



Indian Oil Market

Outlook to 2030

International
Energy Agency





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INTERNATIONAL ENERGY AGENCY

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Abstract

Healthy economic expansion, combined with dynamic population, urbanisation and industrialisation growth, will see India's role in global oil markets rapidly increase towards 2030, with significant implications for its oil trade balances, climate ambitions and energy security goals. As energy transitions gather pace and China's economy shifts gear towards a less energy-intensive phase, India will assume the position as the world's largest source of oil demand growth this decade. In our 2023-2030 forecast period, India accounts for more than one-third of global oil demand growth.

The *Report* looks in-depth at how India's role on the global oil market may evolve over the period through to 2030. It examines investment plans for the refining and petrochemical industry and how these developments may impact Indian crude and product net trade. The *Report* looks at energy transition trends that may affect the demand for oil in different sectors and how these changes could impact the country's energy security.

The *Report* extends and updates the forecast horizon for India from the Oil 2023 medium-term market report published in June 2023. The forecast levels of oil demand in 2030 are lower than those projected for India in the Stated Policies Scenario from the World Energy Outlook 2023 (WEO-2023), which was published in October 2023 and reflects the policy settings of governments worldwide, but they are above those in the WEO-2023's Announced Pledges Scenario, which maps out a pathway to meeting all countries' national energy and climate goals such as India's pledge to reach net zero emissions by 2070. The *Report's* analysis highlights the important structural changes that are underway in India's energy sector and the need for India, as in other countries, to accelerate the pace of change to get on track for national energy and climate goals and the Paris Agreement target of limiting global warming to 1.5 °C.

Acknowledgements, contributors and credits

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Table of contents

Executive summary	9
Chapter 1. Oil Demand	13
India's economic engine powers global oil demand through 2030.....	13
Road transport leads Indian oil demand growth.....	16
Indian air travel demand remains limited, but with room to grow.....	20
Clean cooking initiatives will continue to boost LPG demand.....	21
Petrochemical sector growth smaller than the global average.....	21
Chapter 2. Oil Supply	23
Overview.....	23
Fiscal and licensing reforms.....	25
Geology and exploration outlook.....	26
Chapter 3. Refining	29
Indian refineries set for continued growth.....	29
High-value production rises despite heavier crude slate.....	31
Refineries focus on petrochemical integration and increased light and middle distillates ...	32
Investment plans and capacity.....	34
Chapter 4. Oil trade	39
India ranks as the world's second largest net crude importer and sixth largest product exporter.....	39
Crude trade – Increasing exposure to Russia and the Middle East.....	40
Product trade – modest importer but major exporter.....	42
India set to play an expanded role in global oil markets.....	43
India and Asian refiners in East versus West product balances.....	45
Light-ends balances and trade.....	45
Middle distillate balances and trade.....	47
Fuel oil balances and trade.....	48
LPG balances and trade.....	50
Chapter 5. Biofuels	55
Biofuels key in India's push to decarbonise transportation.....	55
Biofuel use is accelerating, led by emerging economies.....	55
Indian biofuels boosted by strong policies.....	56
Indian biomass use and supply potential.....	58

Chapter 6. Implications for energy security	59
Current oil stockholding situation in India	59
Annex	65
Abbreviations and acronyms.....	65
Units	66

Executive summary

India's role in global oil markets is expected to expand substantially over the remainder of the decade, fuelled by strong growth in its economy, population and demographics. In this *Report*, we look at how these wideranging changes will impact global oil markets. Our analysis is focused on the future evolution of the country's oil sector and its increasingly dominant role in international trade, as well as demand, supply and refining developments and the government's key objectives to reduce oil imports, transition to cleaner fuels and improve energy security.

The global energy crisis has cast energy security as a key political priority for countries across the world – and it is a critical imperative for India given it is highly dependent on oil imports to meet its supply needs. The crisis has also boosted the momentum behind clean energy transitions. For the first time, the IEA sees a peak in global oil demand in all its [scenarios](#) this decade. The pace of demand growth diverges markedly across sectors, with road transport fuels set to enter decline first in response to the rapid uptake of electric vehicles, efficiency improvements and the continued rise of biofuels.

The geographic dispersion is perhaps even more significant as countries embark on their transition paths from very different starting points. India will become the largest source of global oil demand growth between now and 2030, while growth in developed economies and China initially slows and then subsequently goes into reverse in our outlook. Urbanisation, industrialisation, the emergence of a wealthier middle-class keen for mobility and tourism, plus efforts to achieve greater access to clean cooking, will underpin the expansion in oil demand. Consequently, India is on track to post an increase of almost 1.2 mb/d, accounting for more than one-third of the projected 3.2 mb/d global gains, to reach 6.6 mb/d by 2030.

The massive industrial expansion means that diesel/gasoil is the single largest source of oil demand growth, accounting for almost half of the rise in the nation's demand and more than one-sixth of total global oil demand growth through to 2030. Jet-kerosene demand is poised to grow strongly, at around 5.9% per year on average, but from a low base compared to other countries. Gasoline will grow by 0.7% on average, as the electrification of India's vehicle fleet avoids a more substantial rise. LPG rounds out the growth picture, as petrochemical industry investments in production facilities boost feedstock demand. The Indian government's world-leading progress in bringing clean cooking programmes to its

rural populations have led to LPG imports surging nearly three-fold in the past decade and further initiatives will see demand growth continue through 2030.

Indian oil companies are investing heavily in the refining sector to meet the rise in domestic oil demand. Over the next seven years, 1 mb/d of new refinery distillation capacity will be added – more than any other country in the world outside of China. Several other large projects are currently under consideration that may lift capacity beyond the 6.8 mb/d capacity that we expect so far.

India is set to maintain its position as a key exporter of transportation fuels to markets in Asia and the Atlantic Basin. Continued investment in refining capacity and complexity will boost light and middle distillate production, even as the industry pivots further towards heavier and more sour crudes. India's role as a global swing supplier has risen since 2022 as the loss of Russian product exports to European markets has increased the pull of Asian diesel and jet fuel westward. In 2023, India was the fourth-largest exporter of middle distillates globally and the sixth largest refinery product exporter at 1.2 mb/d. New refining capacity is forecast to boost product supplies to global markets to 1.4 mb/d through mid-decade before edging lower to 1.2 mb/d by 2030 given the steady rise in domestic demand.

As a relatively small oil producer, and with limited potential for near-term growth, India's domestic production accounted for just 13% of the country's supply needs. In 2023, domestic oil production averaged around 700 kb/d. Despite renewed efforts by the government to attract foreign upstream investment, domestic crude oil production is expected to see continued declines over the medium term. A dearth of new discoveries in recent years will contribute to Indian oil supply falling to 540 kb/d by 2030.

Notably, India's efforts to accelerate its energy transition is set to deliver significant oil savings in the forecast period. Increased uptake in electric vehicles is set to play a key role in decarbonising the transport sector. We estimate that, combined, new EVs and energy efficiency improvements will avoid 480 kb/d of extra oil demand in the 2023-2030 period. That means without these gains India's oil demand would reach a much higher 1.68 mb/d by 2030 compared with the current forecast.

Biofuels are also expected to play a key role in India's decarbonisation of the transport sector. The South Asian nation is already the world's third-largest producer and consumer of ethanol, as domestic production has tripled over the last five years. Supported by the country's abundant feedstocks, political support and effective policy implementation, its ethanol blending rate of around 12% is amongst the world's highest. India has advanced by five years its deadline for doubling nationwide ethanol blending in gasoline to 20% in Q4 2026. Achieving

20% ethanol blending in such a short time frame presents several challenges, not least rapidly expanding feedstock supplies.

The country's spectacular economic growth story, however, brings myriad challenges for its security of energy supplies. India was already the world's second-largest crude oil net importer in 2023, having boosted imports by 36% over the past decade to 4.6 mb/d to meet rising refinery intake. Increased refining processing will lift crude oil imports further, to 5.8 mb/d by 2030, with major implications for India's security of supply.

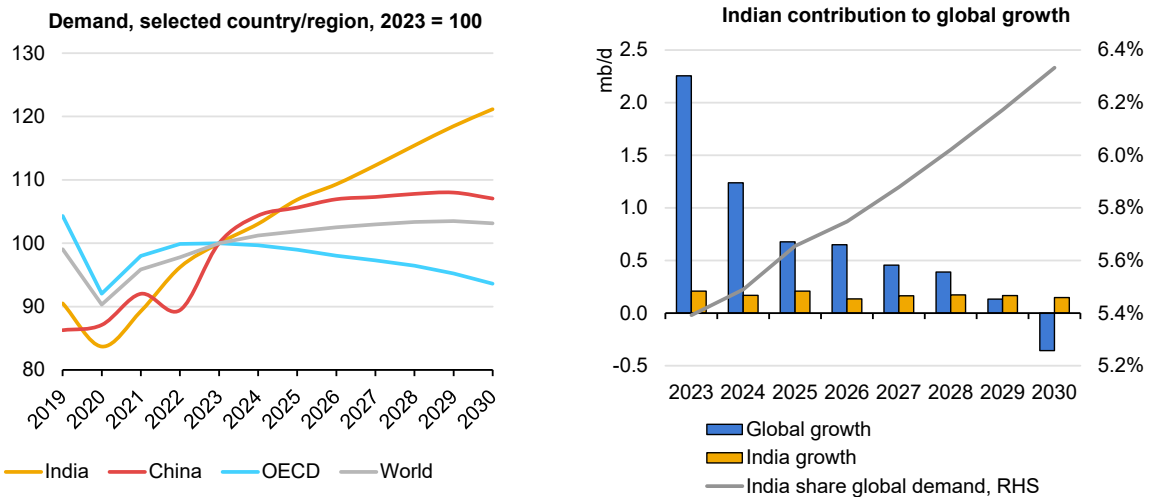
The energy crisis and recent surge in long-haul crude sources, notably from Russia, has also added further impetus to sustaining the country's oil resilience in case of market disruptions. Based on IEA methodology, current stock holding levels equate to 66 days of net-import cover, with SPR stocks of 26 mb equal to seven days. India needs to enhance its capacity to respond to possible oil supply disruptions by implementing and strengthening its SPR programmes and improving oil industry readiness.

