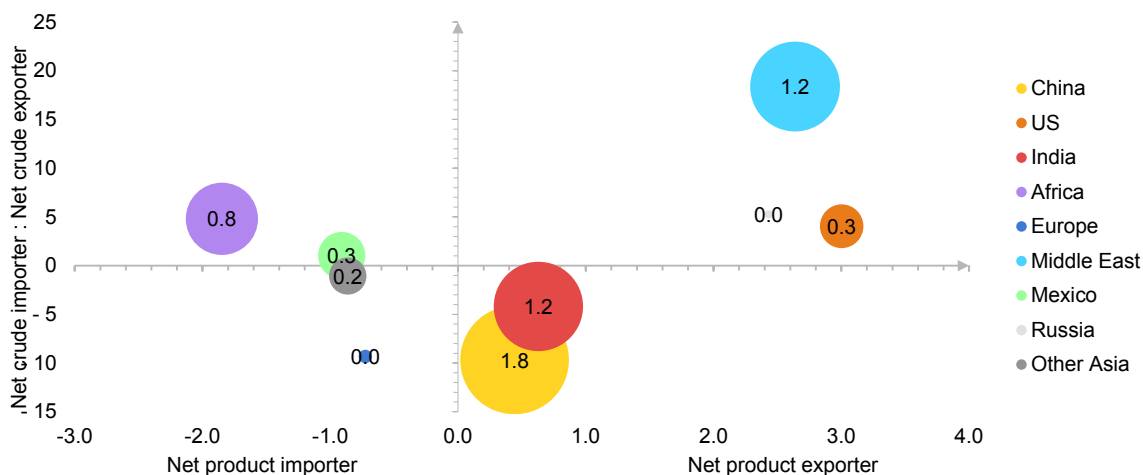


IEA. CC BY 4.0.

The addition of several world class refineries underpins China’s capacity increase, which have the flexibility to produce both oil products and petrochemical feedstocks. The Yulong Petrochemical (2025), the Saudi Aramco/Norinco Panjin (2026) and Sinopec Zhangzhou (2027) will each boost capacity by more than 300 kb/d each. However, even China is expected to see mounting refinery capacity closures by the end of the forecast period as the government shuts down smaller teapot refineries and as a consequence of falling domestic demand in the later years of our forecast. Elsewhere in Asia, Indian refinery expansions drive much of the remaining regional growth.

The commissioning of 1.8 mb/d of new refining capacity in the Atlantic Basin stands in stark contrast to the longer-term trend for capacity closures. However, this shift is a temporary reprieve and reflects the start-up of two world-scale refineries in Nigeria (650 kb/d) and Mexico (340 kb/d), plus the expansion of ExxonMobil’s Beaumont refinery (+250 kb/d) and the completion of the second train of the RNEST refinery in Brazil. (+115 kb/d).

Net product exporters dominate refining capacity building, 2022-2028 (mb/d)



IEA. CC BY 4.0.

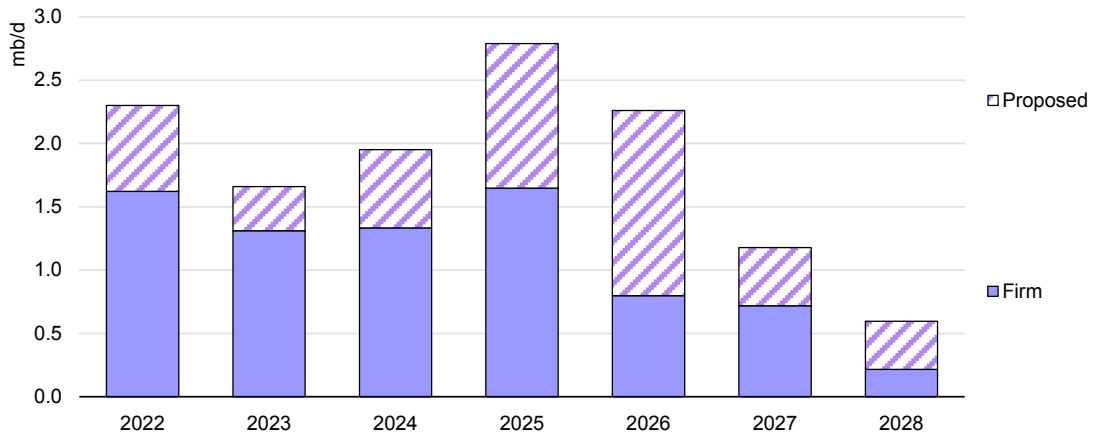
Note: Circle size represents the 2022-2028 gross change in refining capacity, placement on axis represents trade position.

After the onset of the pandemic and a sharp decline in global product demand, the refining industry was pushed into turmoil resulting in a record wave of shutdowns. Refinery rationalisation removed 3.9 mb/d of capacity over the three-year period from 2020 to 2022. Furthermore, many new-build projects were delayed by contracting problems and logistical issues.

Projects delayed by Covid-19 are now advancing and capacity additions remain broadly steady over the forecast period. While 2022 projects are not included in our forecast period, it was an impressive year for new refining projects. Last year, net refining capacity additions rose by 1.6 mb/d, with most projects ramping up in

4Q22. The Middle East increased capacity by 640 kb/d, with the first phase of Kuwait's Al Zour plant adding 410 kb/d of crude distillation while Iran's Abadan complex was boosted by 200 kb/d. At the same time, China brought on line three new refineries totalling 820 kb/d.

Firm and proposed refinery capacity additions



IEA. CC BY 4.0.

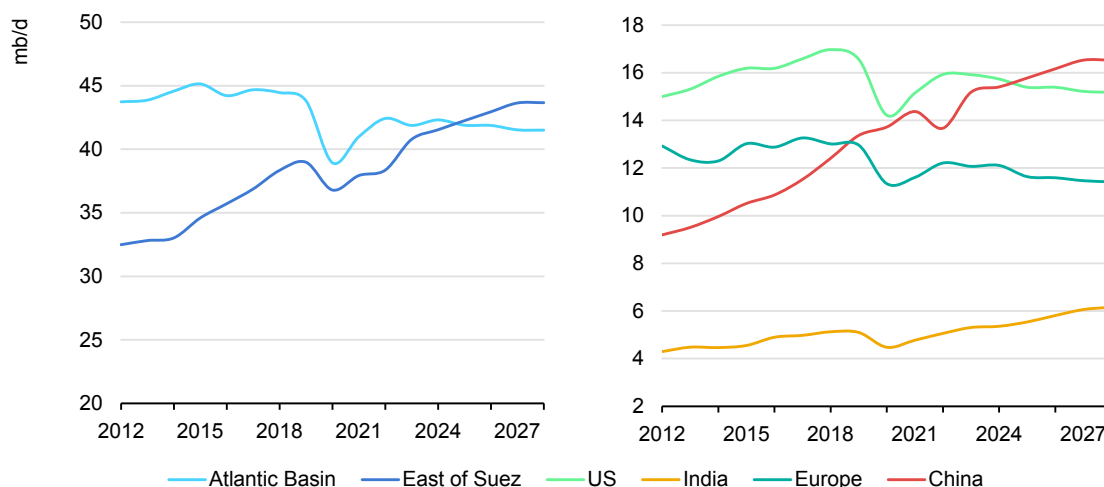
The eastward migration of refinery activity is accelerating, driven by the recent capacity closures in Europe and the United States and additions in the Middle East and Asia.

In terms of net capacity additions, regions East of Suez make up the bulk of the increase, with 3.3 mb/d of net capacity growth. China leads the new builds, contributing 1.5 mb/d or 34% to the net global additions through 2028. The Middle East raises net capacity by 900 kb/d, while Other Asia adds 1.1 mb/d over the same period. India also accounts for a significant share of the increase, with a net add of 1 mb/d, of which 880 kb/d are expansion projects.

By contrast, the Atlantic Basin is expected to only add 1.1 mb/d of net capacity, as the Dangote mega refinery in Nigeria and Dos Bocas in Mexico come online in 2024 and 2025, respectively.

Announced shutdowns amount to 1.6 mb/d, of which roughly 40% will be in the United States and Europe. East of Suez has 1 mb/d of closures scheduled; mainly as ageing capacity is rejuvenated and replaced by new units.

Regional and country refinery throughputs, 2012-2028



IEA. CC BY 4.0.

Refining industry adapts to demand changes

Global oil demand growth is set to slow dramatically in the coming years, driven by the peak and subsequent decline for transportation fuels. Demand will also be constrained by tepid economic activity, efficiency gains and behavioural changes. Owing to the post-pandemic rebound, headline demand growth is set to average 3.4 mb/d per annum in 2021-23 but is projected to slow to just 1 mb/d on average for 2022-28. Excluding the last impact of the post-Covid-19 recovery in 2023 this rate of growth slows to 690 kb/d on average over the 2023-28 period.

As highlighted in the table below, the demand for refined products is further depressed by increased non-refinery supply. Primarily this comes from NGL fractionation plants, which increases by 1.2 mb/d over the forecast period. Similarly, biofuels supply growth as well as higher coal-to-liquids (CTL) and gas-to-liquids (GTL) volumes further reduce the call on refined products as we approach the end of the forecast period. Refined product market share declines to 82.5% in 2028 from 83.3% in 2022 and 86.8% in 2012. Consequently, we expect refiners will see demand for their products lag the headline increase, averaging 690 kb/d per annum in 2022-28. This growth slips to just 450 kb/d on average if we consider only the 2023-28 post Covid-recovery period.

The loss of Russian feedstocks due to embargoes has forced US and European refineries to increase crude oil imports from alternative sources. A reduction in Nigerian crude oil exports following the start-up of the Dangote refinery next year will squeeze Atlantic Basin crude supplies and further burden export-oriented Atlantic Basin refineries.

Oil demand and call on refined products (mb/d), 2022-2028

	2022	2023	2024	2025	2026	2027	2028	2022-28 growth
Total liquids demand	99.8	102.3	103.1	104.1	104.8	105.3	105.7	5.9
Biofuels	2.8	3.0	3.2	3.3	3.4	3.5	3.4	0.6
Total Oil demand	97.0	99.2	100.0	100.8	101.4	101.9	102.3	5.3
CTL/GTL*/additives	0.7	0.8	0.8	0.8	0.8	0.9	0.9	0.2
Direct use of crude oil	1.0	1.0	1.0	1.0	0.9	0.9	0.8	-0.2
Total call on refined oil products	95.2	97.4	98.2	99.0	99.6	100.1	100.5	5.3
Fractionation products**	12.1	12.4	12.6	12.7	12.9	13.1	13.3	1.2
Refinery product demand	83.1	85.0	85.6	86.3	86.8	87.0	87.2	4.1
Refinery market share	83.3%	83.1%	83.0%	82.9%	82.8%	82.6%	82.5%	-0.8%

Notes: *CTL/GTL: Coal-to-liquids and gas-to-liquids. **Ethane, LPG and pentanes plus, excluding estimated diluent use in North America.

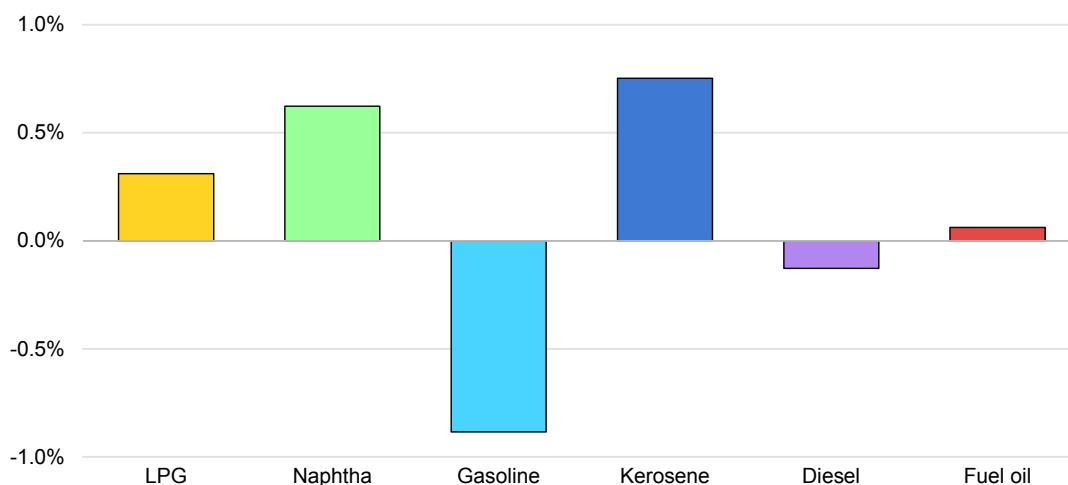
Transportation fuels have been the bedrock of product demand growth for the past 50 years, but a sea change in demand trends amid the energy transition diminishes their role in the future. As a result, peak transportation demand for oil products presents an existential challenge for less competitive refineries. Demand growth for transport fuels is forecast to turn negative before 2028, driven by gasoline. Crucially, key regional demand centres, such as the United States and Europe, will all see their gasoline consumption contract. In aggregate, between 2022 and 2028 gasoline demand falls by more than 1 mb/d. Furthermore, key export markets for gasoline for both the US Gulf Coast and European refiners will shrink over the forecast period as new refinery capacity starts up. With both domestic and export demand set to slump, margins and runs will likely come under pressure.

Globally, the refining industry will have to adjust to the decline in gasoline consumption post-2023 in contrast to sustained diesel/gasoil demand growth. This accentuates the mismatch between the two products, which will increase the strain on refineries to further increase middle distillate yields, given robust jet/kerosene demand. Simultaneously, the resilience of the petrochemical industry underpins growth of naphtha and LPG, but much of this will be met by increasing US NGL supplies, that bypass the refining sector.

The decline in gasoline demand will undermine refineries' reliance on upgrading units to maximise the production of light distillates from residual feedstocks. At the same time, incremental naphtha demand – to meet rising petrochemical use – could pressure gasoline's premium to naphtha. The growth in jet/kerosene consumption will tighten middle distillates markets and sustain the incentive to maximise middle distillate yields.

On balance, we expect to see refining yields adjust to the global demand dynamics by boosting jet/kerosene production by close to a full percentage point and, where possible, increasing diesel's share of output marginally.

Change in global refining yields, 2022-2028



IEA. CC BY 4.0.

Note: The category of Other Products is excluded as yields have zero change over the period.

The demand shock created by the pandemic prompted widespread run cuts in the face of weak and, at times, negative product cracks. This challenge, while global, was simple to solve given the scale of the demand collapse. Rapidly implemented run cuts – and capacity closures – offered the solution to a weak margin environment. Conversely, the global realignment of crude and product flows during 2022 offered challenges and opportunities in equal measure.

Some 2.5 mb/d of Russian crude has been dislodged from long-term buyers in Europe and the United States and has been heavily discounted to find new customers in Asia. This has created a two-tier market for sour crude grades, which has pressured Asian crude differentials for Middle Eastern grades to compete with heavily discounted Russian supplies. By contrast, European and US refiners have bid up Atlantic basin sour crude values in order to attract incremental cargoes.

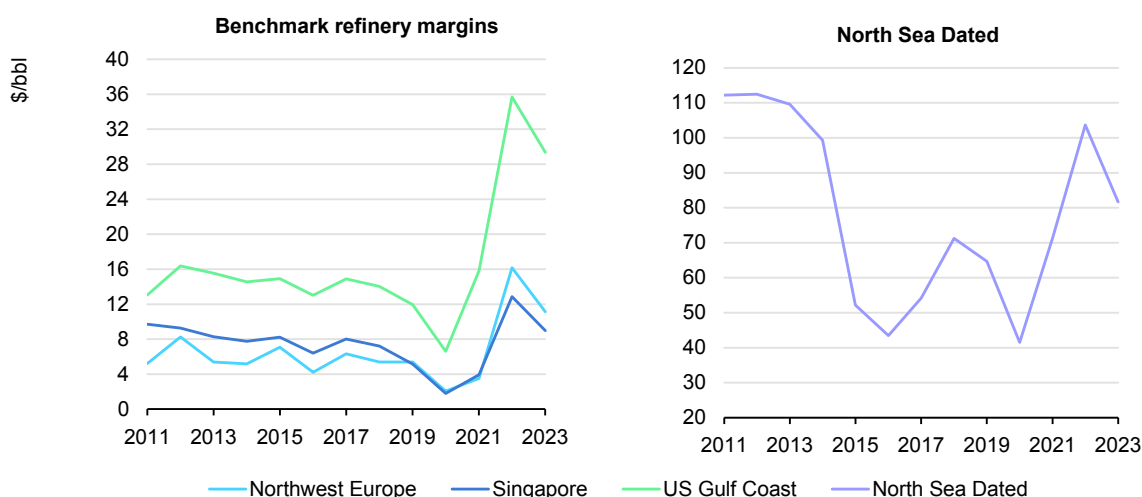
China will remain the largest holder of spare refining capacity over the medium term. The forecasts for product balances demonstrate the need for China to remain a key supplier of product exports, in particular for diesel. Chinese middle distillate exports will be subject to government export licences and the refining industry must regain its bias towards producing and exporting diesel if even tighter middle distillate markets in the medium term are to be avoided. Other policy considerations, such as supplying a burgeoning petrochemical industry, stimulating the wider economy, or possibly once again limiting carbon emissions could also prove more compelling policy priorities.

Record profits unlikely to spur new wave of refinery investment

Refinery margins and profits rose to record highs in 2022 as the industry struggled to keep pace with the post-pandemic demand rebound amid restrained OPEC+ crude supplies. Unprecedented dislocations in global oil trade flows following Russia’s invasion of Ukraine further compounded the market tightness. Prolonged Covid-19 lockdowns in China that cut its oil demand, the release of strategic stocks by IEA member countries and the warm Northern Hemisphere winter eventually facilitated the return to more normalised inventory levels and product cracks.

The factors that contributed to the exceptional profits generated last year are unlikely to be repeated on a sustained basis. Consequently, the oil industry’s newly rediscovered capital discipline is not expected to be reversed on the back of 2022’s record middle and light distillate cracks to justify capacity additions.

Record refining margins posted in 2022, especially for US Gulf Coast



IEA. CC BY 4.0.