Chapter 1. Oil Demand

India’s economic engine powers global oil demand through 2030

India is forecast to be the single largest source of global oil demand growth from 2023 to 2030, narrowly ahead of China. Underpinned by strong economic and demographic growth, the country is on track to post an increase in oil demand of almost 1.2 mb/d over the forecast period, accounting for more than one-third of the projected 3.2 mb/d global gains.

India oil demand growth in a global context, 2019-2030



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Notably, India’s additional demand will be more diversely spread across product categories than in other major economies. Only 18% of the country’s demand growth will be for petrochemical feedstock use while globally this figure will be in excess of 90%, and in China virtually all net gains will be for chemical production.

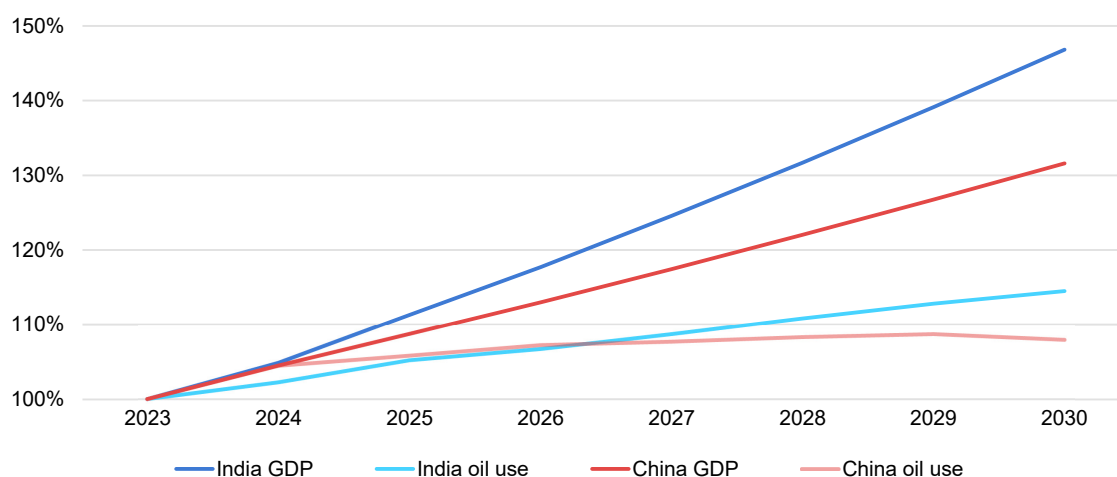
This balanced growth profile results from India’s dynamic economic development trajectory and relatively low per-capita fuel use. In particular, rapid progress in the manufacturing, commerce, transport and agriculture sectors will translate into continued sharp gains in diesel use. Indian gasoil consumption growth of 540 kb/d is set to account for one sixth of total gains in global oil demand between 2023 and 2030. India will account for one-third of non-OECD gasoil growth, and, with OECD usage declining, the country’s increase will be more than the net worldwide rise for the product.

Oil demand by product (mb/d): India, 2019-2030

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2023-30 Growth Rate	2023-30 Growth
LPG/Ethane	0.8	0.9	0.9	0.9	0.9	1.0	1.0	1.0	1.0	1.1	1.1	1.1	3.2%	0.2
Naphtha	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	5.9%	0.1
Gasoline	0.7	0.7	0.8	0.9	0.9	0.9	1.0	1.0	1.0	1.0	1.0	1.0	0.7%	0.0
Jet/Kerosene	0.2	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	6.9%	0.1
Gasoil/Diesel	1.6	1.5	1.5	1.7	1.8	1.8	1.9	2.0	2.1	2.2	2.2	2.3	4.5%	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	0.2	0.2	1.3%	0.0
Other products	1.1	1.0	1.0	1.1	1.2	1.2	1.2	1.2	1.2	1.3	1.3	1.3	2.1%	0.2
Total products	5.0	4.6	4.9	5.3	5.5	5.7	5.9	6.0	6.2	6.3	6.5	6.6	3.2%	1.2
Annual change	0.0	-0.4	0.3	0.4	0.2	0.2	0.2	0.1	0.2	0.2	0.2	0.1		

India's economic performance has been stellar since the start of the 21st century. Annual GDP growth averaged 6.8% in the decade before 2020 and quickly reverted to trend after the pandemic. This has made the country a global economic powerhouse and the uncontested favourite with emerging market investors. India is on track to register the world's fastest expansion among major economies in 2024 for a third straight year, with the International Monetary Fund projecting that it will contribute more than 16% to global economic growth this year. This upward trajectory looks set to continue, with forecaster Oxford Economics seeing a 6.5% average annual GDP growth rate for the 2024-2030 outlook period, propelled by the massive domestic consumer market, low-cost labour force and supportive demographics. In this context, India overtook China as the world's most populous country in 2023, growing at about 1% and contrasting with China's population entering structural decline.

India and China per capita GDP and oil use, index (2023 = 100)



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Source: GDP growth estimates from Oxford Economics.

India's oil consumption is set to increase at a faster pace than other countries, in part, because the country is still in the initial stages of economic development. The World Bank estimates Indian GDP per capita was USD 2 400 in 2022 – behind the Democratic Republic of the Congo, Bangladesh and Angola, and a fraction of China's USD 12 700. A common phenomenon is that when developing countries achieve GDP per capita growth between the USD 2 000 to USD 10 000 range, growth in energy use is at its fastest. In other words, the income elasticity of energy demand is at its highest during this period.

This faster pace also reflects the emergence of a burgeoning middle class, characterised by higher living standards and changing spending habits. As consumers become wealthier, they are more inclined to purchase energy-intensive big-ticket items such as cars and domestic appliances. This is especially pertinent to India due to its relatively youthful demographics (the median age is 28.7 years), as it creates considerable long-term potential as consumers shift towards higher income and wealth brackets.

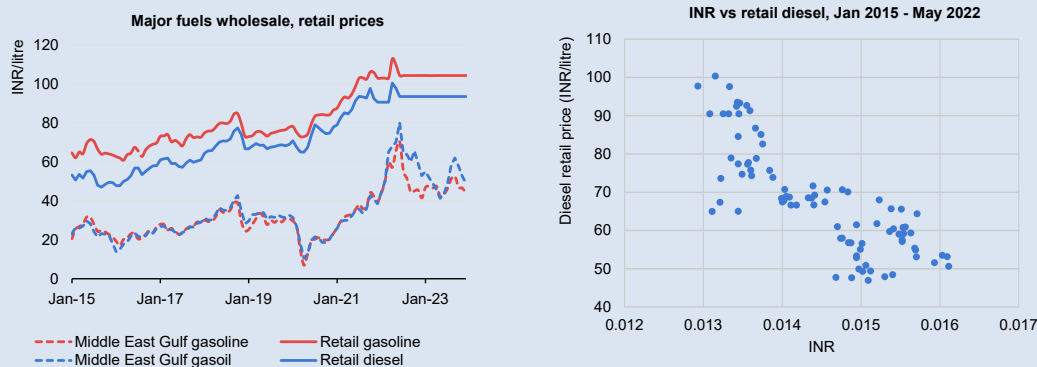
Industrialisation accounts for an additional boost to oil consumption growth. As buoyant domestic aggregate consumption in turn increases demand for capital goods, the energy-intensive manufacturing sector also expands. Here too, India's prospects are lifted by the country's emergence in recent years as a key industrial hub toward which international companies are shifting their supply chains away from China. Additionally, the government's ambitions to improve the country's sub-par infrastructure is supporting both industrialisation and faster oil demand growth.

Indian pump prices decouple from global oil market

Indian retail energy (and food) prices have historically been controlled by extensive government oversight and interventions. However, 2014 saw a deregulation push that introduced a more market-based mechanism. This resulted in a much closer relationship between pump prices and their underlying market drivers such as global oil prices and currency rates. Between 2015 and mid-2022, the monthly correlation between domestic gasoline/diesel prices and their wholesale equivalents (FOB Mideast Gulf) was about 60%. Even stronger was the correlation between pump prices and the Indian rupee (INR) versus the US dollar exchange rate, at about -80%.

This firm inverse relationship between the local currency and the price of oil is a feature that India has in common with other emerging market commodity importers such as Türkiye, Pakistan and Egypt. Combined with the rupee's recent relative weakness, this causes persistent upward pressure on domestic pump prices. Higher oil prices tend to be accompanied by weaker currencies in commodity

importing countries, contributing to consumer inflation and worsening trade and fiscal balances. The rupee's slump is structural – it has declined against the US dollar in 12 out of past 13 years, losing about half of its value in total. India's annual consumer inflation averaged 6.1% over this period, accompanied by persistent current account and budget deficits (averaging 1.8% and 5.3% of GDP, respectively).



Sources: Argus Media Group, GlobalPetrolPrices.com.

The linkage between pump prices and market drivers halted in May 2022 when Indian oil marketing companies froze retail petroleum prices in the wake of Russia's Ukraine invasion and ensuing spike in commodity markets, at INR 104.18/litre for gasoline (USD 1.33/litre) and INR 93.48/litre for diesel (USD 1.19/litre) – significantly below the then-market levels. While the freeze sheltered India's consumers from inflationary pressures and economic hardship that gripped other countries like Pakistan and Egypt, state-run refiners initially incurred large losses. These were partially recouped in early 2023 by the payment of USD 3.7 billion in government capital support. Lower oil prices in 2023 allowed refiner margins to recover further, while the import of massive volumes of heavily discounted Russian crude also bolstered profit margins.

Indian pump prices have now remained unchanged for 20 months. A prolonged absence of price signals might dampen incentives for the country's refining sector to continue to invest. A return to market-based pricing would be opportune now that oil markets have normalised, and price volatility has receded after the turmoil in 2022.

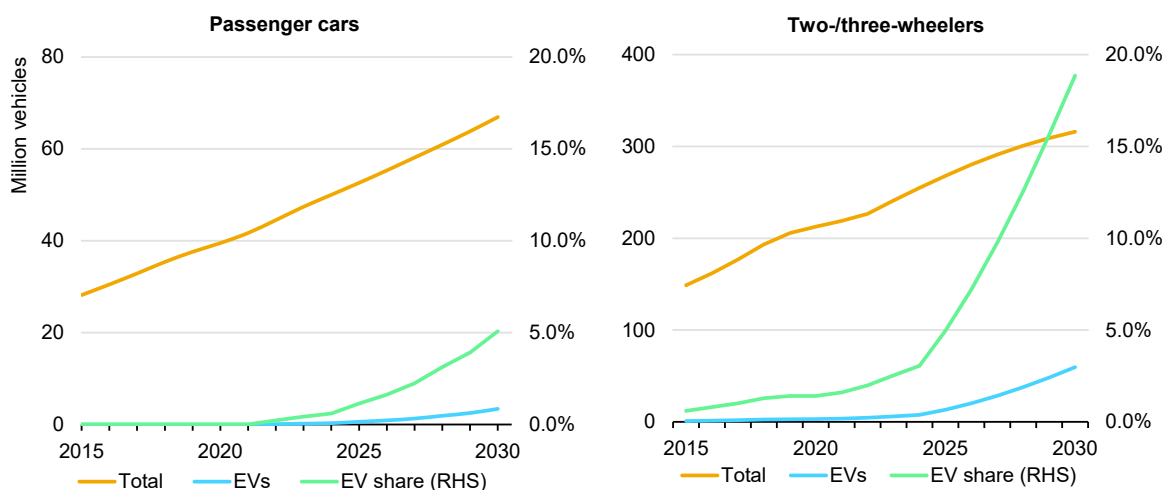
Road transport leads Indian oil demand growth

India's momentous economic growth story has major implications for personal mobility, business activity and, therefore, transportation demand. The country's exceptional road-fuel dominated growth profile results from these burgeoning requirements and the centrality of road vehicles to meeting them. [Travel by road](#)

accounts for about 90% of personal mobility and 70% of freight movement. Indeed, these shares rose in line with India’s economic development in recent decades. Given the crucial importance of oil products for road fuels, this means that we anticipate the growth of India’s economy to translate into continued strong growth led by diesel.

Despite recent increases, car ownership remains comparatively limited. We estimate that there were around 58 million cars on India’s roads in 2023. While this was an eightfold increase compared with 2000 levels, it remains low in international terms. For example, China had almost seven times as many cars on its roads in 2023, which highlights the potential for further growth in Indian ownership levels. Our projections assume more than 40% growth in the size of the Indian car fleet by 2030.

Growth and electrification of the passenger vehicle fleet, 2015-2030



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Two- and three-wheel vehicles are another major driver of demand growth. Motorised two-wheelers are estimated to account for about three-quarters of Indian vehicles and remain of high importance because of their lower purchase prices and operating costs. Similarly, motorised three-wheelers play an important role in urban passenger services and last-mile delivery of goods. While fuel consumption per kilometre (estimated at roughly 25%) and the average distance driven per year is lower than for cars, the scale of this fleet means it remains highly relevant to overall demand estimates. Given the present ubiquity of this fleet, it will increase more slowly than for cars and, combined with the high potential for electrification, will mean that these vehicles will likely act as a drag on gasoline growth.

Commercial trucks weighing over 3.5 tonnes account for about four-fifths of [road freight traffic](#) in India, with lighter trucks having a comparatively limited share due to competition with three-wheelers. They are more important in India than in most major economies, owing to rather fragmented patterns of ownership and the constraints of the road network that limits use of larger trucks. These diesel-consuming vehicles play an essential role in Indian manufacturing and commerce, which are set to continue to grow rapidly. This underpins our expectations of strong growth in diesel use but also contributes to wider challenges regarding air quality in urban areas, especially in the cities of the Indo-Gangetic plain.

Road diesel demand dominated by these trucks is estimated to account for about 70% of the national total. This is despite diesel vehicles also comprising a large part of the passenger car fleet, with diesel-powered cars consistently registering a 40-50% share of sales during the 2010s. In combination with the stellar performance in Indian manufacturing, this means that road diesel will account for almost all of the 540 kb/d projected increase in the country's gasoil demand and will be the most important single element in domestic oil demand growth in the 2023-2030 period.

While public transport plays a significant role in India's cities, the country's population remains predominantly rural. Metro and suburban rail systems exist in almost 20 cities and bus services are more widely available. During the pandemic years, utilisation of these services suffered in favour of cars, two- and three-wheelers and non-motorised transportation options. We estimate that this decline has proved relatively persistent. It may now be reducing diesel consumption by buses by more than 50 kb/d and boosting gasoline use in other transport options by a comparable amount. Our forecasts assume that this effect will gradually unwind over the next five years adding to overall diesel growth and restricting headline gasoline demand gains over the period.

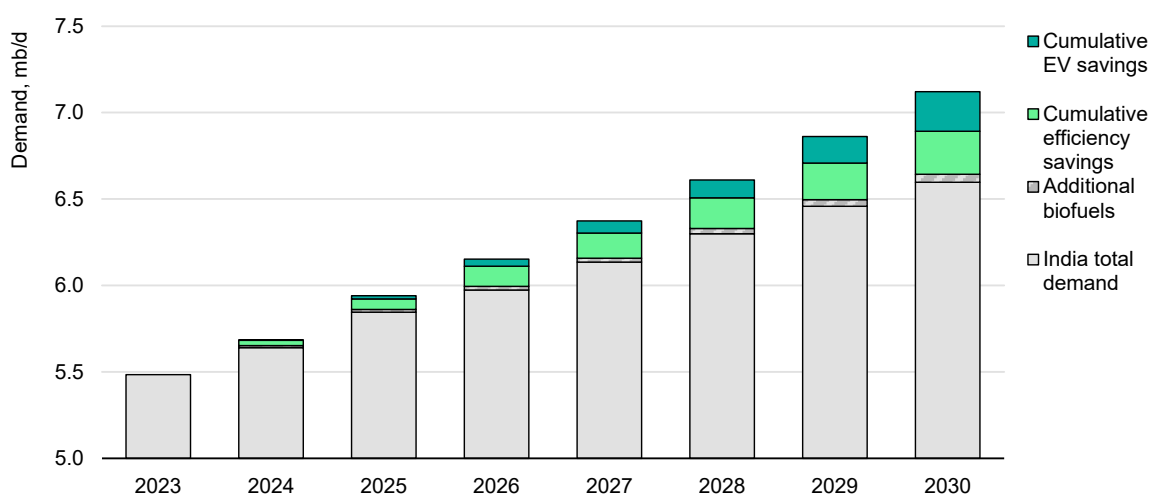
Increasing vehicle electrification is another factor that disproportionately weighs on gasoline demand growth but has a smaller impact on diesel. Gasoline demand growth is forecast to rise by a very modest 0.7% per annum from 2023 to 2030, moderated by robust growth in EVs, especially two- and three-wheelers, increased biofuels uptake and gains in fleet efficiency levels. We estimate that electrification will displace more than 200 kb/d of oil consumption by 2030, with about 70% coming from lower gasoline use. This exceeds the relative share of gasoline vehicles in the car fleet. The major reason for this is the additional impact of electrification of two- and three-wheelers. These lighter vehicles are especially suitable for replacement, given less demanding battery charging and range requirements. About 3.5 million EVs were registered in India by the end of 2023, according to data from the Ministry of Road Transport and Highways.

Two-wheelers accounted for 56% of the 1.5 million EVs sold last year, three-wheelers 38% and electric cars only 5%. Total EV sales increased by 50% y-o-y.

Electrification will become especially important in the later years of this decade and we assume that about half of new two- and three-wheelers and one-in-eight cars and light commercial vehicles entering the fleet will be electric by 2030. For two- and three-wheelers this progress is primarily the result of economic drivers. The total cost of ownership (TCO) for these vehicles is substantially lower than their gasoline equivalents, with two-wheelers 30-50% less costly, and three-wheelers around two-thirds cheaper over the lifetime of the vehicle (see IEA, [Transitioning India's Road Transport Sector](#)). Nevertheless, higher initial costs continue to present a barrier and policy tools will remain essential in promoting further progress. For cars, TCO for an EV is currently similar to that for a gasoline or diesel vehicle, with a substantially higher purchase price, despite government subsidies. We expect electric cars to become more cost competitive over time and this will be instrumental in increasing their market share.

The government's Faster Adoption and Manufacturing of Electric Vehicles (FAME) programme began in 2015, with the second phase launched in 2019 set to run until mid-2024. This scheme is primarily aimed at incentivising demand by reducing the upfront cost of vehicles as well as financing the installation of charging infrastructure. While FAME is the major plank of government support for EVs, reduced sales tax also applies and many states have their own policies.