The hurdles that need to be cleared to build new refining capacity appear prohibitive for many. Capital costs are still high when measured versus mid-cycle margin assumptions. Chinese refining projects appear to benefit from a streamlined permitting process and sit at the low end of the global cost curve. Furthermore, the heavy integration with new petrochemical capacity underpins the long-term demand for the refinery’s output. Select stand-alone projects, such as the Barmer refinery in India, can also be justified where there are compelling economics. However, the lead time for new-build refining capacity can stretch to 5-10 years given complex environmental permitting processes. Even under the most optimistic assumptions, a new refinery project under consideration today will

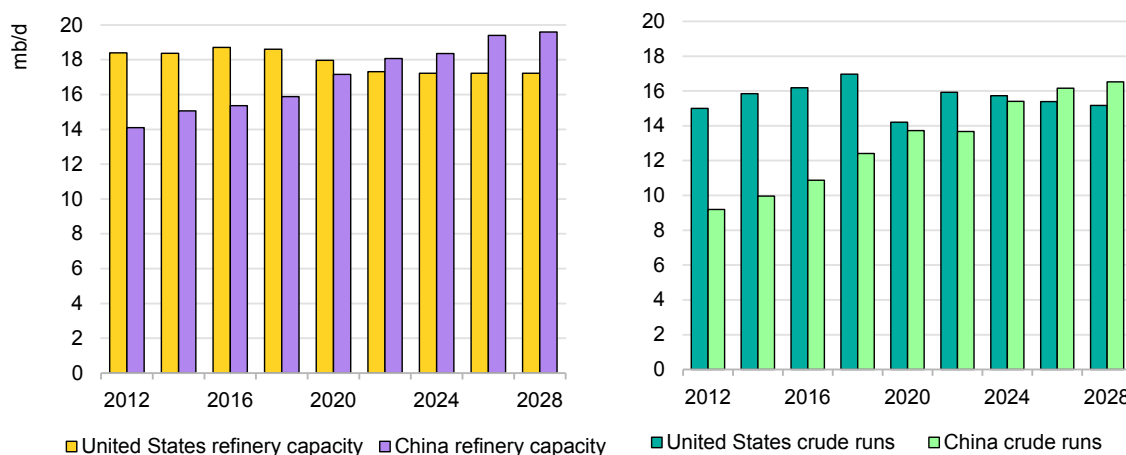
become operational in an oil market where global oil demand is declining. Without the security of protected domestic demand, international competition for market share will likely intensify.

Regional developments

Americas refining capacity posts marginal gains

The United States lost its position as the world’s largest refiner by installed capacity in 2022 due to the rapid rise in new Chinese refinery builds. However, the United States is still expected to process more crude than China until 2024, before being overtaken in the subsequent years. US throughputs in 2028 are seen 750 kb/d lower than in 2022, and 1.8 mb/d below the pre-Covid 2018 peak due to refinery closures in recent years. The United States shale revolution, combined with the ban on crude exports in place until the end of 2015, triggered a mini-boom in refining capacity, with new additions between 2014-2023 totalling 840 kb/d, from both greenfield projects and expansions. However, ExxonMobil’s Beaumont refinery build-out, which came online early in 2023, is likely to be the last major project in the United States.

China refining capacity overtook United States in 2022, throughputs in 2025



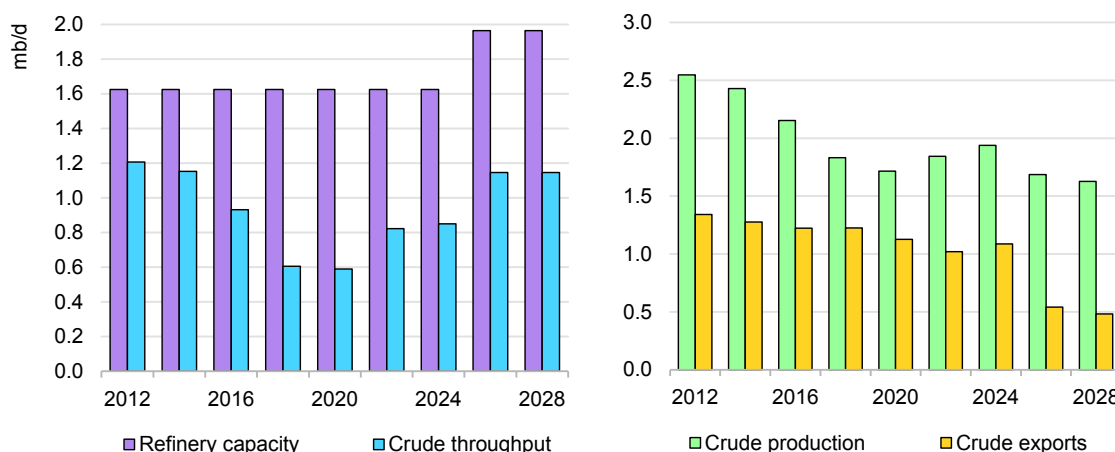
IEA. CC BY 4.0.

Nevertheless, challenges lie ahead for the region. North American demand growth is the most severely impacted by shift to EVs and efficiency improvements. Regional gasoline contracts by 1 mb/d between 2022 and 2028. If measured against the pre-Covid demand peak, the cumulative loss is 1.6 mb/d. Diesel/gasoil use is also forecast to decline by 400 kb/d over the forecast period.

The **Mexican** government is pushing ahead with the new 340 kb/d Olmeca/Dos Bocas project along with extensive repairs to its current fleet of refineries. Despite the large cost burden, the plans will increase clean product output and expand the domestic processing capacity of heavier crude grades. The country’s 1.6 mb/d refining capacity operated at just 51% on average in 2022 and only slightly ahead of this processing rate in 1Q23. We assume that Dos Bocas will start in 2025, well behind schedule and significantly over budget. With successful rehabilitation, Mexico could effectively increase its operable refining capacity by about 1 mb/d. However, for now we take a more cautious approach and forecast runs increasing to 1.1 mb/d in 2028, from 820 kb/d in 2022.

Industry reports indicate that Pemex plans to stop selling its heavy Maya grade, a staple for several US Gulf Coast coking refineries, to third parties when its 340 kb/d Dos Bocas refinery starts operations.

Mexican refinery capacity, throughput, crude production and exports



IEA. CC BY 4.0.

Flows of Canadian crudes to the US Gulf Coast have been steadily increasing from their Covid-related collapse in 2020. Despite the cancellation of the Keystone XL project, pipeline developments continue to progress, with the reversed Capline and Enbridge’s expanded Line 3 completed, allowing an important link between Alberta and the US Gulf Coast. Nevertheless, competition for heavy Canadian grades will increase once the Trans Mountain Expansion Project (TMX), which will move crude oil from Alberta to the British Columbia Pacific coast for onward shipping to Asia, comes online. The project, which will increase capacity from 300 kb/d to 890 kb/d, will open up new export markets for Canada’s oil sands production, which currently moves via pipeline to the US Midwest. The pipeline is currently 80% complete and is expected to start shipping oil in 2024.

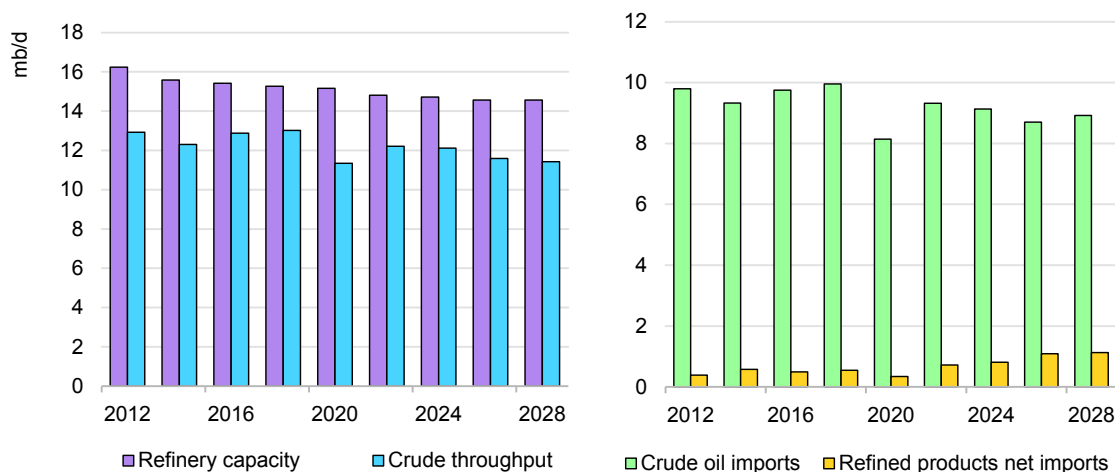
In **Canada**, no major developments are expected in the refining sector throughout the forecast period. The shuttered 115 kb/d Come by Chance refinery is currently being converted into a biorefinery. The conversion is scheduled to be completed by the end of 2023, with the plant's biodiesel available to the market at the end of 1Q24. The refinery will produce more than 18 kb/d of renewable diesel and sustainable aviation fuel made from plant-based waste oils and animal fats.

In **Brazil**, Petrobras' 2023-27 strategic plan allocates USD 4.3 billion for downstream "capacity expansion, quality and efficiency". The Train 1 RNEST expansion project is expected to come online in 4Q24, and will raise processing capacity at Train 1 from 115 kb/d to 130 kb/d. The company has committed to restart work on Train 2, which is currently 82% complete, which will add a further 115 kb/d, nearly doubling the plant's capacity to 245 kb/d. We expect that Train 2 will be commissioned in 2Q28. Furthermore, Petrobras plans to increase processing of the country's crude from subsalt fields to maximise ultra low sulfur diesel (ULSD) output.

Europe

European refiners shut-in 610 kb/d of capacity in 2020-22, extending the region's long-term trend of closures that has seen 2.3 mb/d permanently shut during the 2010-19 period. There is a further 267 kb/d of confirmed closures included in the forecast period.

OECD Europe refinery capacity, throughput, crude imports and product exports



IEA. CC BY 4.0.

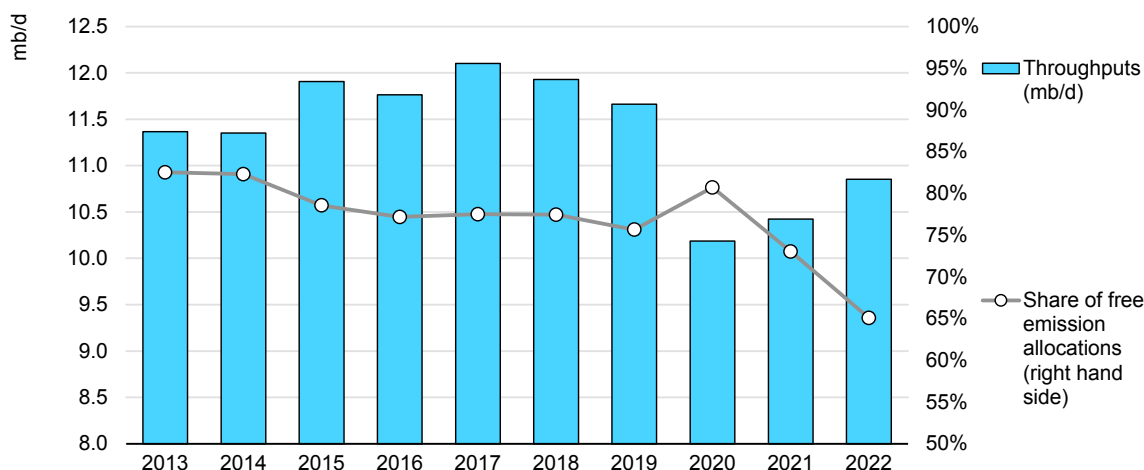
2022 was a particularly challenging year for European refineries. The strong margin environment helped runs recover to post Covid-19 highs. However, the loss of Russian crude supplies to UK and EU refineries following Russia's invasion

of Ukraine forced a rapid realignment of regional crude and feedstock flows. Year-to-date, EU refineries are importing more crude from the North Sea, the United States and North Africa to compensate for the loss of Russia barrels.

In addition to last year’s rapid change in the crude slate, refiners faced increased costs for natural gas, and also from their participation in the EU’s ETS. The cost of a one credit European Union Allowance (EUA) increased from €40/Mt CO₂ equivalent in January 2021 to close to €100/Mt CO₂ in 1Q23. Data for 2022 show that EU refining emissions bounced back to their highest level since 2017, rising at a slightly faster pace than the increase in crude throughputs. The higher energy intensity reflects the closure of simpler refining capacity and production of an increasing share of clean transportation fuels.

Furthermore, the allocation of free allowances which help refiners compete with international players continues to fall, covering just 65% of the sector’s emissions last year. This compares with 81% in 2020. The European Union has agreed to introduce a Carbon Border Adjustment Mechanism and to revise the EU ETS scheme to remove the free allowances. The annual rate at which these free allowances will decline will accelerate from the current 2.2% to 4.3% in 2024-27 and to 4.4% for 2028-30.

European refinery throughputs and free emission allocations, 2013-2022



IEA. CC BY 4.0.

At current EUA prices, this implies a financial cost of USD 1/bbl, considerably higher than the average costs of USD 0.20/bbl in 2019-2020. One of the factors behind the soaring costs of EUA credits were higher natural gas prices. Consumers were encouraged to burn cheaper and more carbon-intensive fuels to replace lost Russian gas supplies, requiring them to purchase more allowances. Higher natural gas prices also increased refinery costs, as it is used both as fuel

and as input to hydrogen production. European refining throughputs are forecast to contract by 790 kb/d in the 2022-28 period. The drop in throughput more than reverses the post-Covid-19 recovery seen in 2020-22 that lifted runs on the back of record-high margins.

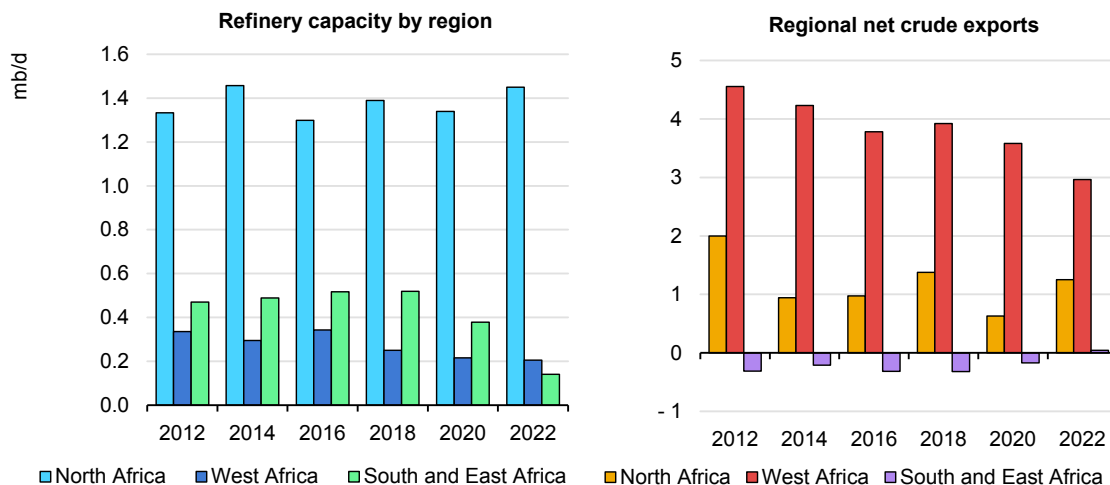
FSU

Russian refiners have completed much of the large-scale secondary capacity build-up that started two decades ago, aimed at modernising the refineries and lowering fuel oil yields. While G7 sanctions will likely depress runs in the short term, we assume this drag on activity fades over the course of the next five years. Higher yields of transport fuels will support clean products and, based on our forecasts, Russia will be able to meet its domestic gasoline demand.

Africa

African refinery capacity is set for its largest boost since the 1980s, with **Nigeria** preparing to launch the 650 kb/d Lekki refinery, which we assume will be fully operational in mid-2024. Nigeria’s plans to rehabilitate its 440 kb/d of shuttered refineries remains mired in bureaucracy and we see little prospect of these returning to service before 2028. Elsewhere in Africa, a handful of mini-refinery projects already materialised or expected to start before 2028, amount to a further 130 kb/d of crude processing capacity. Many more projects languish in search of substantive backing.

North, West and South and East African refinery crude throughput and net crude exports



IEA. CC BY 4.0.

South Africa has closed 60% of its capacity since 2021. Two of the country's four refineries, with a combined capacity of nearly 300 kb/d, are now permanently shut. The government has deferred its clean fuels legislation for 2023 to 2027 but the remaining refiners have yet to commit to upgrading their facilities to meet tighter product specifications. The 108 kb/d Natref refinery restarted last year after being shut down in 2020 due to operational problems while the remaining 110 kb/d Cape Town refinery may restart in the coming months after being shut for repairs in mid-2020 following a fire.

Middle East

The Middle East remains a region with a busy downstream sector. **Kuwait** leads in terms of capacity additions. The first phase of the 615 kb/d Al Zour refinery came online at the end of 2022 at an initial 410 kb/d, while the remaining crude distillation unit will start up before the end of 2023. Kuwait will overtake Iraq and the UAE and become the number three refiner in the region after Saudi Arabia and Iran during our forecast period. **Iran** recently delayed the shutdown of a replacement crude distillation tower to 2028, boosting the current capacity up to 2.5 mb/d. **Iraq** also has ambitions to scale up capacity, but we forecast more modest net additions of 310 kb/d between 2023-28.