New EVs and improved efficiency will avoid 480 kb/d of extra oil demand, 2023-2030



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Improving fleet efficiencies also provide a drag on consumption growth. Led by government mandated improved fuel economy standards and the large number of

new vehicles entering the fleet, the average passenger car was estimated to be 8% more efficient in 2023 than in 2015. The Indian fleet is already substantially less fuel intensive than comparable countries and about 20% below the global average, because of smaller vehicle size and the relatively high share of diesel vehicles. Notably, echoing the government's [Lifestyle for Environment](#) (LiFE) initiative, Indian vehicle efficiency gains have been unusually resilient in the face of the increasing demands of car size and performance. In the United States and China some 40% of cumulative 2010-2019 efficiency improvements were nullified by increased vehicle size but this ratio was only about [17% in India](#). However, increasing penetration of SUVs, from a low base, the comparatively small number of older cars to be replaced and a gradual decline in the share of diesel sales will limit future fuel economy improvements in the light duty vehicle (LDV) fleet. Truck efficiencies have shown less progress due to delays in implementing updated standards, meaning that comparatively little diesel demand will be mitigated in this way.

Mirroring the comparatively outsized status of the sector for India's economy, gasoil use in agriculture and forestry is a little over 200 kb/d and about 4% of total oil demand. This is more than double the global average and about one-eighth of total Indian gasoil use. Gasoil is used to power farm equipment and in irrigation. As such it can vary meaningfully depending on weather conditions and crop yields. Notwithstanding potential year-to-year changes, our projections assume that this segment remains largely constant until 2030 at about 45% of non-road gasoil consumption.

Indian air travel demand remains limited, but with room to grow

At just 180 kb/d, jet/kerosene accounted for only 3.4% of Indian oil demand in 2023, less than half of the global average (7.3%). This reflects the fact that air travel, and therefore jet fuel use, is strongly correlated to income. As such, India's total aviation activity and jet fuel requirements were roughly equal to those of France, leaving substantial potential for growth. While we expect an average of 5.9% annual growth between 2023 and 2030, these incremental gains would leave consumption at only about one-quarter of current Chinese levels.

Substantial further gains might take place after 2030 if India's growth trajectory can be maintained beyond our forecast period and the country moves towards middle-income status, where access to air travel increases sharply. As with the road vehicle fleet, efficiency gains play an important role, with new commercial aircraft around 20% more efficient than those they replace. India's airlines have comparatively youthful fleets, meaning that jet fuel consumption requirements per passenger kilometre are lower than average. Globally, airline fleet turnover was at

elevated levels during the pandemic years and, combined with robust uptake of new models, this is set to restrain the overall increase in jet fuel demand.

Clean cooking initiatives will continue to boost LPG demand

The government of India has promoted the use of LPG as a clean cooking fuel starting with the [Pradhan Mantri Ujjwala Yojana \(PMUY\)](#) scheme in 2016, which called for the distribution of 50 million LPG stoves and connections to women below the poverty level for families. This effort was primarily designed to replace the use of various highly-polluting solid fuels which can be a leading cause of premature death, especially for [women and children](#). These schemes, including the provision of stoves and subsidies, have contributed to substantially higher LPG demand, which grew by a total of 51% (5.3% per year) between 2015 and 2023. By 2021, 62% of Indian households used LPG as their primary cooking fuel. However, 34% still used firewood, according to the National Sample Survey Office's [Multiple Indicator Survey](#). This additional room for progress accounts for a little over half of our expected 2023-2030 LPG/ethane demand growth of 200 kb/d (2.7% per year).

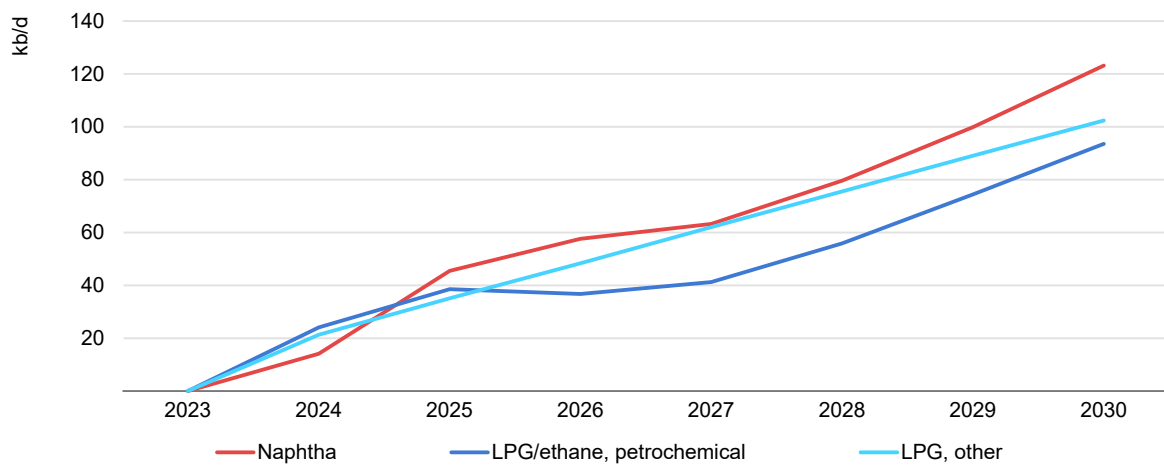
Petrochemical sector growth smaller than the global average

On a global basis, the most important driver of oil demand growth over the medium term is projected to be petrochemicals, accounting for about 2.7 mb/d of additional oil product demand during 2023-2030. Where this demand takes place is largely the result of patterns of investment in production facilities, which typically take around five years to progress from final investment decision to commercial operations. We estimate that a combination of new plants and incremental expansions will see Indian feedstock demand rise by about 210 kb/d over the period. Of this growth, 120 kb/d is additional naphtha input to steam crackers and for aromatics production, and 90 kb/d is LPG and ethane used in steam crackers and propane dehydrogenation (PDH) plants.

The major known petrochemical investments behind this rise in naphtha and LPG/ethane requirements are a mixture of steam crackers and PDH plants. HPCL-Mittal Energy Ltd (HMEL) completed construction of a 1.2 Mt/yr ethylene capacity steam cracker at their Guru Gobind Singh Refinery in Bathinda, Punjab in late 2022 and as full operations are achieved this will continue to boost naphtha requirements into 2024. Commercial operations at Hindustan Petroleum Corp. Ltd's (HPCL) petrochemical complex, including an 820 kt/yr steam cracker, in Barmer, Rajasthan, are expected during 2024. The Indian Oil Corp. Ltd (IOCL) is

conducting incremental expansions at their Panipat facility that will increase naphtha use. GAIL, India’s largest natural gas supplier, is expected to start operations at a 500 kt/yr PDH facility at Usar during 2025, with a long-term agreement for propane supply from Bharat Petroleum Corp. Ltd’s (BCPL) terminal at Uran. Petronet will build a 750 kt/yr PDH unit, which is likely to start in late-2026 or 2027. In addition, expansions in aromatics production and processing capacity at existing refineries, especially for polyester production, will contribute to increased naphtha intake.

Aggregate growth in Indian naphtha and LPG/ethane demand, 2023-2030



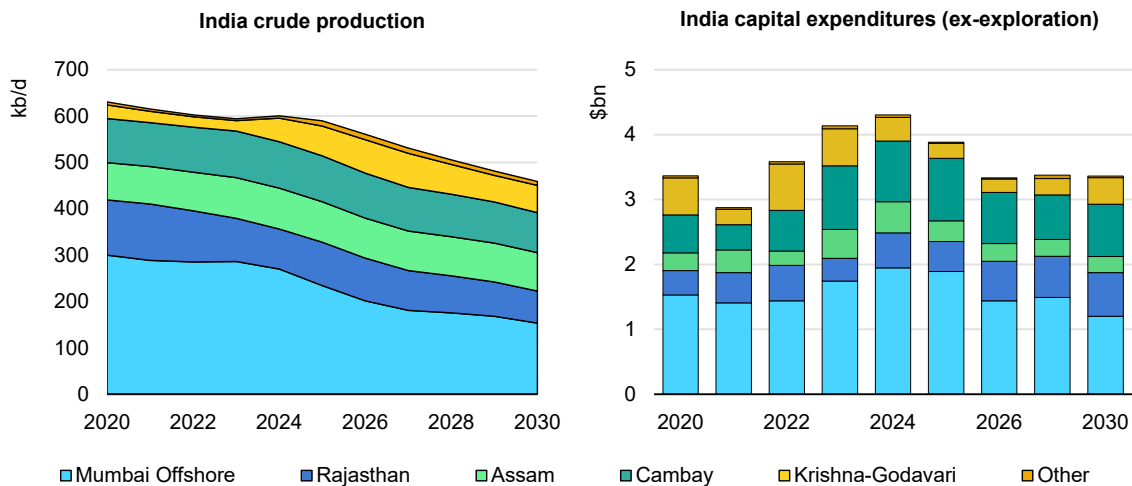
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Chapter 2. Oil Supply

Overview

Indian oil production has been on a managed decline for more than a decade, following its peak at just over 900 kb/d in 2011. In 2023, output was just under 700 kb/d, of which crude oil production was 600 kb/d and the remainder natural gas liquids (NGLs). Output is overwhelmingly concentrated in the western part of the country, with the Mumbai Offshore Basin accounting for 60% of output and the Rajasthan Basin near 20%.

Indian crude oil production and capital expenditures by basin, 2020-2030



IEA. CC BY 4.0.

Note: Assumes the KG-D5 project comes online in 1Q24 and ramps up over the next two years.

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

Domestic oil production accounts for just 10% of India’s oil supply needs, with the country’s high dependence on imports a major concern for the government. A key energy policy objective is to cut India’s oil import dependency by accelerating domestic oil exploration and production activities. Since 2016, the government has implemented a series of policy and fiscal reforms, and improved contract terms for private and foreign companies in an effort to attract more investment aimed at reversing steep decline rates and raising crude oil production to narrow the gap with refinery intake that is currently met by imports. The more supportive policy and investment regime, combined with favourable geology in recently opened and under explored areas, offers potential opportunities to bring on new supplies.

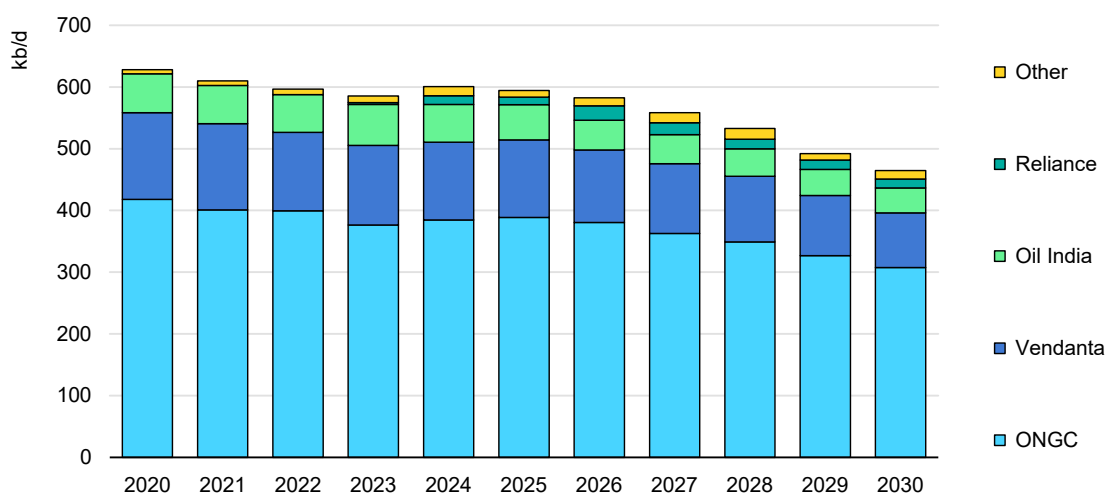
However, there are formidable challenges in increasing production enough to reverse declining crude output in the near term.

Production declined by around 4% per year between 2018 and 2023, lower than the global average annual rate of 7%. Field output declines are expected to continue at a similar rate through 2030, bringing total oil output down to 540 kb/d, and crude production to 460 kb/d, as growth in the Krishna-Godavari and Mumbai Offshore Basins help support legacy fields. In the longer term, exploration successes from the recent Open Acreage Licensing Program (OALP) bid rounds may help stem the decline.

State-owned Oil and Natural Gas Corp. (ONGC) produces approximately 70% of all oil in India at 380 kb/d. The second largest company, Vedanta Resources (Cairn India), produces just under 20% at 130 kb/d and has built up a large position during recent open acreage licensing rounds. Oil India Ltd (OIL), also state-owned, rounds out the top three producers, with 2023 volumes averaging 60 kb/d.

BP is currently the only major international oil company (IOC) with a presence in the Indian upstream, via a joint venture (JV) with Reliance Industries Ltd. ONGC signed an exploration memorandum of understanding (MoU) with Chevron and ExxonMobil in 2022. In an effort to attract additional IOCs, the Directorate General of Hydrocarbons (DGH) is collaborating with the University of Houston to better understand the country’s offshore basins. This comes after a series of attractive fiscal reforms and licensing revitalisation efforts. Additionally, private data providers have seen an uptick in interest and purchases of new Indian offshore data on offer.

Indian oil production by company, 2020-2030



IEA. CC BY 4.0.

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

Fiscal and licensing reforms

Following years of steep production losses, the government implemented a number of reforms to stem/reverse declines. Now, the Indian exploration and production sector boasts a supportive policy regime, low surface risk and high data availability. This, combined with favourable geology in recently opened and under explored areas, presents promising new opportunities.

India's policy regime has been supported by recent licensing and fiscal reforms, beginning with the approval of the Hydrocarbon Exploration Licensing Policy (HELP) in 2016. Under the HELP model, bids are assessed with an equal weighting given to work programme commitments and the post-royalty government revenue share, with the latter element as a biddable amount.

The revenue after royalty is anchored by government determined high and low revenue points but ultimately bid upon by the companies as part of the Open Acreage Licensing Program (OALP). In addition, for deep water developments there is a royalty holiday period of seven years with reduced rates. Furthermore, ultra deep-water royalties can be as low as 2% – compared to the 12.5% onshore rate. Corporate income tax was recently revised down for domestic companies while foreign investment has seen new efforts stimulated by a 100% tax deduction for exploration activities, research and development (R&D) and drilling costs. Additionally, 2023 saw efforts to stimulate Category II and III basins (basins that have hydrocarbons but aren't producing and those with non-commercial accumulations, respectively) by limiting revenue sharing to windfall gains only and providing higher originator incentives.

Bid rounds have also been replaced by semi-annual expression of interest (EOI) rounds in January and July of each year under OALP. OALP-1 was launched in late 2017 and saw 55 EOIs submitted, with Cairn India awarded 41 blocks. Including the recent OALP-8, 144 blocks have been awarded through the process. Bids on the 28 blocks offered in OALP-9 are due at the end of February and the OALP-10 window of submission for EOIs closed late 2023 with the bidding process expected to be completed in the second half of the year. The ninth and tenth rounds together will open more than 1 million square kilometres of previous “no-go” areas.

In addition to the OALP rounds, HELP also created the Discovered Small Field (DSF) rounds. DSF rounds place previously discovered yet undeveloped fields up for competitive bidding due to either low resources or infrastructure constraints. The three rounds launched since 2016 have awarded 85 contract areas to close to 20 different operators.

Including the favourable policy framework, India has also adopted globally recognised and accepted dispute mechanisms which strengthen contracts and

facilitate the ease of doing business for multinational organisations. Additionally, the upstream service sector is mature with fully built out supply chains. However, the continued streamlining of bureaucracy should remain a priority for the government. Adopting best practices for permitting, regulatory approvals and dissemination of geological data would facilitate and shorten the time frame for commercial production from new discoveries.

Geology and exploration outlook

India has 26 sedimentary basins covering 3.36 million square kilometres, with 10 of them accounting for 51% of the area and 59% of the resources located offshore. India has approximately 2 500 mb of proven plus probable (2P) reserves, with the Mumbai Offshore, Rajasthan Basin and Assam Shelf holding 80% among the three of them. ONGC holds two-thirds of the remaining 2P reserves on their books with Vendanta and Oil India Ltd each owning around 13%.

The DGH estimates that yet-to-find potential offshore resources amount to 16 600 mb (assuming a 30% recovery factor). The sedimentary basins are divided broadly into three categories based on the degree of commerciality. Category I basins have established commercial production, Category II basins have known accumulations of hydrocarbons but no commercial production as of yet and Category III basins have geological prospectivity.

Indian Sedimentary Basins by Category

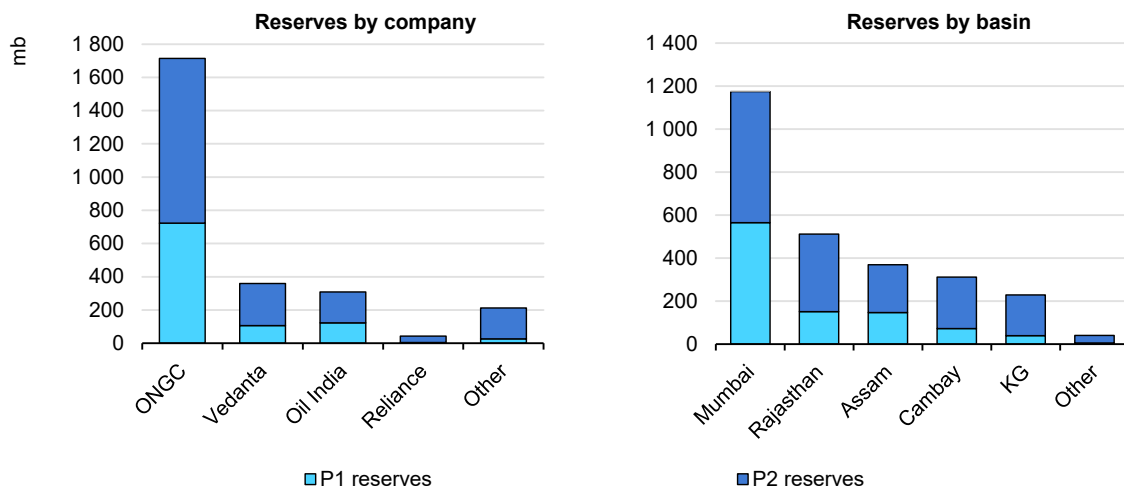
Type of Basin	Area (km ²)	Prospectivity	Basins
Category I (7 Basins)	998 325	Commercial production	Assam (Shelf and Arakan Fold Belt), Cambay, Cauvery, Krishna Godavari, Mumbai Offshore, Rajasthan
Category II (5 Basins)	780 974	Known accumulations of hydrocarbons but no commercial production	Andaman, Kutch, Mahanadi, Saurashtra, Vindhyan
Category III (14 Basins)	1 586 150	Pre-commercial accumulations	Himalayan Foreland, Ganga-Punjab, Kerala-Konkan, Bengal-Purnea, Karewa, Spiti-Zaskar, Satpura-South Rewa-Damodar, Narmada, Deccan Syncline, Bhima-Kaladgi, Cuddapah, Pranhita-Godavari, Bastar, Chhattisgarh

Source: India's Directorate General of Hydrocarbons.

Close to 99% of the Exclusive Economic Zone off the southwestern coast of India has been opened up in the recent OALP-9 round. Among the new acreage,

currently the Kutch, Saurashtra, Andaman and Krishan Godavari Basins appear to hold the most interest. The Kutch and Saurashtra Basins are adjacent to each other and geologically similar. Both are analogous to the East African Rift. Combined, they are estimated to contain 5 000 mb of potential resources in place. The Andaman Basin is one of the least explored Category II basins with approximately 97% of the resource base yet to be discovered and a geology similar to the South Sumatra Basin.