Middle East refinery capacity expansions (kb/d), 2022-2028

Countries	2022	2023	2024	2025	2026	2027	2028	2022-2028 growth
Bahrain	268	268	380	380	380	380	380	112
Iran	2 505	2 531	2 531	2 651	2 711	2 711	2 476	-29
Iraq	903	1 043	1 043	1 113	1 113	1 213	1 213	310
Jordan	90	90	90	90	90	90	90	0
Kuwait	1 212	1 417	1 417	1 417	1 417	1 417	1 417	205
Oman	298	558	558	558	558	558	558	260
Qatar	429	429	429	429	429	429	429	0
Saudi Arabia	3 269	3 269	3 289	3 289	3 289	3 289	3 289	20
Syria	242	242	242	242	242	242	242	0
United Arab Emirates	1 141	1 141	1 141	1 141	1 141	1 141	1 141	0
Yemen	160	160	160	160	160	160	160	0
Total	10 517	11 148	11 280	11 470	11 530	11 630	11 395	878

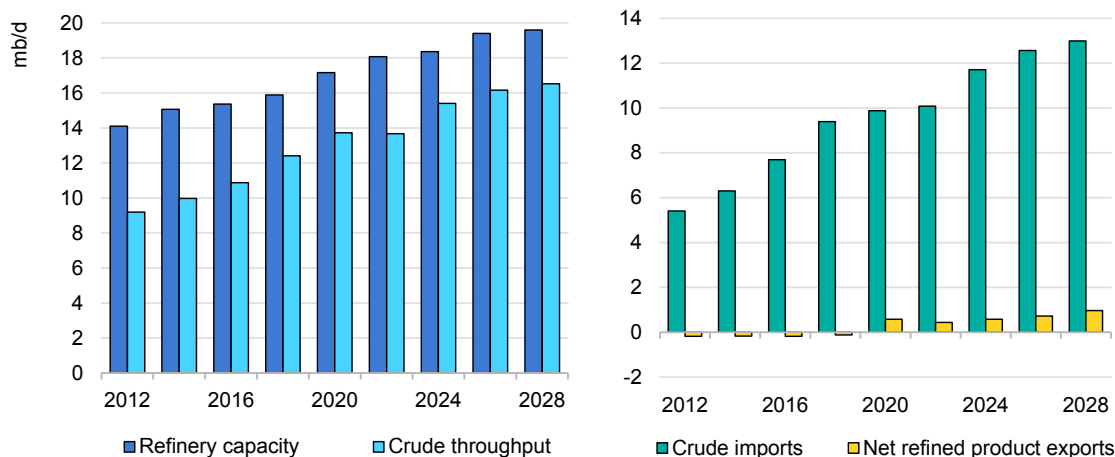
Bahrain and Oman are finalising work on their respective expansions and new projects that are slated to launch in 2H23 or 2024, totalling a net 370 kb/d increase in capacity. With only minimal new projects planned in **Saudi Arabia**, Saudi Aramco has shown renewed interest in expanding their downstream businesses overseas after a pause that coincided with the pandemic. In 2021, it acquired 30% of the 210 kb/d Gdansk refinery in Poland, traditionally an outlet for Russian crude. Earlier this year, it announced two deals in China to secure demand for its production in the key export market. Subject to approvals, Saudi Aramco will purchase a 10% stake in Rongsheng, which in turn owns 51% of the 800 kb/d ZPC

refinery in Zhejiang province. The agreement includes a long-term crude supply deal for 480 kb/d to the ZPC refinery. The company also acquired a 30% interest in the 300 kb/d Panjin refinery that we expect to start before the end of 2026, with a provision to supply up to 210 kb/d.

China

China will build more refineries than any other country over the 2022-28 period. A further 1.5 mb/d of crude distillation capacity is expected to come online by the end of the forecast period, taking total nameplate capacity to 19.7 mb/d. China overtook the United States last year in terms of installed capacity after three large-scale facilities were completed. At the same time, refinery activity fell for the first time since 1998 following the fallout from the Asian financial crisis. Domestic demand slumped due to stringent Covid-19 restrictions and a change in Beijing's stance on product exports. The turnaround in government policy regarding restricting exports, and the lifting of pandemic-related measures, saw Chinese oil demand and refinery runs reached record highs at the start of 2023.

China refinery capacity, throughput, net crude imports, and net product exports



IEA. CC BY 4.0.

Despite the fast growth in refining throughputs in recent years, China still accounts for the single largest amount in global spare capacity, with 3 mb/d unutilised at the start of 2023. Of this, about 500 kb/d is located in the Shandong province, home to the largest number of smaller-scale independent refineries (also referred to as teapot refineries). Utilisation rates in Shandong are currently only around 70%, suggesting activity is constrained by a lack of import quotas. The recent tightening of the custom agency's enforcement on bitumen and fuel oil imports (a means for independent refineries to access feedstocks on the international market) may stymie runs even further. Even so, Chinese refinery throughputs are forecast to

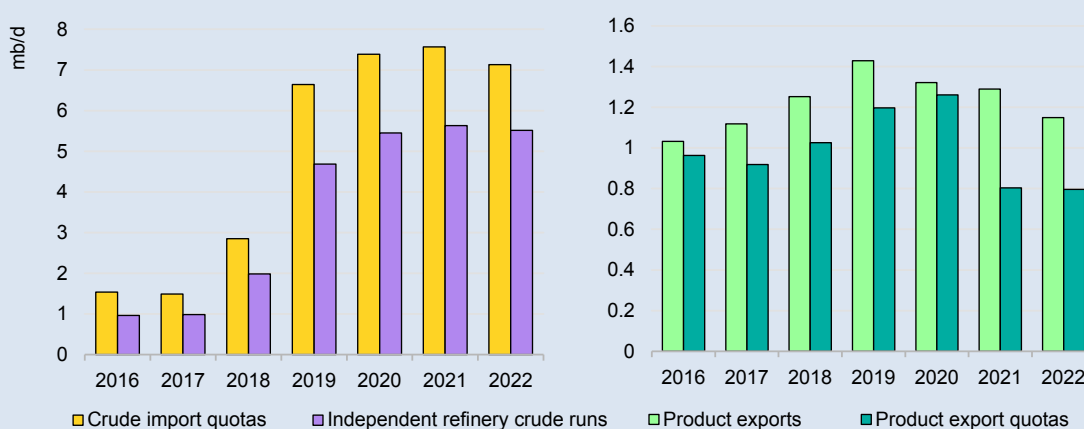
rise by 2.8 mb/d from 2022-28 to 16.5 mb/d, leaving 3.2 mb/d of spare capacity. China overtakes the United States in terms of runs in 2025 in our projections, but actual levels will be highly dependent on domestic policy considerations.

Chinese policy key to balancing global fuel markets

China's internal policies aimed at reducing emissions from its refining operations are part of its overall strategy to decarbonise the economy. Its refining sector has long been designed to meet the country's fast pace domestic demand growth, not to increase its role as a product exporter. The state-owned oil companies have—in line with government policy—embarked on a massive refining expansion of more technologically advanced and integrated complexes while it aims to shut down surplus, antiquated and inefficient processing capacity.

The government controls the volume of product exports to international markets by enforcing a strict quota system. The government deftly uses its crude imports and refined oil product export quotas to balance domestic demand, with excess products either going into storage or exported.

Chinese crude and product trade driven by import and export quotas



IEA. CC BY 4.0

China policy decisions will continue to hold sway over markets, not least because the country will maintain the largest share of spare refining capacity in the world over the 2022-28 forecast period. Indeed, our forecast for product balances is heavily dependent on higher Chinese product exports, especially for diesel, yet the country's policy priorities appear to have shifted to focus on the supply of feedstocks to the petrochemical industries. The wave of Covid-19 that swept through China in 2022 brought on extensive pandemic-related mobility restrictions and a slump in industrial activity. Demand for oil products plummeted, with refinery throughput declining by roughly 700 kb/d y-o-y. In the first eight months of 2022, the government opted to cut product export quotas even further as it prioritised

reducing emissions through lower runs. The decision exacerbated already tight markets for gasoil, diesel and jet fuel, further driving margins and consumer prices to record levels.

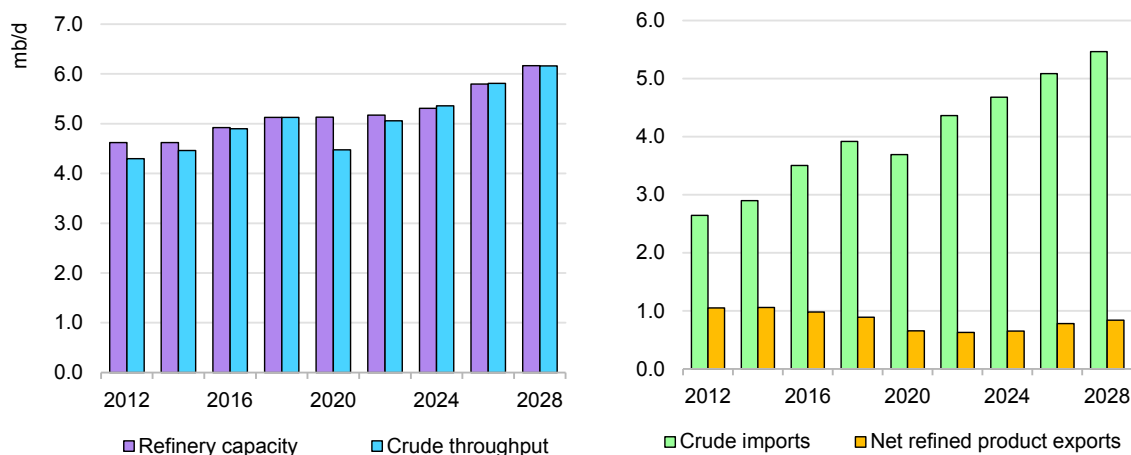
In a reversal of the policy in the third quarter of 2022, the government issued sharply higher crude oil import quotas in an attempt to boost economic activity. Crucially, product export quotas were increased by a further 15 Mt in September, resulting in a surge of diesel shipments to world markets. The additional supplies proved a significant contributor to the normalisation of diesel cracks that had reached all-time highs.

China's diesel production and export policy will play a key role in balancing global product markets over the medium term. The shift in Chinese refinery activity towards petrochemical integration poses a dilemma for the international oil market. Its priority of petrochemical precursors has for the most part come at the expense of middle distillates. Tightness in global middle distillate markets could be partly offset if China were to lift diesel yields back to their pre-Covid-19 levels and import more naphtha and other feedstocks. However, the risk is that integration with petrochemical capacity will mean these products are prioritised at the expense of middle distillates.

Other Asia

Refinery shutdowns have also accelerated elsewhere in Asia, with capacity reductions in Japan, Australia, the Philippines and Singapore since 2020 totalling some 860 kb/d.

India refinery capacity and crude runs, net crude import and products exports



IEA. CC BY 4.0.

Over the medium term, regional growth is underpinned by **Indian** additions that total 1 mb/d. The new capacity comes mostly from expansions at existing sites, with only the 180 kb/d Barmer greenfield project coming online.

The fate of the planned 1.2 mb/d Ratnagiri refinery remains unclear. Land acquisition constraints are the latest roadblock to the project that was first proposed in the middle of the last decade. Even if finally approved, the refinery is not expected to come online in our forecast period.

Other countries in the region are expected to bring online some 155 kb/d among them while two refineries in Japan with a combined capacity of 240 kb/d are scheduled to shut.

Global oil trade

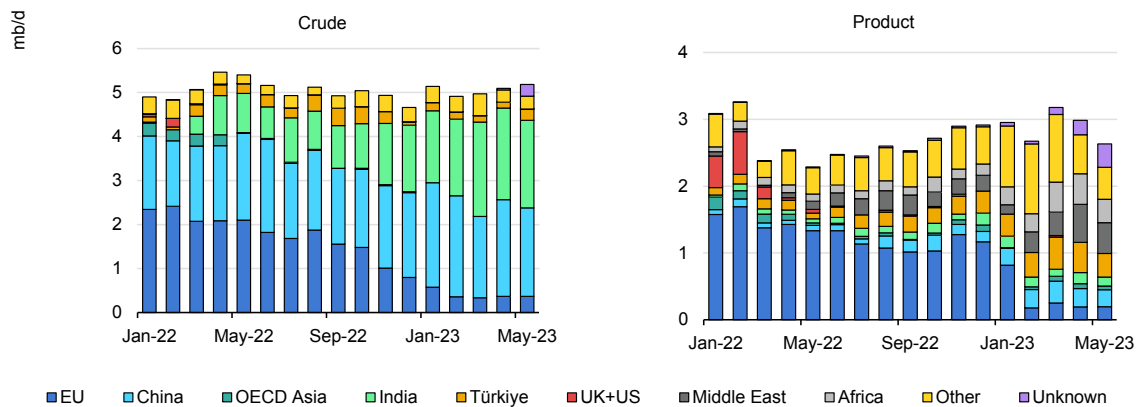
Global summary

Russia's war on Ukraine upends global oil trade flows

World oil trade flows are undergoing an unprecedented sea change amid international embargoes on Russian energy exports, with no return to the *status quo ante* expected in the foreseeable future. Around 2.5 mb/d of Russian crude has been backed out of Europe and G7 countries while a further 2 mb/d of products have had to find new homes.

The long lead-time before the EU embargoes on crude and oil products came into effect and the G7 price cap that allowed EU maritime services to be used to ship Russian oil to third countries facilitated the rerouting of oil flows and minimised production losses for the global market. European refiners were able to source crude oil from new suppliers, most notably from the United States and the Middle East, while higher North Sea volumes stayed in the region.

Russian oil exports, January 2022-May 2023



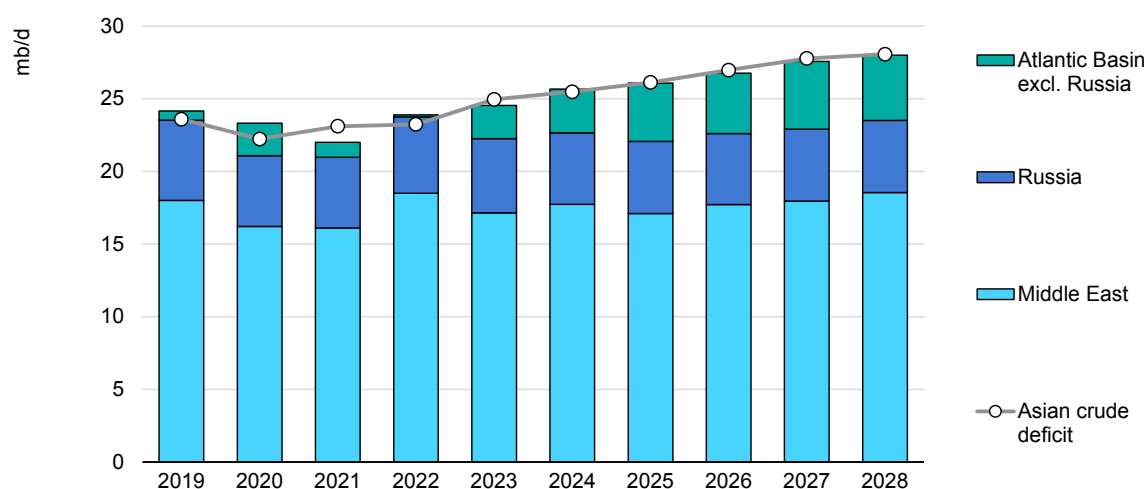
IEA. CC BY 4.0.

Heavily discounted Russian crude oil has found new buyers primarily in Asia. India has increased purchases from almost nothing to close to 2 mb/d, while China has raised liftings by 500 kb/d to 2.2 mb/d. In May 2023, India and China accounted for almost 80% of Russian crude oil exports. In turn, Russia made up 45% and 20% of crude imports in India and China, respectively.

World product trade flows also shifted dramatically in response to G7 and EU embargoes on Russian oils, which came into effect in during 2022 and early 2023. Russia previously accounted for large import shares of naphtha, gasoil, fuel oil in Europe as well as feedstocks in the United States. Import replacements in these markets came from further afield, including North America, the Middle East and Asia. Russian volumes in turn were routed to Türkiye, East of Suez, Latin America and Africa. The call on available tankers to carry volumes over longer distances massively tightened the market for available capacity and boosted freight rates.

Over the medium term, trade flows in crude and products will expand. The Atlantic Basin, excluding Russia, will see its crude oil and condensate surplus increase by 4.3 mb/d to 4.5 mb/d, as production rises in the United States, Brazil and Guyana while refinery activity falls in line with the contraction in demand for transport fuels. Continued demand growth in Asia will by far outpace increased crude supplies from the Middle East over the forecast period. Asia's crude and condensate import requirements will rise by 4.8 mb/d to 28 mb/d in 2028. With Middle Eastern crude and condensate exports constrained by the start up of new refinery and splitter capacity and the call on OPEC supplies, the Atlantic Basin crude surplus will play a critical role in meeting Asian demand over the forecast period.

World crude and condensate balances by region, 2019-2028

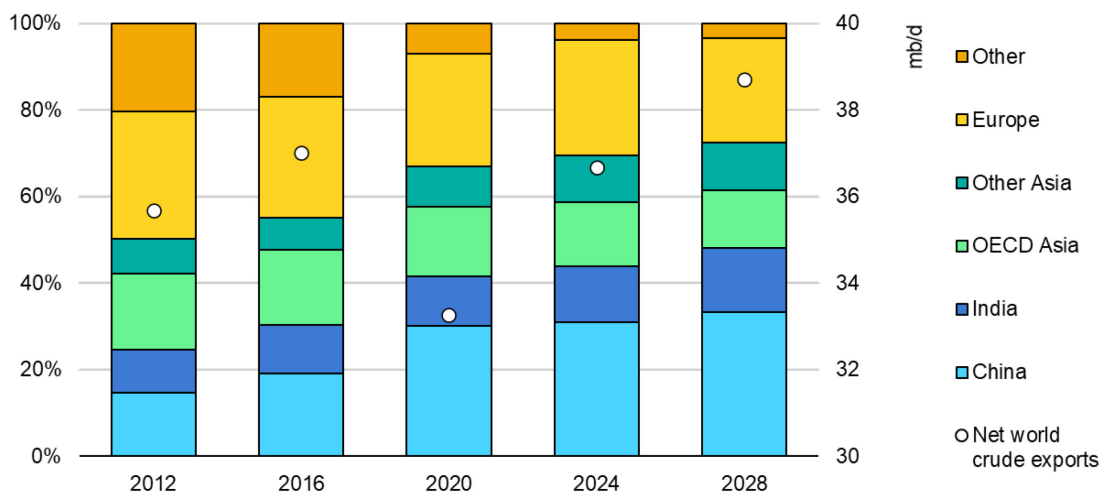


IEA. CC BY 4.0.

Despite the loss of Russian supply, the rest of the Atlantic Basin swings from roughly balanced in 2022 to a surplus of approximately 4.5 mb/d in 2028. The change reflects the continued surge in crude and condensate output as well as falling refinery runs (-900 kb/d). These trends lower the share of Atlantic Basin buyers of net world crude exports to around 25% over the forecast period and increase the concentration of those East of Suez. Despite the growth in global crude production and exports, by 2028 China will account for one-third of total

traded crude volumes while India takes up another 17%. This evolution, accelerated by the pandemic, will require a build-out in the infrastructure and services to accommodate these flows.

Shares in uptake of global volumes from net crude exporting regions



IEA. CC BY 4.0.

Amid these changes, heavy sour crude output tends to decline and growth is concentrated in medium and light sweet grades. The resulting overhang will narrow light-heavy and sweet-sour price spreads to the detriment of complex refinery margins.

The forecast also highlights continued product trade flow adjustments. The concentration of demand growth East of Suez and declining needs in the Atlantic Basin will propel rising west-east movements of crude and light ends. But China, holding the bulk of the world's refinery and petrochemical capacity surplus, will play a key role driving the East of Suez attraction of Atlantic Basin crude barrels and petrochemical feedstocks. Moreover, Chinese exports will support east-west flows of middle distillates, pressuring Asian product prices to maintain an open arbitrage while undermining Asian refinery margins.

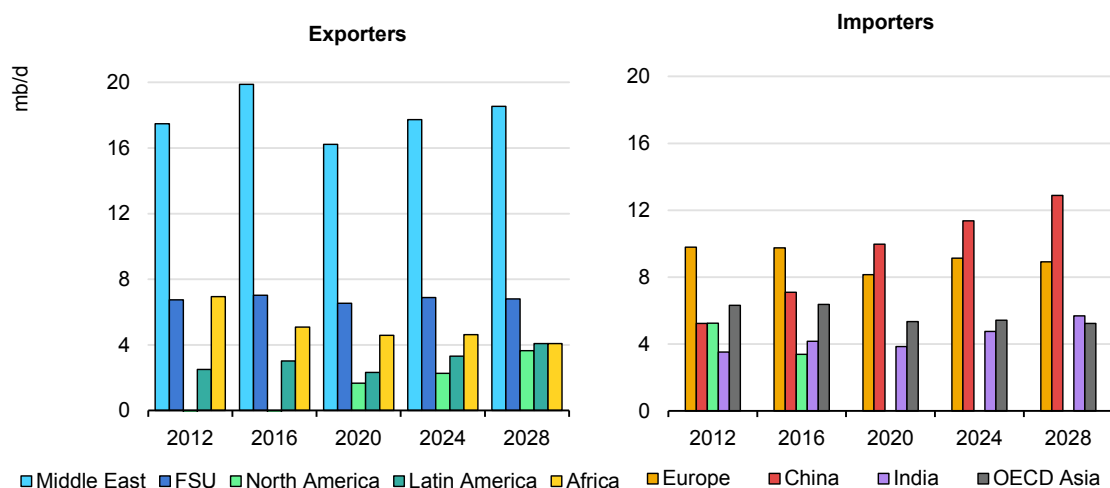
Crude oil balances and trade

The Atlantic Basin will play a critical role in meeting Asian crude oil deficit

The Atlantic Basin, excluding Russia, has moved close to a net crude oil surplus that will continue to grow over the 2022-28 forecast period. Steady demand growth in Asia and new refinery capacity boosts the Asian crude deficit. At the same time, Middle East producer countries will not significantly increase crude exports. The

steady increase of Atlantic Basin crude export volumes to East of Suez will have implications as profound for crude shipping as those resulting from the swing in Russian crude exports from west to east.

Crude oil balances by region, 2012-2028



IEA. CC BY 4.0.

* Includes condensates.

Growth in light sweet crude supply outpaces that of heavier sour grades, contributing to an overhang in light ends at the global level and challenging investments in complex refineries.

The preponderance of light sweet crude streams in the Atlantic Basin increased with the loss of heavier sourer Russian crude that shifted to Asia. This raised the cost of supplying such barrels to Atlantic Basin refiners that still required them, weakening regional refinery economics. The dynamic should persist. A significant increase in condensate and NGL output as well as an incipient decline in gasoline consumption will contribute to an overhang of light ends in the Atlantic Basin as the demand share of middle distillates slowly rises.

Atlantic Basin crude oil balances

The Atlantic Basin crude and condensate surplus (excluding Russia) rises by 4.3 mb/d from 2022 to 2028. The overall shift hides substantial intra-regional differences in crude flows. On the western side of the Atlantic Basin, the Americas (North and South combined) see an overall increase in their crude and condensate surplus of 4.6 mb/d over this period to 7.7 mb/d. But the eastern flank of the basin (excluding Russia) sees its deficit increase by roughly 300 kb/d to 3.2 mb/d as the declines in African and North Sea crude production outstrip the impact of falling European refinery activity and rising production in Central Asia. In addition, Russia's surplus narrows slightly by 300 kb/d to 5 mb/d.

North American net crude and condensate exports increase from 700 kb/d in 2022 to 3.7 mb/d in 2028 (+2.9 mb/d). The growth in US crude oil and condensate production combined with the impact of slowing refinery runs (-750 kb/d) helps reduce the deficit in the US market by around 3 mb/d to 1 mb/d over 2022-28. Mexican crude and condensate production continues to slide over the forecast period while new capacity boosts its refinery runs (+300 kb/d), reducing the exportable surplus of crude by approximately 50% to 480 kb/d, much of which will be light sweet crude. Combined Canadian crude, condensate and bitumen production rises while runs drop by an estimated 100 kb/d, boosting exports by 400 kb/d to 4.2 mb/d.

South America's crude and condensate surplus expands, by 1.6 mb/d (+68%) from 2022 through 2028. Brazil and Guyana each account for around half of this with further incremental volumes from Argentina (+250 kb/d) and Venezuela (+100 kb/d) offsetting losses in Colombia and Ecuador. New production streams in Guyana and Brazil are largely medium sweet. The additional heavy sour barrels from Venezuela only partly offset the loss of similar grades from Mexico and Ecuador.

In the eastern Atlantic Basin, the balances of Europe, Central Asia, as well as North and West Africa, see their combined deficit increase from 2.9 mb/d to 3.2 mb/d over 2022-28. Russia's crude and condensate surplus of 5.3 mb/d in 2022 more than offset this eastern Atlantic Basin deficit in the past, but not since the invasion of Ukraine. Europe now covers its needs with equivalent volumes from other regions.

Europe's deficit narrows from 9.3 mb/d in 2022 to 8.9 mb/d in 2028 as the fall in refinery runs (-800 kb/d) outstrips that for crude production (-400 kb/d).

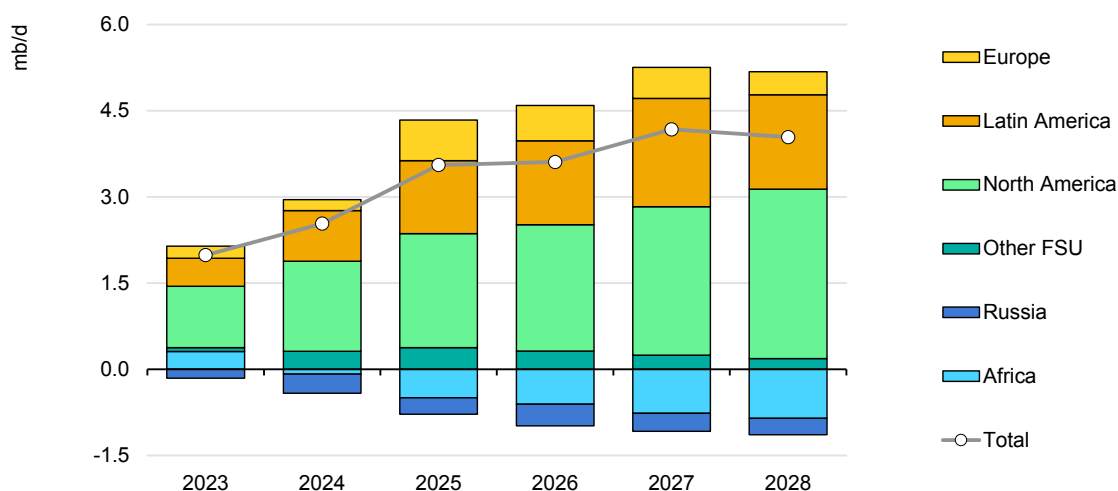
While the net surplus from North Africa rises by around 200 kb/d, it declines by an estimated 1 mb/d from West Africa. Higher Libyan output early in the forecast period offsets losses in Algeria to boost regional supply, while local refinery runs are roughly stable. On the west coast, 300 kb/d of this decline is accounted for by Angola while new refinery capacity in Nigeria boosts runs (+600 kb/d) starting in 2024 and output remains flat. Apart from Senegal (+100 kb/d), production falls in virtually every other country in West Africa.

Notwithstanding the loss of Russian supply, the Atlantic Basin swings by +4.3 mb/d to a surplus of 4.4 mb/d in 2028. The massive reversal reflects the continued surge in crude and condensate output as well as falling runs in refineries and condensate splitters (-600 kb/d).

Part of that surplus will be delivered via Canada's Trans Mountain Corporation's pipeline expansion that reaches mechanical completion in 2023. After starting up in 2024, it will transport almost 590 kb/d of heavy sour diluted bitumen to the

Pacific Coast for export in addition to 300 kb/d of light crude and some product. Some of this will likely move to US West Coast refineries, including displacing imports of heavy sour Mexican Maya (30 kb/d) and Ecuadorian Oriente (110 kb/d) as exportable surpluses of both crudes decline. While the remainder (mostly 450 kb/d of sour crude) will go to Asian refiners who brought online substantial heavy crude upgrading capacity over the past decade, the arbitrage will be challenged by cheap Russian crude that has undermined Mexican exports to the region over the past year.

Change versus 2022 for crude surplus in Atlantic Basin by region



IEA. CC BY 4.0.

As these heavier sour barrels move to Canada’s west coast, US Midcontinent refiners will slow the transfer of remaining volumes to those on the Gulf Coast, creating a new pull on medium and heavy sour barrels in the Atlantic Basin, including those from the US Gulf Coast and Latin America. However, the latter are declining, particularly in Mexico at approximately 200 kb/d, and are only partly offset by expected increases from Venezuela of around 130 kb/d. This will leave the regional market tighter.

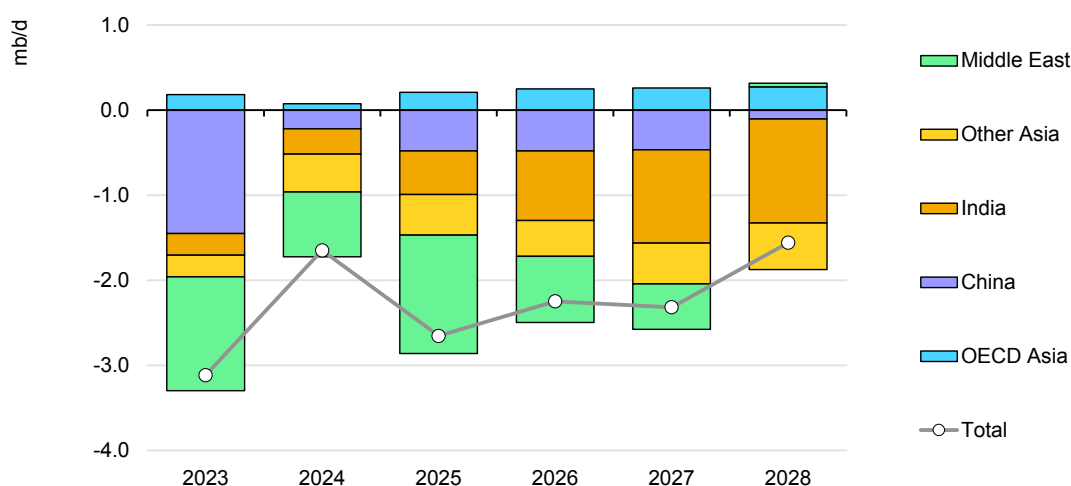
While West African crude exports will decline over the medium term, most of the Atlantic Basin surplus will be made up of light and medium sweet crude thanks to rising exports from the United States, Brazil, and Guyana. In 2022, Asian refiners absorbed over 45% of exports from these three countries and Europe around 40%. As declining gasoline demand drives down Atlantic Basin refinery activity, the burden of light ends will pressure remaining refiners to privilege heavier crudes to maximise middle distillate production, notably from upgrading units. Hence, only incremental volumes of medium sweet grades from Brazil and Guyana will tend to find buyers in Europe and the United States.

Tighter availabilities of heavy sour crudes and an overhang of light sweet grades will narrow light-heavy and sweet-sour price spreads to the detriment of complex refinery margins.

East of Suez crude oil balances

As the driver of future oil demand growth, East of Suez will fundamentally shape global crude balances. Baseload supply has extended from the existing Middle East flow to incorporate the near totality of Russian crude exports since 2022. Yet, still more volumes will be needed by China, India and other regional refiners in the coming years. The Atlantic Basin producers will provide increasing swing supply volumes to meet month-to-month changes and annual growth in Asian refining. This was already the case for flows from West Africa and Northwest Europe (including Baltic Urals cargoes) to refiners in Asia. It will be increasingly so now.

Change versus 2022 for crude surplus East of Suez by region



IEA. CC BY 4.0.

Middle East crude and condensate exports rose to 18 mb/d in 2022, about 1 mb/d below their recent peak in 2018. Production cuts and the start up of new refinery capacity in 2023 will limit regional exports through 2028, with a notable impact on heavier sour grades. After falling 700 kb/d y-o-y in 2023 due to lower targets and voluntary reductions by OPEC+, Middle Eastern crude production will increase through the forecast period while crude used in power generation falls by 200 kb/d to 600 kb/d in total. Together, these contributions lift exports to back to around 18.5 mb/d as in 2022. Part of the rebound in flows will go to feed new refinery capacity owned fully or partially by national oil companies in the Middle East, further constraining exports available to refiners in crude importing countries. The region's condensate surplus rises by an estimated 250 kb/d to 1.2 mb/d from 2022 to 2028 as a boost to production offsets an increase of 190 kb/d in splitter activity.

Atlantic Basin refiners took about 7% of Middle East crude exports in 2022 and 6% in previous years. The modest volumes (1-1.3 mb/d) will likely persist even as Atlantic Basin refining activity falls in the coming years as the heavier sour crudes will help support middle distillate output.

Saudi crude production expansion by 2028 exceeds the increase in domestic refinery runs while crude burning declines, so that exports in 2028 are 340 kb/d above 2022 levels at 8 mb/d. This is the highest level in over a decade. Condensate exports also increase by around 50 kb/d.

The Asian crude and condensate supply deficit will rise by 4.8 mb/d to 28.1 mb/d in 2028. Refinery and splitter throughputs increase by 3.9 mb/d while regional crude and condensate production falls and crude burning eases by around 50 kb/d. China accounts for almost 75% of the increase in import requirements (+3.2 mb/d), reflecting a projected 2.9 mb/d rise in crude and condensate refinery processing to 16.5 mb/d while domestic production falls. India accounts for another 1.2 mb/d of the gain while a 300 kb/d reduction in import needs in the OECD Asia offsets half of the higher pull from other Asian countries where runs increase by 300 kb/d while production falls.

With Middle East crude and condensate exports remaining essentially at the same level in 2028 as in 2022, Asia will need to cover all the incremental exports via the Atlantic Basin's projected net surplus. The majority of these flows are expected to be sweet grades and predominantly light, which will be a poor match for the new upgrading-oriented refinery capacity expected to come into service, predominately in India and China. Dominant sources of incremental supply to Asia will be the United States, Brazil and Guyana that deliver mostly light and sweet barrels.

The Asian condensate deficit increases by about 200 kb/d, as splitter activity rises by 100 kb/d (half in OECD Asia) and regional output declines. Most incremental requirements will be made up by higher Middle East exports (+250 kb/d).

Product balances and trade

Asian refiners set to balance markets east and west

The outlook for product balances differs greatly from that of crude and condensate. East of Suez refined product supply grows in tandem with new capacity start-ups but fails to keep pace with rapidly rising demand that sustains the overall regional deficit. The Atlantic Basin product market surplus that narrowed with the post-pandemic demand recovery and refinery closures increases over the forecast period as slowing demand undermines new regional refinery capacity. However, this overlooks sizeable imbalances for specific products in each region. The Middle East surplus grows for all products as new refinery capacity comes online.

Asia's massive deficits in LPG and other light-ends (naphtha plus gasoline) grows alongside a buoyant petrochemical build-out. The rising overall surplus in middle distillates East of Suez matches an unrelenting deficit in the Atlantic Basin that G7 and EU sanctions on Russia have aggravated.

Our trade analysis on refined products groups jet fuel and kerosene with gasoil/diesel under "middle distillates" but separates "light ends" into naphtha and gasoline. These broader categories, middle distillates and light ends, reflect the marginal fungibility of the underlying products and the larger market implications.

The forecast approach endeavours to balance world refining activity with crude availability over the 2022-28 period. As well, it aims to match refinery output with overall demand for middle distillates. As the forecast advances, an overhang of light ends emerges as world gasoline demand slows and flips into contraction. The Atlantic Basin dominates this surplus as the expanding Asian petrochemical activity keeps its market in deficit.

Finally, fuel oil balances remain tight, in part due to lack of heavy sour crude. The Atlantic Basin surplus narrows due to falling refining activity and more conversion units in new refineries, but Middle East supplies rise with new refinery capacity. These changes just keep pace with Asia's persistent and almost unchanged deficit.

These broad trends don't ignore the vast reshuffling of trade flows for each product that arose from the G7 and EU embargoes on Russia. Russia is a significant exporter of finished products as well as refinery and petrochemical feedstocks, shipping principally from its western ports. Short-haul buyers in Europe and North America have traditionally been the preferred destinations as lower shipping costs benefitted both buyers and sellers.

Subsequent to Russia's invasion of Ukraine, G7 governments and EU-based oil companies and traders rapidly halted imports of Russian products, with remaining flows stopped after the EU embargo came into effect in February 2023. Exports to G7 countries, including the United States, the United Kingdom and Korea, rapidly swung to the Middle East and Asia starting in mid-2022, notably for straight-run fuel oil and vacuum gasoil to US and UK refiners as well as gasoline and gasoil to Europe and naphtha to Korea. The EU embargo has forced more Russian volumes, in particular gasoil, to new destinations.