Indian oil reserves by company and by basin, 2023



IEA. CC BY 4.0.

Notes: Other companies include 17 companies with reserves booked, excludes companies that only hold sub-commercial resources. Mumbai basin is only offshore reserves. KG is short for Krishna-Godavari and other basins includes Mahanadi, Bengal-Purmea and Cauvery.

Source: IEA analysis based on Rystad Energy UCube.

The Krishan-Godavari Basin is an under-explored Category I basin with close to 60% of the basin's 35 000 mb of potential resources still undiscovered. Analogous to the US Gulf of Mexico and the site of current production and development, it contains an onshore and offshore portion along the eastern coast of India. ONGC's KG-DWN-98/2 project in the KG-D5 block is located in the offshore portion of the basin and is the newest project in the country. The development is targeting proved and probable (2P) volumes approximating 150 mb of oil and 250 mboe of gas.

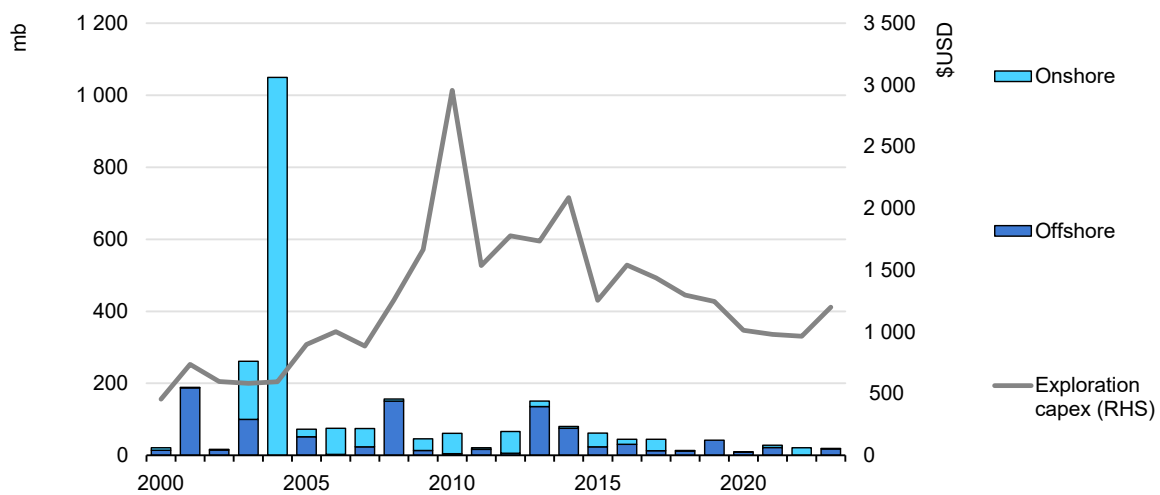
Nonetheless, the project has faced a series of delays, and IOC benchmarking currently shows that exploitation of an exploration discovery takes between 6-10 years, depending on infrastructure needs.

While the recent fiscal and licensing reforms have increased India's relative competitiveness vis-à-vis other fiscal regimes and bid processes, international participation remains sparse. OALP-8, the last round with awarded blocks, saw

seven blocks secured by ONGC, one by OIL, one by Sun Petrochemicals and one by the Reliance Industries-BP consortium.

In part, the absence of international companies may be due to lacklustre discoveries since the turn of the century. Over the last 23 years, 2 000 mb of commercial liquid resources has been discovered in India, with close to half associated with the onshore Rajasthan RJ-ON-90/1 project. By comparison, Angola, Norway and Guyana have all seen around 10 000 mb of oil resources discovered over the same time period, while explorers in Brazil have found a massive 40 000 mb.

Indian discovered resource and exploration spend by year, 2000-2023



IEA. CC BY 4.0.

Note: 800 mb of the large 2004 discovered resource add is associated with the Mangala project in Rajasthan.

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

Against the backdrop of capital discipline, major players may be waiting on the sidelines for a world-class find before establishing operations and cost centres in the country. In addition, IOC exploration capital is shrinking as a percent of total outlays, having slipped from 21% in 2000 to 9% last year. Larger exploration finds may help to prioritise Indian exploration among international players.

It is still too early to determine the impact recent OALP rounds on overall production rates, yet it is unlikely that any new major projects will reach first oil before the end of the decade. While the KG-D5 block is expected to add 45-50 kb/d of production when it fully ramps up, there are no other material projects in the queue that have reached final investment decision (FID). Until then, debottlenecking, optimisation and infill projects should mitigate the country's decline to 4% annually.

Chapter 3. Refining

Indian refineries set for continued growth

India's refining industry has built an enviable reputation as a key source of light and middle distillate supplies to global markets, in addition to meeting robust domestic demand growth. This assessment of oil demand and refining dynamics points to India being well placed to cement its position as a reliable international product supplier. Despite increased competition from Middle East Gulf export refineries, the 1 mb/d rise in crude processing and upgrading capacity expansions by 2030 offer the prospect of private and public refinery operators meeting both robust domestic oil demand growth and sustaining substantial product exports.

In common with refineries elsewhere, Indian operators face the challenge of decarbonising their activities while delivering the energy needs of the customers they serve. Lowering Scope 1 and Scope 2 emissions will require substantial investment in the coming years. This in turn requires the industry to maintain a healthy level of profitability. Refiners are investing to include low-carbon hydrogen into their processes and attempting to source an increased share of electricity from renewable sources, such as solar and wind power. However, the greater global challenge of responding to falling domestic demand, which refineries in mature markets will face by the end of this decade, is beyond the time frame of this report for Indian refiners.

Macroeconomic and social drivers, along with a burgeoning middle class, will propel demand growth for jet fuel, gasoline and diesel. Travel, both domestically and internationally, is becoming a reality for an ever-increasing share of the population. Similarly, heavy duty diesel use is also set to rise rapidly in the coming years as India's manufacturing sector benefits from policy-led initiatives such as [Make In India](#), as well as rising consumption-led service sector growth. So too, rising incomes are intricately linked to higher use of petrochemicals.

Some drag on the domestic call on refined products will come from the push for a 20% ethanol blending mandate. This will dampen gasoline demand growth as the share of ethanol increases over time. Similarly, the rise of EVs – more particularly in the two- and three-wheeler vehicle segments – will crimp gasoline demand growth, especially towards the end of the decade. These factors will boost the volume of gasoline available for export. Nevertheless, we continue to expect rising GDP per capita and urbanisation to support further strong increases in overall demand.

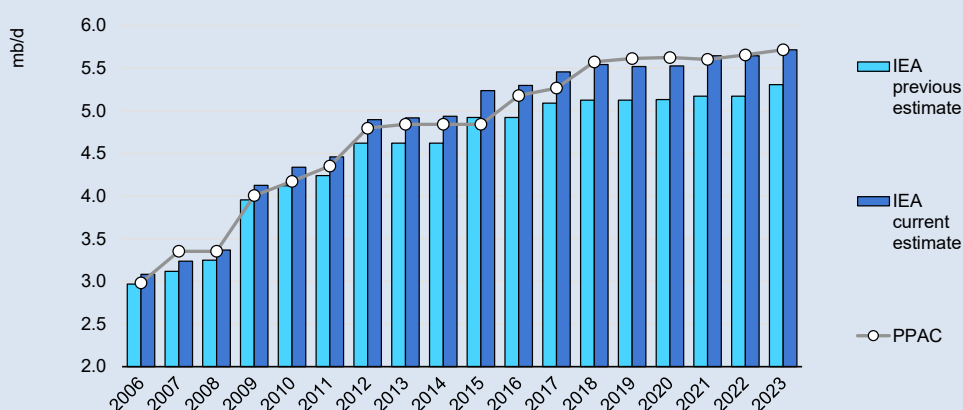
Indian refining capacity is currently assessed at close to 5.8 mb/d and is set to expand by 1 mb/d by the end of the decade. Growth will be dominated by public sector undertaking (PSU) refineries, as they prepare for continued rising domestic demand and an increased share of petrochemical production. By contrast, we see little prospect for private refineries to substantially expand their refining operations over this time frame. However, public and private refinery operators will both continue to expand existing crude processing capacity through the debottlenecking of existing facilities – likely in tandem with the addition of new, or increased hydrotreating capacity, petrochemical unit additions or residue upgrading.

Indian refinery capacity – a question of definition

Indian refinery utilisation rates have historically been assessed among the highest in the world and at times above 100% of nameplate capacity. Arguably, this high utilisation reflects the conversion of capacity stated in millions of metric tonnes per annum (mtpa) into thousands of barrels per day (kb/d). The former measure typically includes an assumption for maintenance and downtime, which can run as high as 16%, while that latter reflects a peak processing rate.

Resetting our assumptions for Indian refinery capacity, monthly refinery crude processing rates for the past two decades have been reassessed. This results in a more nuanced, and slightly higher, assessment of India’s current refining throughput potential and increased spare capacity versus operational volume limits. Moreover, assuming a 12% average downtime for planned maintenance per year brings our revised assessment in line with the Petroleum Planning and Analysis Cell (PPAC) mtpa assessment for the 2006-2023 period.

Indian refinery capacity, 2006-2023



IEA. CC BY 4.0.