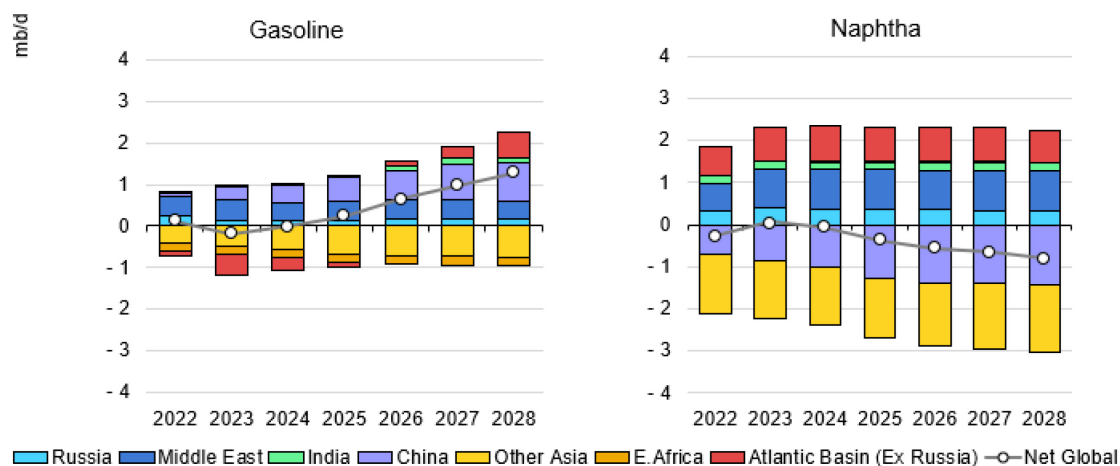
Importers replaced Russian product with that of qualities and origins presumably less optimal or more costly. More gasoil and naphtha moved from refiners in the Middle East and Asia to the Atlantic Basin and more fuel oil moved from Latin America and Mexico to North America and Europe. Russian products have replaced these volumes in Latin America, the Middle East and Asia. Importantly,

for the stability of the world oil balance, the product markets lost little or no overall supply, but increased oil in transit has locked-up substantial volumes on the water.

Light-ends balances and trade: Atlantic Basin surplus seeks buyers

The gasoline pool begins the outlook period relatively well balanced. The deficits in Africa and Other Asia roughly match the surpluses from Russia and the Middle East. However, beginning in 2025 the global market moves into a surplus that grows steadily over the forecast period. By 2028, in the absence of any significant adjustments by refiners, the global gasoline surplus could reach 1.3 mb/d. North America, China and India each move from roughly balanced gasoline markets to net exporters in 2028 of around 600 kb/d, 900 kb/d and 130 kb/d, respectively. The only deficit to increase significantly is for Asia, excluding China and India (+345 kb/d). With a global gasoline market surplus, poor economics will force refiners to dump undervalued naphtha or aromatics molecules into the naphtha pool, push FCC units to maximise propylene output or reduce cracking activity to move heavy gasoil molecules to the middle distillate pool.

World gasoline and naphtha balances, 2022 - 2028



IEA. CC BY 4.0.

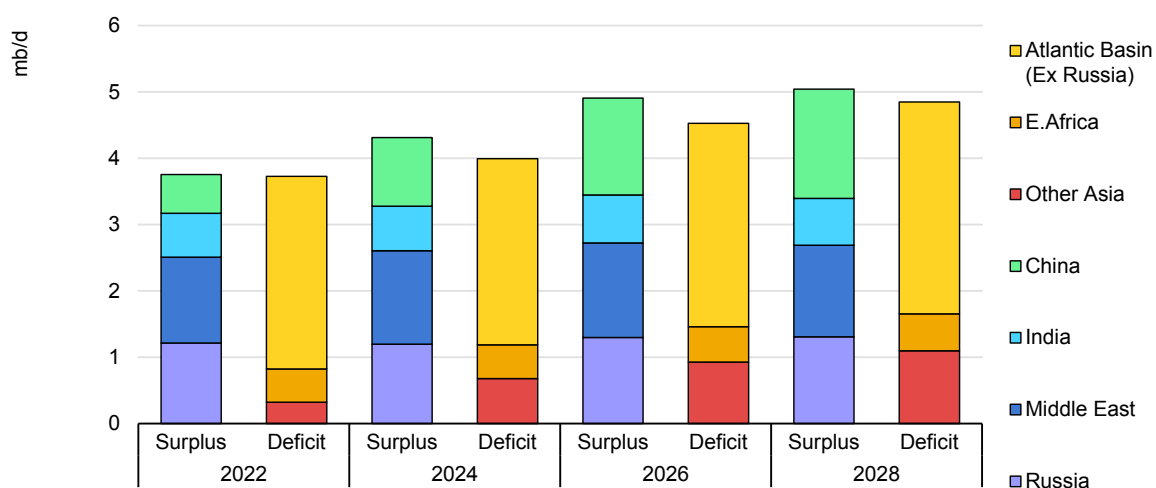
The east-west naphtha market split reflects the preponderance of Asian importers, including China, driven by vast petrochemical industry feed requirements. Exporters are more broadly based and include the Middle East, Russia, India, Europe and North America. Over the forecast period, a continued concentration of petrochemical activity in Asia drives a significant widening of the deficits in China (+700 kb/d to 1.4 mb/d) and other Asia excluding India (+200 kb/d to 1.6 mb/d). On the other hand, only limited gains arise from key exporting regions, including the Middle East (+270 kb/d to 940 kb/d) and the United States

(+120 kb/d to 600 kb/d). This implies ample potential to move appropriate molecules from the gasoline pool to the naphtha pool if the economics allow it, particularly given the size of the overhang of gasoline supply in the United States and Europe.

Middle distillate balances and trade – East moves West

Global middle distillate markets, including jet fuel, kerosene, gasoil and diesel, remain roughly balanced over the 2022-28 period. The regions in overall deficit (Atlantic Basin excluding Russia, East Africa and Other Asia including OECD Asia Oceania) see their gap widen by 1.1 mb/d over the forecast period, of which 800 kb/d East of Suez. This is only matched by increases from net exporting regions including Russia (+100 kb/d), India (+50 kb/d), the Middle East (+80 kb/d) and most notably a very substantial 1.1 mb/d rise from China.

World middle distillate balances (diesel, gasoil, jet fuel and kerosene), 2022-2028



IEA. CC BY 4.0.

Since early 2023, increasing exports from India, the Middle East and China have moved west to European and G7 buyers in the Atlantic Basin to offset Russian cargoes now moving to buyers East of Suez (300 kb/d or roughly one-third of Russian exports).

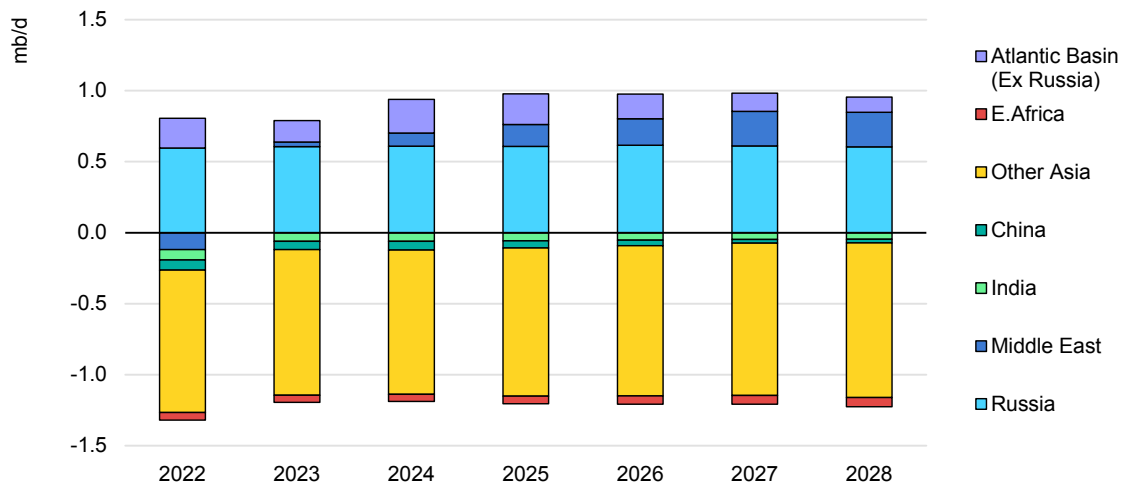
The Atlantic Basin middle distillate deficit rises over the next five years (+200 kb/d) as production lost with falling refinery throughputs and adjustments in product yields (jet/kerosene +260 kb/d but gasoil -670 kb/d) exceeds the fall in overall demand. The widening of the Atlantic Basin supply shortfall will attract more barrels from the Middle East while declining domestic demand will push more Russian volumes to Africa and to the east.

Chinese exports of gasoil plus jet and kerosene will triple from 2022 to 2028 (+1 mb/d). This amounts to a scale change requiring a huge infrastructure build-out to accommodate terminaling facilities for storage and loading of product to export. Failing this necessary development, middle distillate markets will remain tight. The widening middle distillate deficit in Other Asia, due to stagnant refinery output (+50 kb/d) and strong demand growth (kerosene +580 kb/d, diesel +240 kb/d), will absorb some of this surplus, while remaining volumes serve the incremental requirements of Atlantic Basin buyers.

Fuel oil balances and trade: East offers a permanent sink to Russia

Fuel oil balances reflect the drivers in two key regions. Russia remains the principal source of fuel oil exports while Other Asia, notably Singapore and Korea, dominates fuel oil imports to meet bunkering requirements. This changes very little over the course of the outlook as the shipping industry has made only limited progress in developing alternatives for bunkering while major upgrading projects to reduce fuel output at Russian refineries have largely been completed or put on hold. However, since March 2022, Russian exports shifted entirely to the east, requiring increased flows from East of Suez to balance the Atlantic Basin. Middle East exports develop as local refinery capacity grows faster than demand.

World fuel oil balance, 2022-2028



IEA. CC BY 4.0.

Tables

Table 1
WORLD OIL SUPPLY AND DEMAND
(million barrels per day)

	2021	1Q22	2Q22	3Q22	4Q22	2022	1Q23	2Q23	3Q23	4Q23	2023	2024	2025	2026	2027	2028
OECD DEMAND																
Americas	24.3	24.8	25.0	25.3	25.0	25.0	24.6	25.2	25.6	25.2	25.1	24.8	24.7	24.4	24.2	23.9
Europe	13.1	13.2	13.4	14.0	13.3	13.5	13.1	13.5	14.1	13.5	13.6	13.4	13.3	13.1	13.0	12.8
Asia Oceania	7.4	7.9	7.0	7.2	7.7	7.4	7.9	7.0	7.5	7.9	7.6	7.6	7.5	7.5	7.5	7.5
Total OECD	44.8	45.8	45.4	46.6	46.0	45.9	45.5	45.7	47.1	46.6	46.2	45.8	45.5	45.0	44.7	44.3
NON-OECD DEMAND																
FSU	4.9	4.8	4.8	5.1	5.1	4.9	4.9	4.8	5.0	5.0	4.9	4.9	5.0	5.0	5.1	5.1
Europe	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
China	15.1	15.1	14.0	14.5	15.0	14.7	15.6	16.3	16.2	16.6	16.1	16.6	17.0	17.3	17.5	17.6
Other Asia	13.4	14.2	14.1	13.5	14.2	14.0	14.3	14.3	14.0	14.7	14.3	14.8	15.3	15.8	16.1	16.5
Latin America	6.0	6.0	6.2	6.4	6.3	6.2	6.2	6.2	6.4	6.4	6.3	6.4	6.5	6.6	6.7	6.8
Middle East	8.5	8.6	9.1	9.5	9.0	9.0	8.9	9.3	9.7	9.1	9.2	9.3	9.4	9.6	9.7	9.8
Africa	4.0	4.3	4.2	4.2	4.3	4.2	4.4	4.3	4.2	4.4	4.3	4.4	4.5	4.6	4.7	4.8
Total Non-OECD	52.7	53.6	53.1	54.0	54.7	53.9	55.0	55.9	56.2	56.9	56.0	57.3	58.6	59.8	60.6	61.4
Total Demand¹	97.5	99.4	98.5	100.6	100.6	99.8	100.5	101.6	103.4	103.5	102.3	103.1	104.1	104.8	105.3	105.7
OECD SUPPLY																
Americas	24.3	24.9	25.3	26.1	26.3	25.6	26.6	26.7	27.1	27.2	26.9	27.4	27.7	27.9	28.1	28.1
Europe	3.4	3.3	3.0	3.1	3.2	3.2	3.3	3.2	3.1	3.3	3.2	3.2	3.3	3.1	2.9	2.7
Asia Oceania	0.5	0.5	0.5	0.4	0.5	0.5	0.5	0.4	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.4
Total OECD²	28.2	28.7	28.8	29.6	30.0	29.3	30.4	30.3	30.6	31.0	30.6	31.1	31.4	31.5	31.4	31.2
NON-OECD SUPPLY																
FSU	13.8	14.4	13.4	13.7	14.1	13.9	14.1	13.6	13.4	13.5	13.7	13.6	13.7	13.7	13.6	13.4
Europe	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
China	4.1	4.2	4.2	4.1	4.1	4.2	4.3	4.3	4.3	4.2	4.3	4.3	4.3	4.2	4.1	4.0
Other Asia	2.9	2.8	2.7	2.6	2.7	2.7	2.7	2.7	2.7	2.6	2.7	2.6	2.5	2.4	2.3	2.2
Latin America	5.3	5.4	5.5	5.8	5.9	5.6	6.0	5.9	6.1	6.2	6.0	6.4	6.8	7.0	7.3	7.5
Middle East	3.1	3.1	3.2	3.2	3.2	3.2	3.2	3.2	3.1	3.1	3.1	3.1	3.2	3.3	3.4	3.5
Africa	1.3	1.3	1.3	1.3	1.3	1.3	1.2	1.3	1.3	1.3	1.3	1.3	1.4	1.5	1.5	1.5
Total Non-OECD²	30.5	31.3	30.4	30.8	31.4	31.0	31.6	31.0	30.9	31.0	31.1	31.5	31.9	32.1	32.2	32.2
Processing gains ³	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.4	2.4	2.4	2.4	2.5	2.5	2.5	2.5
Global Biofuels	2.8	2.5	3.1	3.3	2.9	2.9	2.6	3.2	3.5	3.1	3.1	3.3	3.4	3.4	3.5	3.6
Total Non-OPEC Supply	63.7	64.8	64.6	66.0	66.6	65.5	66.9	66.9	67.5	67.5	67.2	68.3	69.2	69.5	69.6	69.5
OPEC⁴																
Crude	26.4	28.5	28.7	29.6	29.4	29.1	29.3									
NGLs	5.2	5.3	5.4	5.4	5.3	5.3	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.5	5.6	5.6
Total OPEC	31.6	33.9	34.1	35.0	34.7	34.4	34.7									
Total Supply	95.4	98.7	98.7	101.0	101.3	99.9	101.6									
Memo items:																
Call on OPEC crude + Stock ch. ⁵	28.5	29.3	28.6	29.2	28.7	28.9	28.2	29.3	30.5	30.6	29.7	29.4	29.5	29.8	30.1	30.6

¹ Measured as deliveries from refineries and primary stocks, comprises inland deliveries, international marine bunkers, refinery fuel, crude for direct burning, oil from non-conventional sources and other sources of supply. Includes biofuels.

² Comprises crude oil, condensates, NGLs, oil from non-conventional sources and other sources of supply.

³ Net volumetric gains and losses in the refining process and marine transportation losses.

⁴ OPEC includes current members throughout the time series.

⁵ Total demand minus total non-OPEC supply and OPEC NGLs.

For the purpose of this and the following tables:

- OECD comprises of Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Latvia, Lithuania, Luxembourg, Mexico, Netherland, Norway, NewZealand, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland, Republic of Türkiye, UK, US.
- OPEC comprises of Algeria, Angola, Congo, Equatorial Guinea, Gabon, Iran, Iraq, Kuwait, Libya, Neutral Zone, Nigeria, Saudi Arabia, UAE, Venezuela.
- OPEC+ comprises of OPEC members throughout time series plus Sudan, South Sudan, Russia, Oman, Mexico, Malaysia, Kazakhstan, Brunei, Bahrain, Azerbaijan.

Table 1a
WORLD OIL SUPPLY AND DEMAND (Including OPEC+ based on current agreement¹)
(million barrels per day)

	2021	1Q22	2Q22	3Q22	4Q22	2022	1Q23	2Q23	3Q23	4Q23	2023	2024	2025	2026	2027	2028
Total Demand	97.5	99.4	98.5	100.6	100.6	99.8	100.5	101.6	103.4	103.5	102.2	103.1	104.1	104.8	105.3	105.7
OECD SUPPLY																
Americas ²	22.4	22.9	23.3	24.0	24.3	23.6	24.5	24.6	24.9	25.1	24.8	25.3	25.7	26.1	26.4	26.6
Europe	3.4	3.3	3.0	3.1	3.2	3.2	3.3	3.2	3.1	3.3	3.2	3.2	3.3	3.1	2.9	2.7
Asia Oceania	0.5	0.5	0.5	0.4	0.5	0.5	0.5	0.4	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.4
Total OECD (non-OPEC+)	26.3	26.7	26.8	27.6	27.9	27.3	28.3	28.2	28.5	28.9	28.5	29.0	29.4	29.6	29.7	29.7
NON-OECD SUPPLY																
FSU ³	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Europe	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
China	4.1	4.2	4.2	4.1	4.1	4.2	4.3	4.3	4.3	4.2	4.3	4.3	4.3	4.2	4.1	4.0
Other Asia ⁴	2.2	2.1	2.1	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	1.9	1.9	1.8	1.7	1.7
Latin America	5.3	5.4	5.5	5.8	5.9	5.6	6.0	5.9	6.1	6.2	6.0	6.4	6.8	7.0	7.3	7.5
Middle East ⁵	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	2.1	2.2	2.2
Africa ⁶	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.2	1.3	1.3	1.4
Total Non-OECD (non-OPEC+)	15.0	15.2	15.2	15.3	15.5	15.3	15.7	15.6	15.7	15.8	15.7	16.1	16.4	16.7	17.0	17.1
Processing Gains	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.4	2.4	2.4	2.4	2.5	2.5	2.5	2.5
Global Biofuels	2.8	2.5	3.1	3.3	2.9	2.9	2.6	3.2	3.5	3.1	3.1	3.3	3.4	3.4	3.5	3.6
Total Non-OPEC+	46.3	46.7	47.3	48.5	48.6	47.8	48.9	49.4	50.1	50.1	49.7	50.9	51.7	52.3	52.7	52.9
OPEC+ CRUDE																
Algeria	0.9	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.9	0.9
Angola	1.1	1.2	1.2	1.1	1.1	1.1	1.0	1.1	1.1	1.1	1.1	1.0	1.0	0.9	0.9	0.8
Azerbaijan	0.6	0.6	0.6	0.6	0.5	0.6	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.5	0.5	0.5
Bahrain	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Brunei	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Congo	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2
Equatorial Guinea	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0
Gabon	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1
Iran	2.4	2.5	2.5	2.5	2.6	2.5	2.7	2.8	2.9	2.9	2.8	2.9	2.9	2.9	2.9	2.9
Iraq	4.0	4.3	4.4	4.5	4.5	4.4	4.4	4.1	4.2	4.2	4.2	4.2	4.4	4.5	4.6	4.7
Kazakhstan	1.5	1.6	1.4	1.4	1.6	1.5	1.6	1.6	1.5	1.5	1.6	1.6	1.8	1.8	1.8	1.8
Kuwait	2.4	2.6	2.7	2.8	2.7	2.7	2.7	2.6	2.5	2.5	2.6	2.5	2.7	2.8	2.8	2.9
Libya	1.1	1.1	0.8	1.0	1.2	1.0	1.2	1.1	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Malaysia	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.3
Mexico	1.7	1.6	1.6	1.6	1.6	1.6	1.6	1.7	1.7	1.7	1.7	1.7	1.5	1.5	1.3	1.2
Nigeria	1.3	1.3	1.2	1.0	1.1	1.1	1.3	1.2	1.3	1.3	1.2	1.2	1.2	1.1	1.1	1.1
Oman	0.8	0.8	0.8	0.9	0.9	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Russia	9.6	10.0	9.4	9.8	9.8	9.8	9.7	9.5	9.3	9.3	9.5	9.3	9.3	9.3	9.2	9.1
Saudi Arabia	9.2	10.2	10.4	10.9	10.6	10.5	10.4	10.1	9.6	10.0	10.0	10.0	10.5	10.7	10.9	11.2
South Sudan	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Sudan	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
UAE	2.8	3.1	3.3	3.4	3.4	3.3	3.4	3.2	3.2	3.2	3.3	3.2	3.4	3.5	3.5	3.6
Venezuela	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
OPEC+ Crude	41.5	44.1	43.4	44.6	44.6	44.2	44.5	43.5	43.0	43.3	43.6	43.4	44.3	44.4	44.5	44.7
OPEC+ NGLs & Condensate	7.5	7.8	7.8	7.7	7.9	7.8	8.1	7.9	7.9	7.9	8.0	7.9	7.9	8.0	8.0	8.0
OPEC+ Nonconventionals	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Total OPEC+	49.1	52.0	51.3	52.5	52.6	52.1	52.6	51.6	51.0	51.4	51.6	51.4	52.4	52.5	52.6	52.8
Total Supply Oil	95.4	98.7	98.7	101.0	101.3	99.9	101.6	101.0	101.2	101.5	101.3	102.3	104.1	104.8	105.3	105.7
Memo items:																
Call on OPEC+ crude + Stock ch.	43.6	44.9	43.3	44.2	44.0	44.1	43.4	44.1	45.2	45.3	44.5	44.2	44.3	44.4	44.5	44.7

¹ From June to December 2023, OPEC+ supply reflects latest OPEC+ deal and individual countries' sustainable capacity. From 2024, supply is adjusted to reflect the call on OPEC crude. Iran, Russia remain under sanctions.

² OECD Americas excludes Mexico

³ FSU excludes Russia, Kazakhstan, Azerbaijan

⁴ Other Asia excludes Brunei, Malaysia

⁵ Middle East excludes Oman, Bahrain

⁶ Africa excludes Sudan, South Sudan

Table 1b
WORLD OIL SUPPLY AND DEMAND - WEO Regions
(million barrels per day)

	2021	1Q22	2Q22	3Q22	4Q22	2022	1Q23	2Q23	3Q23	4Q23	2023	2024	2025	2026	2027	2028
DEMAND																
North America	23.9	24.4	24.6	25.0	24.6	24.6	24.2	24.8	25.2	24.8	24.7	24.5	24.3	24.0	23.8	23.5
Central and South America	6.4	6.4	6.5	6.7	6.7	6.6	6.6	6.6	6.8	6.8	6.7	6.8	6.9	7.0	7.1	7.2
Europe	14.5	14.5	14.8	15.4	14.7	14.9	14.4	14.8	15.5	15.0	14.9	14.8	14.7	14.6	14.5	14.3
Africa	4.0	4.3	4.2	4.2	4.3	4.2	4.4	4.3	4.2	4.4	4.3	4.4	4.5	4.6	4.7	4.8
Middle East	8.5	8.6	9.1	9.5	9.0	9.0	8.9	9.3	9.7	9.1	9.2	9.3	9.4	9.6	9.7	9.8
Eurasia	4.5	4.4	4.4	4.8	4.7	4.6	4.5	4.4	4.7	4.6	4.6	4.5	4.6	4.7	4.7	4.7
Asia Pacific	35.7	36.9	34.9	35.0	36.6	35.8	37.5	37.3	37.3	39.0	37.8	38.7	39.7	40.3	40.9	41.3
Total Demand¹	97.5	99.4	98.5	100.6	100.6	99.8	100.5	101.6	103.4	103.5	102.3	103.1	104.1	104.8	105.3	105.7
NON-OPEC SUPPLY																
North America	24.3	24.9	25.3	26.0	26.3	25.6	26.6	26.7	27.1	27.2	26.9	27.4	27.7	27.9	28.1	28.1
Central and South America	5.3	5.4	5.5	5.8	5.9	5.7	6.0	5.9	6.1	6.2	6.0	6.4	6.8	7.0	7.3	7.5
Europe	3.6	3.5	3.2	3.2	3.3	3.3	3.4	3.3	3.2	3.4	3.3	3.3	3.4	3.2	3.0	2.8
Africa	1.3	1.3	1.3	1.3	1.3	1.3	1.2	1.3	1.3	1.3	1.3	1.3	1.4	1.5	1.5	1.5
Middle East	3.1	3.1	3.2	3.2	3.2	3.2	3.2	3.2	3.1	3.1	3.1	3.1	3.2	3.3	3.4	3.5
Eurasia	13.7	14.3	13.4	13.6	14.1	13.9	14.1	13.6	13.4	13.4	13.6	13.6	13.7	13.6	13.5	13.4
Asia Pacific	7.4	7.5	7.5	7.2	7.3	7.4	7.5	7.4	7.4	7.3	7.4	7.4	7.2	6.9	6.7	6.5
Total Non-OECD²	58.7	60.0	59.2	60.4	61.3	60.2	62.0	61.3	61.6	62.0	61.7	62.6	63.3	63.6	63.6	63.4
Processing gains ³	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.4	2.4	2.4	2.4	2.5	2.5	2.5	2.5
Global Biofuels	2.8	2.5	3.1	3.3	2.9	2.9	2.6	3.2	3.5	3.1	3.1	3.3	3.4	3.4	3.5	3.6
Total Non-OPEC Supply	63.7	64.8	64.6	66.0	66.6	65.5	66.9	66.9	67.5	67.5	67.2	68.3	69.1	69.5	69.6	69.5
OPEC⁴																
Crude	26.4	28.5	28.7	29.6	29.4	29.1	29.3									
NGLs	5.2	5.3	5.4	5.4	5.3	5.3	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.5	5.6	5.6
Total OPEC	31.6	33.9	34.1	35.0	34.7	34.4	34.7									
Total Supply	95.4	98.7	98.6	101.0	101.3	99.9	101.6									
Memo items:																
Call on OPEC crude + Stock ch. ⁵	28.6	29.3	28.6	29.2	28.7	29.0	28.2	29.3	30.5	30.6	29.7	29.4	29.5	29.8	30.2	30.6

¹ Measured as deliveries from refineries and primary stocks, comprises inland deliveries, international marine bunkers, refinery fuel, crude for direct burning, oil from non-conventional sources and other sources of supply. Includes biofuels.

² Comprises crude oil, condensates, NGLs, oil from non-conventional sources and other sources of supply.

³ Net volumetric gains and losses in the refining process and marine transportation losses.

⁴ OPEC includes current members throughout the time series.

⁵ Total demand minus total non-OPEC supply and OPEC NGLs.

Table 2
SUMMARY OF GLOBAL OIL DEMAND

	1Q22	2Q22	3Q22	4Q22	2022	1Q23	2Q23	3Q23	4Q23	2023	2024	2025	2026	2027	2028
Demand (mb/d)															
Americas	24.8	25.0	25.3	25.0	25.0	24.6	25.2	25.6	25.2	25.1	24.8	24.7	24.4	24.2	23.9
Europe	13.2	13.4	14.0	13.3	13.5	13.1	13.5	14.1	13.5	13.6	13.4	13.3	13.1	13.0	12.8
Asia Oceania	7.9	7.0	7.2	7.7	7.4	7.9	7.0	7.5	7.9	7.6	7.6	7.5	7.5	7.5	7.5
Total OECD	45.8	45.4	46.6	46.0	45.9	45.5	45.7	47.1	46.6	46.2	45.8	45.5	45.0	44.7	44.3
Asia	29.3	28.1	28.0	29.2	28.6	29.9	30.6	30.1	31.3	30.5	31.4	32.4	33.1	33.6	34.1
Middle East	8.6	9.1	9.5	9.0	9.0	8.9	9.3	9.7	9.1	9.2	9.3	9.4	9.6	9.7	9.8
Latin America	6.0	6.2	6.4	6.3	6.2	6.2	6.2	6.4	6.4	6.3	6.4	6.5	6.6	6.7	6.8
FSU	4.8	4.8	5.1	5.1	4.9	4.9	4.8	5.0	5.0	4.9	4.9	5.0	5.0	5.1	5.1
Africa	4.3	4.2	4.2	4.3	4.2	4.4	4.3	4.2	4.4	4.3	4.4	4.5	4.6	4.7	4.8
Europe	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Total Non-OECD	53.6	53.1	54.0	54.7	53.9	55.0	55.9	56.2	56.9	56.0	57.3	58.6	59.8	60.6	61.5
World	99.4	98.5	100.6	100.6	99.8	100.5	101.6	103.4	103.5	102.3	103.1	104.1	104.8	105.3	105.7
of which:															
USA	20.4	20.4	20.6	20.3	20.4	20.1	20.6	20.8	20.5	20.5	20.3	20.1	19.8	19.6	19.4
Euro5*	7.4	7.6	7.8	7.4	7.6	7.3	7.5	7.8	7.5	7.5	7.5	7.4	7.3	7.2	7.1
China	15.1	14.0	14.5	15.0	14.7	15.6	16.3	16.2	16.6	16.1	16.6	17.0	17.3	17.5	17.6
Japan	3.7	3.0	3.2	3.6	3.4	3.7	3.1	3.3	3.6	3.4	3.4	3.4	3.4	3.4	3.3
India	5.4	5.3	5.0	5.4	5.3	5.6	5.4	5.2	5.7	5.5	5.6	5.8	6.0	6.1	6.3
Russia	3.7	3.6	4.0	3.9	3.8	3.8	3.6	3.8	3.8	3.7	3.7	3.7	3.7	3.7	3.7
Brazil	3.0	3.0	3.2	3.2	3.1	3.1	3.1	3.3	3.2	3.2	3.2	3.3	3.3	3.3	3.3
Saudi Arabia	3.3	3.8	4.0	3.7	3.7	3.6	3.9	4.1	3.8	3.8	3.8	3.8	3.8	3.8	3.8
Korea	2.7	2.5	2.5	2.6	2.6	2.6	2.4	2.6	2.7	2.6	2.6	2.6	2.5	2.6	2.6
Canada	2.2	2.2	2.4	2.3	2.3	2.2	2.2	2.4	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Mexico	1.8	2.0	2.0	2.0	1.9	1.9	1.9	2.0	1.9	1.9	1.9	1.9	1.9	1.9	1.9
Iran	1.9	1.8	1.8	1.8	1.8	1.9	1.9	1.8	1.8	1.9	1.9	2.0	2.0	2.0	2.0
Total	70.6	69.4	71.0	71.2	70.5	71.3	71.9	73.3	73.4	72.5	72.8	73.2	73.3	73.3	73.3
% of World	71.0	70.4	70.6	70.7	70.7	70.9	70.8	70.9	70.9	70.9	70.6	70.4	70.0	69.6	69.4
Annual Change (% per annum)															
Americas	8.0	2.5	2.2	-0.7	2.9	-0.8	0.8	0.9	0.8	0.4	-1.1	-0.8	-1.1	-1.0	-0.9
Europe	10.6	6.3	1.2	-4.3	3.0	-1.0	0.3	0.6	1.4	0.4	-1.0	-1.0	-1.0	-1.1	-1.3
Asia Oceania	2.3	-0.2	2.1	-1.3	0.7	0.1	0.8	3.2	3.0	1.8	0.2	-0.5	-0.7	0.5	-0.4
Total OECD	7.7	3.1	1.9	-1.9	2.6	-0.7	0.7	1.2	1.4	0.6	-0.9	-0.8	-1.0	-0.7	-1.0
Asia	3.0	-1.3	0.2	-0.1	0.5	2.2	8.7	7.5	7.3	6.4	3.1	3.0	2.3	1.4	1.5
Middle East	5.1	8.2	6.9	6.3	6.6	4.3	1.8	1.7	1.0	2.2	0.6	1.5	1.7	0.9	0.7
Latin America	3.5	5.3	2.8	2.2	3.4	3.0	1.0	1.2	1.1	1.5	1.9	2.0	1.5	1.4	1.3
FSU	2.4	-0.2	2.2	0.4	1.2	1.9	-0.1	-2.1	-2.3	-0.7	-0.1	1.3	1.3	1.6	0.7
Africa	4.2	5.2	5.5	4.0	4.7	2.5	1.3	1.1	1.0	1.5	3.1	0.9	2.1	2.1	2.2
Europe	2.7	1.9	1.5	1.2	1.8	0.0	1.3	0.1	0.9	0.6	1.5	2.7	0.9	0.9	0.8
Total Non-OECD	3.4	1.6	2.3	1.6	2.2	2.6	5.1	4.2	4.1	4.0	2.2	2.3	2.0	1.4	1.4
World	5.4	2.3	2.1	0.0	2.4	1.1	3.1	2.8	2.8	2.5	0.8	0.9	0.7	0.5	0.4
Annual Change (mb/d)															
Americas	1.8	0.6	0.5	-0.2	0.7	-0.2	0.2	0.2	0.2	0.1	-0.3	-0.2	-0.3	-0.2	-0.2
Europe	1.3	0.8	0.2	-0.6	0.4	-0.1	0.0	0.1	0.2	0.0	-0.1	-0.1	-0.1	-0.1	-0.2
Asia Oceania	0.2	0.0	0.1	-0.1	0.1	0.0	0.1	0.2	0.2	0.1	0.0	0.0	-0.1	0.0	0.0
Total OECD	3.3	1.4	0.9	-0.9	1.1	-0.3	0.3	0.5	0.6	0.3	-0.4	-0.4	-0.4	-0.3	-0.4
Asia	0.9	-0.4	0.1	0.0	0.1	0.6	2.4	2.1	2.1	1.8	0.9	1.0	0.7	0.5	0.5
Middle East	0.4	0.7	0.6	0.5	0.6	0.4	0.2	0.2	0.1	0.2	0.1	0.1	0.2	0.1	0.1
Latin America	0.2	0.3	0.2	0.1	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
FSU	0.1	0.0	0.1	0.0	0.1	0.1	0.0	-0.1	-0.1	0.0	0.0	0.1	0.1	0.1	0.0
Africa	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.0	0.0	0.1	0.1	0.0	0.1	0.1	0.1
Europe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Non-OECD	1.8	0.8	1.2	0.8	1.2	1.4	2.7	2.3	2.2	2.2	1.3	1.3	1.2	0.8	0.8
World	5.1	2.2	2.0	0.0	2.3	1.1	3.0	2.8	2.9	2.4	0.9	1.0	0.7	0.5	0.4

* France, Germany, Italy, Spain and UK

Table 3
WORLD OIL PRODUCTION
(million barrels per day)