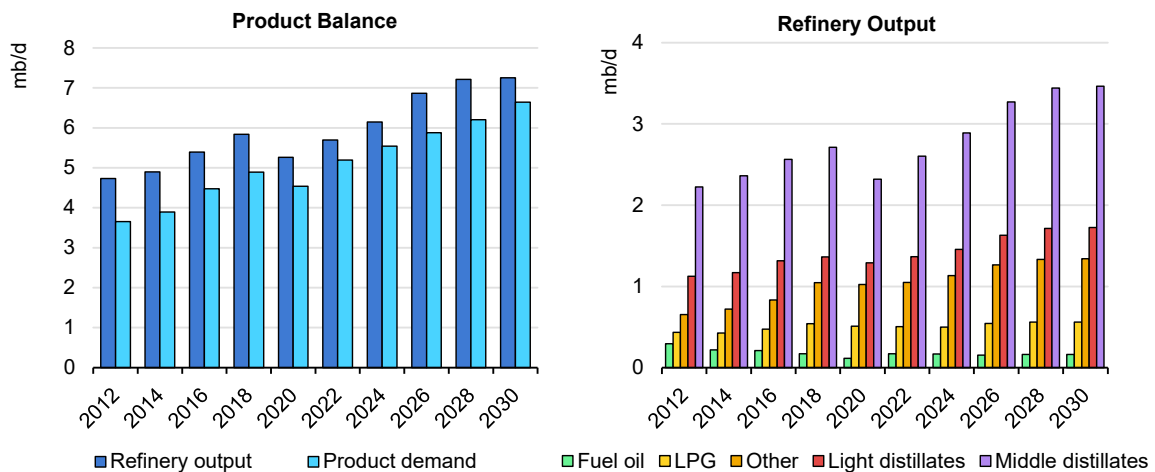
Source: IEA analysis based on data from PPAC.

As a result, we now estimate that Indian refineries operate at utilisation rates close to 90%. This is comparable to levels achieved in other high growth countries. Moreover, it also shows that refineries have the potential for higher runs if markets signal a need for additional supply.

High-value production rises despite heavier crude slate

Over the past two decades, Indian refining investments have raised average complexity levels substantially, via the addition of coking and other residue upgrading technologies. This has facilitated a pivot away from light and medium sweet crude feedstocks towards heavier, sour crudes from the Middle East, Latin America and, on occasion, from Canada and Europe. Simultaneously, the share of light and middle distillates production has increased, with fuel oil yields halving over the past decade, despite average crude imports dipping towards 30 API. This trend is set to continue with two vacuum residue hydrocrackers due to start up this year, with an associated loss of fuel oil output and an increase in petrochemical feedstocks, as well as light and middle distillate production.

Indian product demand and refinery output, 2012-2030



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Against this potential for additional growth in refinery activity, it is important to recognise that Indian refineries face several domestic constraints that may yet slow progress. Factors such as land acquisition constraints, the domestic pricing regime, and the inability for refineries to pass through government sales tax (GST) to their customers may adversely affect the industry. The flip side to increased

crude processing is that India will become more reliant on crude imports and hence increased attention is needed on its security of supply and how the government and industry can best prepare for any possible disruptions.

Despite India maintaining its hefty export potential for light and middle distillates in the coming years, the structural shortfall in LPG supplies will expand and the need to import supplies will increase. Such is the scale of the current and prospective import requirement that India's refiners are unable to adjust yields to compensate. Furthermore, the relative value of LPG to gasoline, jet fuel and diesel argues for continued two-way trade.

The need for imports for increased domestic petrochemical feedstock demand will extend this LPG trade imbalance, but here again the availability of cheap ethane and propane from the United States and the Middle East would point to a net economic benefit for the Indian economy from such an arrangement. Petrochemical capacity expansions are a common theme across much of the industry. The focus on the supply of petroleum, oil and lubricants remains business as usual for all refineries. The move to diversify revenue and meet the rapidly growing need for plastics is understandable, but presents a policy challenge, as it clashes with India's clean cooking initiative.

Refineries focus on petrochemical integration and increased light and middle distillates

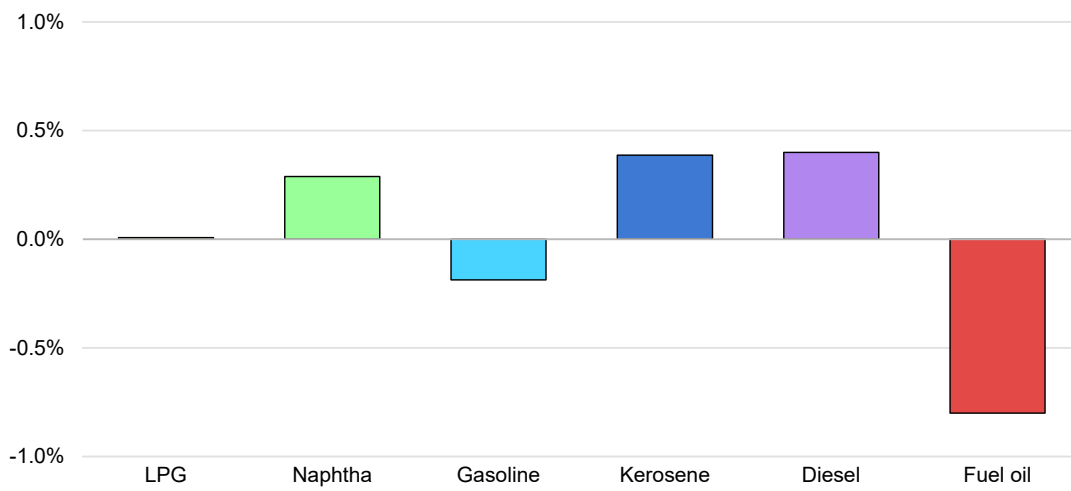
Across all the government-owned public sector undertakings (PSU) refineries, petrochemical integration is targeted to rise from 7% currently to 25% by 2030. The increased exposure will be achieved by adjustments to refinery operating modes. Primarily, these revolve around increased fluid catalytic cracker (FCC) severity to generate higher yields of LPG and olefins. Elsewhere, naphtha reforming will be reconfigured to increase the yield of aromatics.

Average refinery production yields will change over the forecast period. The combined impact of new refinery start-ups, investment in additional gasoline-focused units, e.g. alkylation units, and the addition of coking and vacuum residue hydrocracking will boost light and middle distillate output. Concurrently, we expect Indian refineries to target the acquisition of even greater volumes of heavy Middle East crude, as well as increased extra heavy crude from the Americas. Consequently, we see naphtha yields increasing at the expense of gasoline, and middle distillate yields benefitting from the reduction of residue output.

International competition for oil product export markets remains intense. The imposition of sanctions on Russian crude and product exports by the European Union (EU), as well as G7 sanctions on facilitating Russian oil trade, have provided

India's export refineries with an opportunity to gain market share in Atlantic Basin product markets. However, these opportunities are also open to refineries in the Middle East, as well as elsewhere in Asia. Moreover, the start of export-orientated refineries in Kuwait, Oman and ramp up of activities at the Jizan refinery in Saudi Arabia in recent quarters, has intensified competition. Trade data point to a strong increase in diesel and jet fuel supplies to the European Union since early 2023, in the wake of the sanctions from India, as well as from Saudi Arabia and Kuwait.

Forecast Indian refinery yield evolution, 2023 versus 2030



IEA. CC BY 4.0.

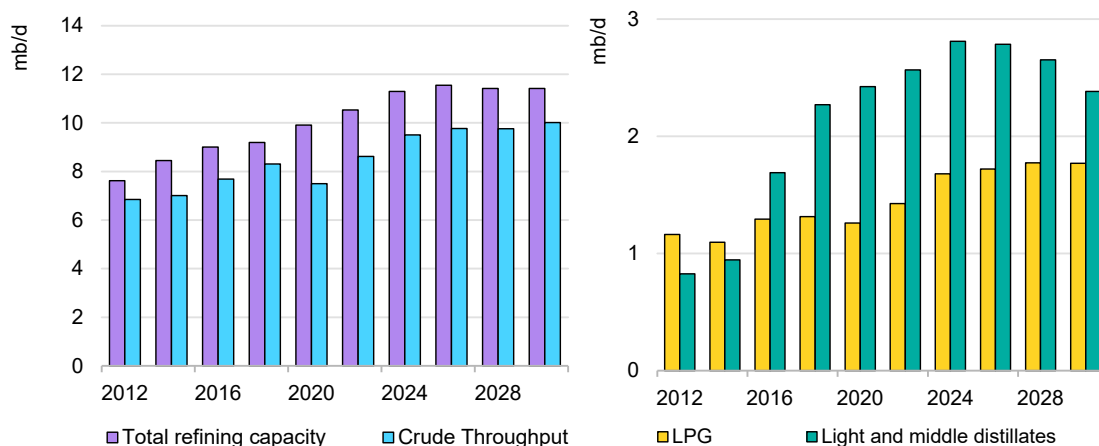
It appears likely that regional demand growth in the Middle East will continue to absorb an increasing share of regional light and middle distillate production over the balance of the decade. Consequently, we expect the competition from recently announced export-related refining capacity to be close to a peak for Indian refineries and that by the end of the decade light and middle distillate exports will have eased by nearly 10% from earlier record levels.

The inverse is likely for Middle East LPG exports. Increasing LNG production will raise associated natural gas liquid volumes, adding to regional supplies. These supplies will need to find demand centres and India is well placed to absorb these volumes.

The other key thrust for Indian refineries is to reconfigure their operations to run on the lowest cost crude possible. The overarching aim of the installation of upgrading and hydrotreating capacity is to increase their operational flexibility in terms of crude that can be processed, without sacrificing light and middle distillate yields. The swing in the crude diet has been significant in recent years, and many refineries are preparing to run increased volumes of new heavy sour crude streams, such as Western Canadian Select, if freight rates make the crude

competitive. Arguably, such is the expansion of coking and residue hydrocracking capacity in the coming years that the Indian refining industry will need to resort to increased imports of high sulphur fuel oil in order to fully utilise their residue upgrading capabilities.