	2021	1Q22	2Q22	3Q22	4Q22	2022	1Q23	2Q23	3Q23	4Q23	2023	2024	2025	2026	2027	2028
OPEC																
Crude Oil																
Saudi Arabia	9.15	10.17	10.44	10.92	10.57	10.53	10.42									
Iran	2.42	2.55	2.46	2.55	2.63	2.55	2.70									
Iraq	4.03	4.29	4.45	4.54	4.50	4.45	4.39									
UAE	2.76	3.13	3.33	3.45	3.37	3.32	3.36									
Kuwait	2.42	2.61	2.67	2.80	2.71	2.70	2.68									
Angola	1.12	1.16	1.17	1.15	1.08	1.14	1.05									
Nigeria	1.31	1.30	1.15	1.00	1.13	1.15	1.27									
Libya	1.15	1.08	0.77	0.96	1.17	0.99	1.15									
Algeria	0.91	0.99	1.01	1.02	1.02	1.01	1.01									
Congo	0.27	0.27	0.26	0.26	0.26	0.26	0.28									
Gabon	0.18	0.19	0.18	0.20	0.18	0.19	0.20									
Equatorial Guinea	0.10	0.09	0.09	0.09	0.06	0.08	0.05									
Venezuela	0.61	0.72	0.74	0.66	0.68	0.70	0.71									
Total Crude Oil	26.43	28.55	28.72	29.59	29.37	29.06	29.28									
Total NGLs¹	5.20	5.32	5.36	5.37	5.33	5.34	5.40	5.37	5.39	5.39	5.39	5.42	5.45	5.51	5.57	5.63
Total OPEC²	31.63	33.87	34.08	34.96	34.70	34.41	34.68									
NON-OPEC³																
OECD																
Americas	24.31	24.89	25.26	26.06	26.27	25.63	26.64	26.71	27.06	27.23	26.91	27.42	27.67	27.92	28.07	28.11
United States	16.76	17.17	17.70	18.24	18.30	17.85	18.69	19.04	19.05	19.09	18.97	19.41	19.75	20.11	20.34	20.44
Mexico	1.95	2.00	1.99	2.02	2.02	2.01	2.10	2.13	2.14	2.14	2.13	2.08	1.94	1.82	1.66	1.50
Canada	5.59	5.71	5.57	5.79	5.95	5.76	5.84	5.53	5.86	5.99	5.81	5.92	5.96	5.98	6.06	6.16
Chile	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Europe	3.39	3.33	3.03	3.09	3.21	3.16	3.29	3.16	3.12	3.29	3.21	3.23	3.27	3.13	2.94	2.74
UK	0.88	0.91	0.85	0.75	0.81	0.83	0.85	0.77	0.70	0.83	0.79	0.77	0.72	0.67	0.63	0.59
Norway	2.05	1.98	1.74	1.91	1.97	1.90	2.00	1.96	1.99	2.03	2.00	2.03	2.14	2.06	1.91	1.76
Others	0.46	0.43	0.44	0.43	0.43	0.43	0.44	0.42	0.43	0.43	0.43	0.42	0.41	0.40	0.40	0.40
Asia Oceania	0.51	0.49	0.51	0.43	0.48	0.48	0.46	0.44	0.47	0.50	0.47	0.47	0.44	0.41	0.38	0.35
Australia	0.44	0.42	0.45	0.37	0.42	0.41	0.39	0.37	0.40	0.42	0.39	0.39	0.36	0.33	0.31	0.28
Others	0.07	0.07	0.07	0.07	0.06	0.07	0.07	0.08	0.07	0.08	0.07	0.08	0.08	0.07	0.07	0.07
Total OECD	28.22	28.71	28.81	29.58	29.96	29.27	30.39	30.31	30.65	31.02	30.59	31.11	31.38	31.47	31.39	31.21
NON-OECD																
Former USSR	13.77	14.40	13.43	13.67	14.09	13.90	14.09	13.64	13.43	13.45	13.65	13.61	13.75	13.66	13.55	13.42
Russia	10.87	11.38	10.70	11.07	11.21	11.09	11.14	10.79	10.64	10.64	10.80	10.64	10.64	10.59	10.51	10.38
Others	2.90	3.02	2.73	2.59	2.89	2.81	2.96	2.85	2.79	2.81	2.85	2.97	3.11	3.07	3.04	3.04
Asia	6.91	6.99	6.95	6.77	6.82	6.88	7.03	6.99	6.93	6.85	6.95	6.90	6.77	6.54	6.37	6.18
China	4.06	4.23	4.23	4.12	4.13	4.18	4.34	4.31	4.27	4.20	4.28	4.30	4.29	4.17	4.08	3.96
Malaysia	0.57	0.57	0.56	0.54	0.57	0.56	0.58	0.57	0.56	0.56	0.57	0.56	0.53	0.49	0.47	0.46
India	0.73	0.72	0.71	0.70	0.69	0.70	0.68	0.69	0.69	0.70	0.69	0.69	0.66	0.62	0.59	0.56
Indonesia	0.68	0.65	0.63	0.62	0.63	0.63	0.64	0.63	0.62	0.62	0.63	0.60	0.58	0.56	0.53	0.51
Others	0.87	0.83	0.81	0.79	0.80	0.81	0.79	0.79	0.78	0.77	0.78	0.74	0.71	0.70	0.70	0.69
Europe	0.11	0.11	0.11	0.10	0.10	0.11	0.10	0.10	0.10	0.10	0.10	0.09	0.09	0.08	0.07	0.08
Latin America	5.30	5.44	5.46	5.77	5.90	5.64	5.97	5.91	6.08	6.16	6.03	6.44	6.76	7.02	7.30	7.52
Brazil	3.00	3.08	3.00	3.16	3.23	3.12	3.30	3.21	3.35	3.41	3.32	3.54	3.77	3.92	4.03	4.09
Argentina	0.64	0.69	0.70	0.72	0.74	0.71	0.75	0.77	0.78	0.79	0.78	0.81	0.84	0.88	0.93	1.01
Colombia	0.74	0.75	0.76	0.76	0.78	0.76	0.78	0.78	0.77	0.77	0.78	0.75	0.71	0.68	0.65	0.62
Ecuador	0.47	0.47	0.45	0.47	0.46	0.46	0.43	0.46	0.47	0.47	0.46	0.46	0.43	0.41	0.39	0.37
Others	0.44	0.44	0.56	0.67	0.69	0.59	0.70	0.70	0.70	0.72	0.70	0.87	1.00	1.14	1.31	1.43
Middle East	3.06	3.11	3.17	3.21	3.18	3.17	3.16	3.16	3.14	3.14	3.15	3.13	3.20	3.32	3.42	3.49
Oman	0.98	1.04	1.07	1.10	1.08	1.07	1.07	1.05	1.03	1.03	1.05	1.03	1.08	1.08	1.08	1.08
Qatar	1.80	1.78	1.81	1.81	1.81	1.80	1.81	1.81	1.81	1.81	1.81	1.81	1.84	1.97	2.07	2.16
Syria	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Yemen	0.06	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Others	0.19	0.19	0.20	0.21	0.20	0.20	0.18	0.20	0.20	0.20	0.20	0.20	0.19	0.18	0.18	0.17
Africa	1.33	1.29	1.29	1.30	1.29	1.29	1.23	1.26	1.26	1.26	1.25	1.31	1.37	1.50	1.50	1.53
Egypt	0.59	0.59	0.61	0.60	0.60	0.60	0.59	0.59	0.59	0.59	0.59	0.59	0.57	0.55	0.53	0.52
Sudan	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.05	0.05	0.05	0.05	0.05	0.04	0.04	0.04
Others	0.68	0.65	0.62	0.64	0.63	0.64	0.58	0.61	0.61	0.62	0.61	0.66	0.75	0.91	0.92	0.97
Total Non-OECD	30.48	31.34	30.41	30.82	31.38	30.99	31.58	31.04	30.93	30.96	31.13	31.47	31.92	32.13	32.22	32.22
Processing Gains ⁴	2.25	2.28	2.29	2.32	2.34	2.31	2.31	2.34	2.37	2.38	2.35	2.44	2.46	2.49	2.49	2.49
Global Biofuels	2.79	2.51	3.08	3.30	2.89	2.95	2.63	3.25	3.52	3.14	3.14	3.28	3.39	3.44	3.50	3.55
TOTAL NON-OPEC	63.74	64.85	64.58	66.02	66.58	65.52	66.91	66.94	67.47	67.50	67.21	68.30	69.16	69.54	69.60	69.48
TOTAL SUPPLY	95.38	98.71	98.66	100.98	101.28	99.92	101.59									

¹ Includes condensates and oil from non-conventional sources.

² Total OPEC comprises all countries which are currently OPEC members.

Total Non-OPEC excludes all countries that are current members of OPEC.

³ Comprises crude oil, condensates, NGLs and oil from non-conventional sources.

⁴ Net volumetric gains and losses in refining and marine transportation losses.

Table 3a
WORLD OIL PRODUCTION (Including OPEC+ based on current agreement¹)
(million barrels per day)

	2021	1Q22	2Q22	3Q22	4Q22	2022	1Q23	2Q23	3Q23	4Q23	2023	2024	2025	2026	2027	2028
OPEC																
Crude Oil																
Algeria	0.91	0.99	1.01	1.02	1.02	1.01	1.01	0.98	0.96	0.96	0.98	0.96	0.97	0.96	0.95	0.94
Angola	1.12	1.16	1.17	1.15	1.08	1.14	1.05	1.10	1.10	1.08	1.08	1.03	0.96	0.91	0.85	0.82
Azerbaijan	0.59	0.58	0.56	0.55	0.55	0.56	0.53	0.51	0.52	0.54	0.52	0.56	0.57	0.55	0.53	0.52
Bahrain	0.17	0.18	0.19	0.20	0.19	0.19	0.17	0.19	0.19	0.19	0.19	0.19	0.18	0.18	0.17	0.17
Brunei	0.08	0.08	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.08	0.08	0.08	0.07	0.08
Congo	0.27	0.27	0.26	0.26	0.26	0.26	0.28	0.28	0.27	0.27	0.28	0.27	0.26	0.25	0.23	0.21
Equatorial Guinea	0.10	0.09	0.09	0.09	0.06	0.08	0.05	0.05	0.07	0.07	0.06	0.06	0.06	0.06	0.05	0.05
Gabon	0.18	0.19	0.18	0.20	0.18	0.19	0.20	0.19	0.17	0.17	0.18	0.17	0.16	0.15	0.14	0.14
Iran	2.42	2.55	2.46	2.55	2.63	2.55	2.70	2.84	2.87	2.87	2.82	2.87	2.87	2.87	2.87	2.87
Iraq	4.03	4.29	4.45	4.54	4.50	4.45	4.39	4.09	4.22	4.22	4.23	4.22	4.40	4.49	4.60	4.71
Kazakhstan	1.52	1.63	1.43	1.35	1.60	1.50	1.64	1.58	1.50	1.51	1.56	1.64	1.77	1.76	1.76	1.75
Kuwait	2.42	2.61	2.67	2.80	2.71	2.70	2.68	2.60	2.55	2.55	2.59	2.55	2.70	2.75	2.82	2.89
Libya	1.15	1.08	0.77	0.96	1.17	0.99	1.15	1.14	1.17	1.18	1.16	1.23	1.23	1.23	1.23	1.23
Malaysia	0.42	0.41	0.39	0.38	0.40	0.40	0.39	0.39	0.38	0.37	0.38	0.37	0.35	0.32	0.30	0.29
Mexico	1.66	1.64	1.62	1.62	1.62	1.62	1.65	1.68	1.69	1.69	1.68	1.65	1.54	1.46	1.33	1.22
Nigeria	1.31	1.30	1.15	1.00	1.13	1.15	1.27	1.18	1.26	1.25	1.24	1.22	1.18	1.15	1.10	1.07
Oman	0.75	0.82	0.84	0.88	0.85	0.85	0.84	0.81	0.80	0.80	0.81	0.80	0.84	0.85	0.84	0.84
Russia	9.62	10.04	9.40	9.78	9.78	9.75	9.73	9.47	9.34	9.34	9.47	9.34	9.34	9.29	9.21	9.08
Saudi Arabia	9.15	10.17	10.44	10.92	10.57	10.53	10.42	10.14	9.64	9.98	10.04	9.98	10.46	10.66	10.93	11.20
South Sudan	0.15	0.14	0.14	0.15	0.14	0.14	0.12	0.13	0.13	0.13	0.13	0.12	0.12	0.12	0.11	0.11
Sudan	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.05	0.05	0.05	0.05	0.05	0.04	0.04	0.04
UAE	2.76	3.13	3.33	3.45	3.37	3.32	3.36	3.24	3.20	3.20	3.25	3.20	3.38	3.45	3.54	3.62
Venezuela	0.61	0.72	0.74	0.66	0.68	0.70	0.71	0.80	0.83	0.83	0.79	0.84	0.84	0.84	0.84	0.84
Total Crude Oil	41.47	44.12	43.43	44.63	44.62	44.20	44.48	43.51	42.98	43.32	43.57	43.39	44.32	44.41	44.52	44.68
<i>of which Neutral Zone</i>	0.25	0.27	0.28	0.31	0.27	0.28	0.26	0.27	0.24	0.24	0.25	0.24				
Total NGLs (OPEC+)	7.59	7.91	7.89	7.86	8.02	7.92	8.17	8.05	8.05	8.04	8.08	8.06	8.06	8.08	8.09	8.13
Total OPEC+ NON-OPEC+	49.06	52.03	51.31	52.48	52.64	52.12	52.65	51.56	51.03	51.37	51.65	51.45	52.38	52.48	52.61	52.81
OECD																
Americas²	22.36	22.89	23.27	24.04	24.25	23.62	24.54	24.58	24.92	25.09	24.78	25.34	25.73	26.10	26.41	26.61
United States	16.76	17.17	17.70	18.24	18.30	17.85	18.69	19.04	19.05	19.09	18.97	19.41	19.75	20.11	20.34	20.44
Canada	5.59	5.71	5.57	5.79	5.95	5.76	5.84	5.53	5.86	5.99	5.81	5.92	5.96	5.98	6.06	6.16
Chile	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Europe	3.39	3.33	3.03	3.09	3.21	3.16	3.29	3.16	3.12	3.29	3.21	3.23	3.27	3.13	2.94	2.74
UK	0.88	0.91	0.85	0.75	0.81	0.83	0.85	0.77	0.70	0.83	0.79	0.77	0.72	0.67	0.63	0.59
Norway	2.05	1.98	1.74	1.91	1.97	1.90	2.00	1.96	1.99	2.03	2.00	2.03	2.14	2.06	1.91	1.76
Others	0.46	0.43	0.44	0.43	0.43	0.43	0.44	0.42	0.43	0.43	0.43	0.42	0.41	0.40	0.40	0.40
Asia Oceania	0.51	0.49	0.51	0.43	0.48	0.48	0.46	0.44	0.47	0.50	0.47	0.47	0.44	0.41	0.38	0.35
Australia	0.44	0.42	0.45	0.37	0.42	0.41	0.39	0.37	0.40	0.42	0.39	0.39	0.36	0.33	0.31	0.28
Others	0.07	0.07	0.07	0.07	0.06	0.07	0.07	0.08	0.07	0.08	0.07	0.08	0.08	0.07	0.07	0.07
Total OECD (non-OPEC +)	26.26	26.71	26.82	27.56	27.94	27.26	28.30	28.18	28.51	28.88	28.47	29.03	29.44	29.64	29.73	29.71
NON-OECD																
Former USSR	0.35	0.34	0.30	0.31	0.31	0.32	0.32	0.31	0.31	0.31	0.31	0.31	0.30	0.29	0.29	0.29
Asia	6.24	6.32	6.29	6.14	6.16	6.23	6.35	6.32	6.27	6.19	6.28	6.24	6.14	5.95	5.81	5.63
China	4.06	4.23	4.23	4.12	4.13	4.18	4.34	4.31	4.27	4.20	4.28	4.30	4.29	4.17	4.08	3.96
India	0.73	0.72	0.71	0.70	0.69	0.70	0.68	0.69	0.69	0.70	0.69	0.69	0.66	0.62	0.59	0.56
Indonesia	0.68	0.65	0.63	0.62	0.63	0.63	0.64	0.63	0.63	0.62	0.63	0.60	0.58	0.56	0.53	0.51
Others	0.77	0.73	0.71	0.70	0.71	0.71	0.70	0.69	0.68	0.68	0.69	0.64	0.62	0.61	0.61	0.60
Europe	0.11	0.11	0.11	0.10	0.10	0.11	0.10	0.10	0.10	0.10	0.10	0.09	0.09	0.08	0.07	0.08
Latin America	5.30	5.44	5.46	5.77	5.90	5.64	5.97	5.91	6.08	6.16	6.03	6.44	6.76	7.02	7.30	7.52
Brazil	3.00	3.08	3.00	3.16	3.23	3.12	3.30	3.21	3.35	3.41	3.32	3.54	3.77	3.92	4.03	4.09
Argentina	0.64	0.69	0.70	0.72	0.74	0.71	0.75	0.77	0.78	0.79	0.78	0.81	0.84	0.88	0.93	1.01
Colombia	0.74	0.75	0.76	0.76	0.78	0.76	0.78	0.78	0.77	0.77	0.78	0.75	0.71	0.68	0.65	0.62
Ecuador	0.48	0.47	0.45	0.47	0.46	0.47	0.44	0.46	0.47	0.47	0.46	0.47	0.44	0.42	0.40	0.38
Others	0.43	0.44	0.55	0.66	0.68	0.58	0.69	0.69	0.69	0.71	0.70	0.87	0.99	1.13	1.30	1.42
Middle East	1.90	1.87	1.91	1.90	1.90	1.90	1.91	1.91	1.90	1.90	1.91	1.90	1.93	2.06	2.16	2.24
Qatar	1.80	1.78	1.81	1.81	1.81	1.80	1.81	1.81	1.81	1.81	1.81	1.81	1.84	1.97	2.07	2.16
Others	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.08
Africa	1.12	1.10	1.10	1.09	1.09	1.09	1.06	1.07	1.07	1.08	1.07	1.13	1.20	1.34	1.34	1.38
Egypt	0.59	0.59	0.61	0.60	0.60	0.60	0.59	0.59	0.59	0.59	0.59	0.59	0.57	0.55	0.53	0.52
Others	0.52	0.51	0.48	0.49	0.49	0.49	0.47	0.48	0.48	0.50	0.48	0.54	0.63	0.79	0.81	0.87
Total Non-OECD (non-OPEC+)	15.01	15.18	15.16	15.32	15.46	15.28	15.71	15.62	15.73	15.75	15.70	16.12	16.42	16.75	16.98	17.14
Processing Gains	2.25	2.28	2.29	2.32	2.34	2.31	2.31	2.34	2.37	2.38	2.35	2.44	2.46	2.49	2.49	2.49
Global Biofuels	2.79	2.51	3.08	3.30	2.89	2.95	2.63	3.25	3.52	3.14	3.14	3.28	3.39	3.44	3.50	3.55
TOTAL NON-OPEC	46.32	46.68	47.35	48.50	48.64	47.80	48.95	49.39	50.14	50.14	49.66	50.86	51.71	52.33	52.70	52.89
TOTAL SUPPLY	95.38	98.71	98.66	100.98	101.28	99.92	101.59	100.95	101.17	101.51	101.30	102.31	104.08	104.81	105.31	105.71

¹ From June to December 2024, OPEC+ supply reflects latest OPEC+ deal and individual countries' sustainable capacity. From 2025, supply is adjusted to reflect the call on OPEC crude.

Iran, Russia remain under sanctions.

² Excludes Mexico

Table 3b
SELECTED UPSTREAM PROJECT START-UPS

Country	Project	Peak Capacity (kb/d)	Start Year	Country	Project	Peak Capacity (kb/d)	Start Year
NON-OPEC							
OECD Americas				Latin America			
Canada	Terra Nova	30	2024	Brazil	Mero 1 (Guanabara)	180	2022
Canada	White Rose	80	2026	Brazil	Buzios 5 (Almirante Barroso)	150	2023
Mexico	Amoca-Mizton-Tecoalli	70	2024	Brazil	Marlim redev 1 (Garibaldi)	80	2023
US	Kings Quay	80	2022	Brazil	Mero 2 (Sepetiba)	180	2023
US	Power Nap	35	2022	Brazil	Marlim redev 2 (Anna Nery)	70	2023
US	Mad Dog Ph 2 (Argos)	140	2023	Brazil	Itapu (P-71)	150	2023
US	Vito	100	2023	Brazil	Mero 3 (Mal. Duque de Caxias)	180	2024
US	Anchor	75	2024	Brazil	Atlanta FDS	50	2024
US	Whale	80	2024	Brazil	IPB (Maria Quitéria)	100	2025
US	Shenandoah	60	2024	Brazil	Buzios 7 (Alm. Tamandaré)	220	2025
US	Ballymore	75	2025	Brazil	Bacalhau	220	2025
US	Leon/Castile	60	2025	Brazil	Mero 4 (Alexandre de Gusmão)	180	2025
US	Pikka Phase 1 (Alaska)	80	2026	Brazil	Buzios 6 (P-78)	180	2025
OECD Europe				Brazil			
Denmark	Tyra Redevelopment	20	2024	Brazil	Buzios 8 (P-79)	180	2025
Norway	Nova	30	2022	Brazil	Buzios 9 (P-80)	225	2026
Norway	Johan Sverdrup Ph 2	220	2022	Brazil	Buzios 10 (P-82)	225	2027
Norway	Njord/Bauge	30	2023	Brazil	Buzios 11 (P-83)	225	2027
Norway	Fenja	30	2023	Brazil	BM-C-33	125	2028
Norway	Eldfisk North	30	2024	Guyana	Stabroek Ph 2 (Unity)	220	2022
Norway	Balder X	50	2024	Guyana	Stabroek Ph 3 (Paraya/Prosperity)	220	2023
Norway	Breidablikk	50	2024	Guyana	Stabroek Ph 4 (Yellowtail)	250	2025
Norway	Johan Castberg	170	2024	Guyana	Stabroek Ph 5 (Uaru)	250	2026
UK	Penguins	45	2023	Guyana	Stabroek Ph 6 (Whiptail)*	250	2028
UK	Seagull	30	2023	Asia			
Africa				China	Kenli	40	2022
Ghana	Mahogany-Teak-Akasa (MTAB)	30	2024	China	Enping Joint Development Project	35	2022
Senegal	Sangomar Ph 1 (SNE)	100	2023	India	KG-DWN-98/2	50	2023
Uganda	Lake Albert (Kingfisher and Tilenga)	230	2025	Viet Nam	Lac Da Vang*	55	2025
FSU				Middle East			
Azerbaijan	Azeri Central East (ACE)	100	2024	Israel	Karish/Karish North	30	2023
Kazakhstan	Tengizchevroil FGP-WPMP	260	2023	Qatar	North Field Expansion East	260	2026
				Qatar	North Field Expansion South	130	2028
OPEC							
Angola	Zinia 2, Clov 2, Dalia 3	110	2021-22	Saudi	Zuluf Expansion	600	2026
Angola	Cuica, Cabaca, Ndungu	45	2022	UAE	Belbazem	45	2023
Saudi	Marjan Expansion	300	2024-25				
Saudi	Berri Expansion	250	2024-25				

*Included in the forecast but pre-FID

Table 3c
NON-OPEC SUPPLY - OIL MARKET REPORT AND WEO DEFINITIONS
(million barrels per day)

Calculation	2021	2022	2023	2024	2025	2026	2027	2028	
Oil 2023 Report definitions									
NON-OPEC SUPPLY		63.7	65.5	67.2	68.3	69.2	69.5	69.6	69.5
Processing gains		2.3	2.3	2.4	2.4	2.5	2.5	2.5	2.5
Global biofuels		2.8	2.9	3.1	3.3	3.4	3.4	3.5	3.6
NON-OPEC PRODUCTION (excl. processing gains and biofuels)	1	58.7	60.3	61.7	62.6	63.3	63.6	63.6	63.4
Crude	2	48.0	49.1	50.3	51.0	51.6	51.7	51.5	51.1
of which: Condensate	3	4.0	4.2	4.4	4.4	4.4	4.5	4.5	4.5
Tight oil	4	7.8	8.5	9.4	9.9	10.3	10.6	10.8	11.1
Un-upgraded bitumen	5	3.8	4.0	4.0	4.1	4.1	4.1	4.2	4.4
NGLs	6	8.7	9.1	9.4	9.5	9.6	9.7	9.9	10.2
Syncrude (Canada)	7	1.4	1.3	1.4	1.4	1.4	1.4	1.4	1.4
CTL, GTL, kerogen oil and additives ¹	8	0.6	0.7	0.7	0.7	0.7	0.8	0.8	0.8
World Energy Outlook definitions									
NON-OPEC PRODUCTION (excl. processing gains and biofuels)	=1	58.7	60.3	61.7	62.6	63.3	63.6	63.6	63.4
Conventional		45.1	45.7	46.2	46.5	46.8	46.8	46.4	45.7
Crude oil	=2-3-4-5	32.4	32.4	32.4	32.6	32.8	32.6	32.0	31.1
Natural gas liquids (total)	=3+6	12.7	13.3	13.8	13.9	14.0	14.2	14.4	14.7
Unconventional		13.6	14.6	15.5	16.1	16.5	16.8	17.2	17.7
EHOB (incl. syncrude) ²	=5+7	5.2	5.3	5.4	5.5	5.5	5.5	5.6	5.8
Tight oil	=4	7.8	8.5	9.4	9.9	10.3	10.6	10.8	11.1
CTL, GTL, kerogen oil and additives ¹	=8	0.6	0.7	0.7	0.7	0.7	0.8	0.8	0.8

¹ CTL = coal to liquids; GTL = gas to liquids.

² Extra-heavy oil and bitumen

Table 4
WORLD REFINERY CAPACITY CHANGES

(thousand barrels per day)

	2022	2023	2024	2025	2026	2027	2028	Total
Refining Capacity Additions and Expansions¹								
OECD Americas	-247	290	-389	340				241
OECD Europe			-92	-147				-239
OECD Asia Oceania	-249	-122	-120					-242
FSU	-142	26	86		50			162
Non-OECD Europe								
China	586	72	220	680	350	320	-120	1,522
Other Asia	55	134	4	322	287	299	100	1,146
Non-OECD Americas	33	45		15			115	175
Middle East	643	631	132	190	60	100	-235	878
Africa	-160	12	750	30				792
Total World	519	1,088	591	1,430	747	719	-140	4,435
Upgrading Capacity Additions²								
OECD Americas	-135	-110						-110
OECD Europe	-14	22	30					52
OECD Asia Oceania	-45	-65	-27					-92
FSU	289	148	222	170	181			721
Non-OECD Europe		20						20
China	528	130	319		-58		-118	273
Other Asia	73	161	211	183	110	197	57	919
Non-OECD Americas	135						85	85
Middle East	140	166	177		45			388
Africa	-32	-37	280	26		29		298
Total World	939	435	1,212	379	278	226	24	2,553
Desulphurisation Capacity Additions³								
OECD Americas	-255	-403						-403
OECD Europe	22	38	54					92
OECD Asia Oceania		-243	-109					-352
FSU	52	91	70	40				201
Non-OECD Europe								
China	168	128	408		-34		-42	460
Other Asia	17	88	242	48	160	310	162	1,010
Non-OECD Americas	64				-37		80	43
Middle East	877	470	72	100	111			753
Africa	-74	-11	250	43		38		320
Total World	871	157	987	231	200	348	201	2,124

¹ Comprises new refinery projects or expansions to existing Crude distillation units including condensate splitter additions. Assumes zero capacity creep.

² Comprises gross capacity additions to coking, hydrocracking, residue hydrocracking, visbreaking, FCC or RFCC capacity.

³ Comprises additions to hydrotreating and hydrodesulphurisation capacity.

Table 4a
SELECTED REFINERY CRUDE DISTILLATION CHANGES LIST

Country	Project	Capacity (kbd)	Year	Country	Project	Capacity (kbd)	Year
OECD Americas				Asia			
Mexico	Pemex - Dos Bocas	340	2025	China	CNPC - Jieyang	400	2022
United States	Phillips 66 - Belle Chasse	-247	2022	China	Independent - Lianyungang	320	2022
United States	ExxonMobil - Beaumont	250	2023	China	Sinopec - Yangpu	100	2022
United States	Houston Refining - Houston	-264	2024	China	Independent - Cangzhou	172	2023
United States	Phillips 66 - Rodeo	-125	2024	China	Independent - Panjin	-100	2023
OECD Europe				China			
Germany	Shell - Rheinland	-147	2025	China	CNOOC - Ningbo	120	2024
Italy	Eni - Livorno	-120	2024	China	Shandong Independent - Dongying	100	2024
OECD Asia Oceania				China			
Japan	ENEOS - Negishi	-120	2022	China	Sinopec - Ningbo	220	2025
Japan	ENEOS - Wakayama	-122	2023	China	Saudi Aramco/Norinco - Panjin	300	2026
Japan	Seibu Oil - Yamaguchi	-120	2024	China	CNPC - Karamay	100	2026
New Zealand	New Zealand Refining Co. Ltd. - Marsden Point	-129	2022	China	Sinopec - Zhangzhou	320	2027
Middle East				India			
Bahrain	Bahrain Petroleum - Sitra	225	2024	India	Hindustan Petroleum Corp. Ltd. - Visakhapatnam 2/Vizag	134	2023
Bahrain	Bahrain Petroleum - Sitra	-113	2024	India	Indian Oil - Barauni	131	2025
Iran	NIOC - Abadan	200	2022	India	Indian Oil - Koyali	81	2025
Iran	NIOC - Abadan	-235	2028	India	Indian Oil - Barauni	-71	2025
Iraq	INOC ORA - Karbala	140	2023	India	Hindustan Petroleum Corp. Ltd. - Barmer, Rajasthan	180	2026
Iraq	South Refining Company - Basra	70	2025	India	Numaligarh Refinery - Numaligarh	100	2026
Iraq	South Refining Company - Nassiriya	100	2027	India	Chennai Petroleum - Narimanam	169	2027
Kuwait	KPC - Al-Zour	410	2022	India	Indian Oil - Panipat	100	2027
Kuwait	KPC - Al-Zour	205	2023	India	Indian Oil - Panipat	100	2028
Oman	Oman Refinery Co. - Duqm	230	2023	Thailand	Thai Oil - Sriracha	125	2025
FSU							
Ukraine	Ukratnafta - Kremenchug	-201	2022				
Non-OECD Americas							
Brazil	Petrobras - Abreu e Lima	115	2028				
Africa							
Nigeria	Dangote - Lekki	650	2024				
South Africa	Shell/BP (50%/50%) - Durban	-172	2022				

Note: Only includes refinery capacity changes (additions or closures) above 70 kbd.

Table 5
WORLD ETHANOL PRODUCTION¹

(thousand barrels per day)

	2021	2022	2023	2024	2025	2026	2027	2028
OECD North America	1,008	1,031	1,028	1,017	1,017	1,009	1,001	999
United States	979	1,002	994	982	981	971	964	961
Canada	28	29	34	35	36	37	37	37
OECD Europe	101	106	107	110	115	120	121	116
Austria	4	4	4	4	4	4	4	4
Belgium	8	8	8	8	8	8	8	8
France	18	20	20	22	23	23	23	23
Germany	12	13	13	13	13	13	13	13
Italy	0	0	1	2	4	4	4	4
Netherlands	10	10	10	10	11	12	13	13
Poland	5	5	5	5	5	5	5	5
Spain	10	10	10	10	10	14	15	10
UK	9	9	9	9	9	9	9	9
OECD Pacific	4	4	4	4	9	11	12	12
Australia	4	4	4	4	4	4	4	4
Total OECD	1,113	1,142	1,139	1,131	1,141	1,140	1,134	1,126
FSU	0	0	0	0	0	0	0	0
Non-OECD Europe	2	2	2	2	2	2	2	2
China	57	58	61	61	61	61	61	61
Middle East	0	0	0	0	0	0	0	0
Africa	2	3	3	3	3	3	3	3
Other Asia	109	131	149	160	168	177	181	179
India	61	80	95	104	109	113	117	118
Indonesia	1	1	3	3	3	3	3	1
Malaysia	0	0	0	0	0	0	0	0
Philippines	23	23	23	23	23	23	23	23
Singapore	0	1	2	3	4	7	7	7
Thailand	24	26	26	28	29	30	30	30
Latin America	553	568	623	646	668	677	687	705
Argentina	17	21	20	20	20	21	21	21
Brazil	515	528	581	603	625	634	644	662
Colombia	7	6	9	9	9	9	9	9
Total Non-OECD	723	762	838	872	903	921	934	951
Total World	1,836	1,904	1,977	2,004	2,044	2,061	2,068	2,077

¹ Volumetric production; to convert to energy adjusted production, ethanol is assumed to have 2/3 energy content of conventional gasoline.

Table 5a
WORLD BIODIESEL PRODUCTION

(thousand barrels per day)

	2021	2022	2023	2024	2025	2026	2027	2028
OECD North America	167	209	253	308	325	337	350	355
United States	160	202	238	291	302	310	317	323
Canada	7	6	15	18	23	27	33	33
OECD Europe	300	307	313	323	330	332	333	322
Austria	6	6	8	8	8	8	8	8
Belgium	5	6	6	6	6	6	6	6
France	48	48	48	48	52	52	52	52
Germany	64	64	63	62	61	59	57	57
Italy	24	25	25	25	25	25	25	25
Netherlands	44	43	43	42	44	47	49	48
Poland	18	18	18	18	18	18	18	18
Spain	31	31	32	35	35	35	35	35
UK	16	16	16	15	16	16	16	9
OECD Pacific	14	14	13	13	13	13	13	13
Australia	0	0	0	0	0	0	0	0
Total OECD	481	530	580	644	668	682	696	690
FSU	0	0	0	0	0	0	0	0
Non-OECD Europe	13	13	12	13	14	14	14	11
China	39	45	47	47	47	47	47	47
Middle East	2	2	2	2	2	2	2	2
Africa	2	2	3	3	3	3	3	0
Other Asia	252	295	334	359	374	381	386	373
India	3	4	4	5	5	5	6	6
Indonesia	158	191	214	231	241	247	251	248
Malaysia	28	29	38	44	46	46	46	46
Philippines	3	3	3	3	3	3	3	3
Singapore	27	29	33	32	33	33	33	32
Thailand	32	39	42	45	46	47	48	37
Latin America	165	156	182	207	240	256	258	260
Argentina	34	34	34	34	34	34	34	34
Brazil	116	108	126	156	183	197	198	199
Colombia	11	10	12	12	12	13	13	13
Total Non-OECD	471	512	579	630	679	702	709	692
Total World	952	1,042	1,158	1,275	1,347	1,384	1,404	1,382

Abbreviations and acronyms

ACG	Azeri Chirag-Guneshli (Azerbaijan)
ADNOC	Abu Dhabi National Oil Company
CAPP	Canadian Association of Petroleum Producers
CTL	coal-to-liquids
CCUS	carbon capture, utilisation and storage
CDU	crude distillation unit
CNPC	China National Petroleum Corporation
CNOOC	China National Offshore Oil Corporation
EEDI	Energy Efficiency Design Index
EOR	enhanced oil recovery
E&P	exploration and production
ESG	environmental, social and governance
ETS	emissions trading system
EU	European Union
EUA	European Union Allowance
EVs	electric vehicles
FEED	front-end engineering and design
FCC	fluid catalytic cracker unit
FPSO	floating production storage and offloading
FID	final investment decision
G7	Group of Seven (major economies)
GTL	gas-to-liquids
GDP	gross domestic product
GHG	greenhouse gas
GoM	Gulf of Mexico
HDV	heavy-duty vehicle
IATA	International Air Transport Association
ICE	internal combustion engines
ILO	International Labour Organization
ILX	infrastructure-led exploration
IMO	International Maritime Organization
IOC	international oil company
IRA	US Inflation Reduction Act
JCPOA	Joint Comprehensive Plan of Action
JLL	Jones Lang LaSalle
KRG	Kurdistan Regional Government
LDAR	leak detection and repair
LNG	liquefied natural gas
LPG	liquefied petroleum gas
LTO	light tight oil

MTAB	Mahogany-Teak-Akasa- Banda
NGL	natural gas liquids
NFE	Qatar North Field East
NFS	Qatar North Field South
NIOC	National Iranian Oil Co
NNPC	Nigerian National Petroleum Corporation Limited
NOC	national oil companies
NREP	National Renewable Energy Program (Saudi Arabia)
NZE Scenario	Net Zero Emissions by 2050 Scenario
OPEC	Organization of the Petroleum Exporting Countries
PDH	propane dehydrogenation
PDVSA	Petróleos de Venezuela SA
PIA	Petroleum Industry Act (Nigeria)
RFS	US Renewable Fuel Standard
RNEST	Brazil Abreu e Lima Refinery
RPK	revenue passenger kilometres
RRR	reserve replacement ratio
STEPS	Stated Policies Scenario
SUV	sports utility vehicle
TfL	Transport for London
TMX	Trans Mountain Expansion Project (Canada)
UAE	United Arab Emirates
ULSD	ultra low sulfur diesel
UNCTAD	United Nations Conference on Trade and Development
US WTI	US West Texas Intermediate
YPF	Yacimientos Petrolíferos Fiscales (Argentina)

Units of measure

b/d	barrels per day
Bcf/d	billion cubic feet per day
CO ₂	carbon dioxide
g CO ₂ /km	grams of CO ₂ per kilometre
GW	gigawatt
km	kilometre
L/100km	litres per 100 kilometres
mcm/d	million cubic metres per day
Mt CO ₂	million tonnes of carbon dioxide
Mt	million tonnes
Mt/yr	million tonnes per year
MW	megawatt
TWh	terawatt hour

International Energy Agency (IEA)

This work reflects the views of the IEA Secretariat but does not necessarily reflect those of the IEA's individual Member countries or of any particular funder or collaborator. The work does not constitute professional advice on any specific issue or situation. The IEA makes no representation or warranty, express or implied, in respect of the work's contents (including its completeness or accuracy) and shall not be responsible for any use of, or reliance on, the work.



Subject to the IEA's [Notice for CC-licensed](#) Content, this work is licenced under a [Creative Commons Attribution 4.0 International Licence](#).

This document and any map included herein are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Unless otherwise indicated, all material presented in figures and tables is derived from IEA data and analysis.

IEA Publications

International Energy Agency

Website: www.iea.org

Contact information: www.iea.org/about/contact

Revised version, June 2023

Information notice found at: www.iea.org/corrections

Typeset in France by 2023 - June 2023

Cover design: IEA

Photo credits: © Shutterstock