Peak Middle East pressure on Indian distillate exports appears imminent



IEA. CC BY 4.0.

Source: PPAC and IEA calculations.

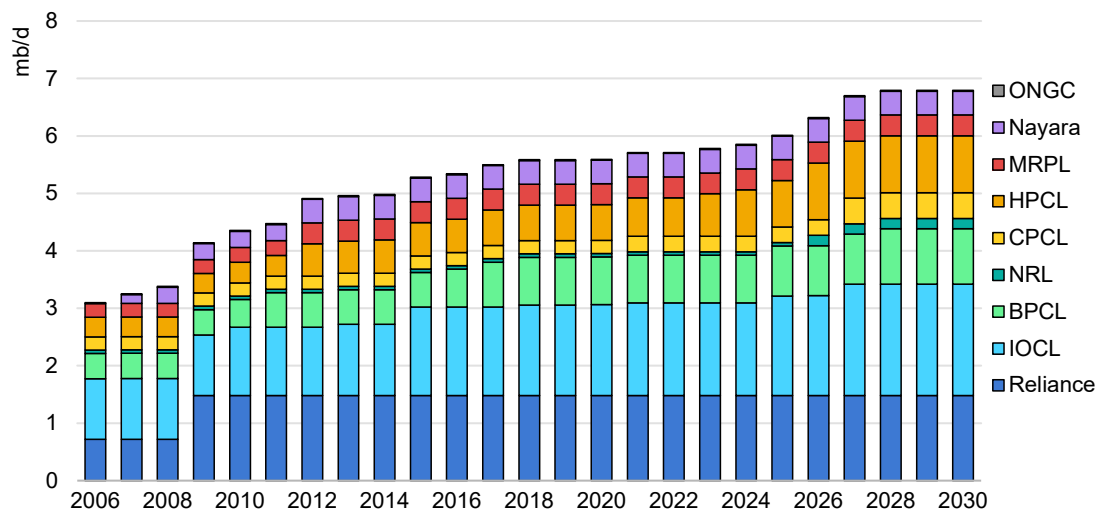
Investment plans and capacity

India has significantly expanded its nameplate refining capacity, from 3.1 mb/d in 2006 to 5.8 mb/d by 2023, pegging the country as the fourth largest refiner in the world. This 2.7 mb/d capacity increase has been accompanied by notable improvements in refinery configurations and, in recent years, a strategic emphasis on integrating petrochemicals.

There are presently 23 operating refineries in India, with an additional greenfield project slated to be commissioned by 2026. Between 2023 to 2030, 1 mb/d of new distillation capacity is expected to come online with an average yearly addition of around 150 kb/d. Net capacity will therefore increase from 5.8 mb/d to 6.8 mb/d by 2030, with the majority of those additions starting up by 2026.

Indian Oil Corp. Ltd (IOCL) commands a significant position in the country’s downstream sector, operating and holding approximately 28% of total refinery capacity as of 2023. IOCL is planning to expand and enhance its existing capacity by 327 kb/d by 2030. The 321 kb/d Panipat refinery operated by IOCL is gearing up for a significant 200 kb/d capacity boost by early 2027. This expansion is designed to enable the processing of heavier crude grades.

Indian refinery capacity, 2006-2030



IEA. CC BY 4.0.

Source: PPAC and IEA calculations.

IOCL aims to commission the 60 kb/d expansion at its 140 kb/d Barauni refinery in 2025. The project involves the replacement of one of the plant's current 71 kb/d crude distillation unit (CDU) towers, with a new 131 kb/d unit. This project also includes the expansion of the hydrocracker, contributing to an increase in middle and light distillates output.

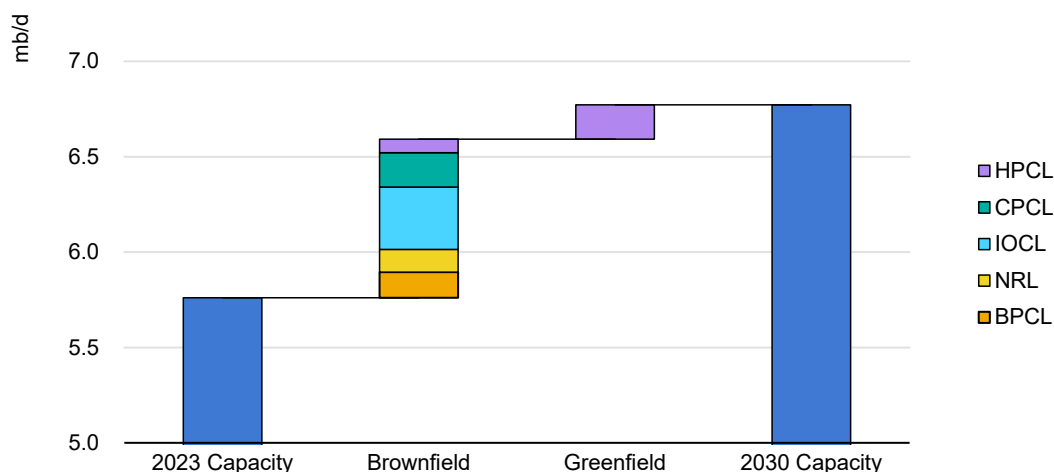
IOCL's Koyali refinery is planning to raise capacity by 60 kb/d by mid-2025, lifting crude processing capacity to 384 kb/d. The plant's FCC and diesel hydrotreater will also be expanded, ultimately boosting middle and light distillates output. IOCL's Digboi oil refinery will undergo a minor expansion of 7 kb/d, taking its capacity from 13 kb/d to 20 kb/d by 2026.

Chennai Petroleum Corp. Ltd (CPCL), a subsidiary of IOCL, oversees the Nagapattinam refinery in the Cauvery Basin. The original 24 kb/d refinery, which was shut down for dismantling in 2019, is undergoing extensive refurbishment and expansion works, making up 18% of total additions for India out to 2030. The new refinery is set to have a capacity of 180 kb/d, with commissioning targeted for 2025.

Numaligarh Refinery Ltd (NRL), a division of Oil India Ltd, will increase the facility's capacity from 60 kb/d to 180 kb/d. The extensive project is expected to start up by the end of 2025 and will include significant upgrades in naphtha reforming, catalytic cracking, hydrocracking and hydrotreating capacities. The upgrades will lead to reduced LPG imports and increased middle distillate and polypropylene production.

Bharat Petroleum Corp. Ltd (BPCL) will see all three of its refineries add capacity, totalling 134 kb/d. The Bina manufacturing complex will include both a refinery expansion and a greenfield petrochemical project. The plans also include the addition of an ethylene cracker complex, utilising captive feedstocks such as naphtha, LPG and kerosene sourced from the refinery. The current refinery capacity at Bina stands at 170 kb/d, and the planned expansion will add 64 kb/d, bringing the total capacity to 234 kb/d upon commissioning in 2028. Other BPCL refineries will see some minor upgrades to existing facilities. The Kochi refinery is set to undergo a modest expansion of 30 kb/d in 2028, raising its capacity to 390 kb/d while in Mumbai a planned addition of 40 kb/d will push the overall capacity up from 300 kb/d to 340 kb/d by 2025.

Indian refinery capacity growth, 2023-2030



IEA. CC BY 4.0.

Source: PPAC and IEA calculations.

In 2016, HPCL initiated significant expansion plans to address the disparity between regional production and demand. In response to this, the Mumbai refinery underwent a 50 kb/d expansion in 2021, boosting the total refinery capacity in the area to 210 kb/d. As the same time, HMEL (a joint venture between HPCL and ArcelorMittal), increased CDU capacity at its Bhatinda refinery from 220 kb/d to 260 kb/d to alleviate local product shortages.

HPCL's Visakhapatnam refinery, operating at around 200 kb/d since 2006, is set to undergo a sizeable and somewhat unique expansion project. The first instalment, of 70 kb/d, that took capacity to 270 kb/d was completed in 2023. The final phase is scheduled for 2024 and aims to further increase capacity to 340 kb/d, with a focus on enhancing coking and vacuum residue hydrocracking.

The Barmer refinery and petrochemical complex, developed by a joint venture between HPCL Rajasthan Refinery Ltd (HRRL) and HPCL holding 74%, with the government of Rajasthan taking 26%, is a groundbreaking project for clean fuel production in the district. Once fully operational, likely by 2026, the refinery is expected to produce 180 kb/d. The facility will be the first of its kind in Rajasthan, producing BS-VI grade motor spirit, diesel fuel, as well as ethylene and propylene derivatives. These derivatives are intended for use as feedstock in various industries such as textiles, packaging and petroleum.

Reliance Industries currently operates the largest and most intricate refinery in India, which was one of the first full conversion refineries with significant coking and upgrading capacity. The Jamnagar refining complex has total capacity of 1.48 mb/d and can refine over 216 various types of crude. The refinery has no plans to expand on its current capacity, with future debottlenecking and upgrades dependent on the outlook for product markets.

Located in the Gulf of Kutch, Gujarat, Nayara Energy's Vadinar refinery stands as the second-largest refinery in the country. With a nameplate capacity of 410 kb/d, it can process a variety of complex crudes and is equipped to produce fuels that adhere to international standards such as Euro VI and BS VI grades. As of now, there are no confirmed plans for expansion at this refinery within the next five years.

Mangalore Refining & Petrochemicals (MRPL) operates the Mangaluru refinery, in the Karnataka state. The 363 kb/d plant has a versatile design with complex secondary processing units and a high flexibility to process crudes of various API, delivering a variety of quality products. The company has no plans to expand in the forecast horizon.

ONGC runs the Tipitaka mini-refinery and condensate splitter in Hazirah, in the East Godavari district of Andhra Pradesh. The refinery produces and markets products such as LPG, kerosene, aromatic-rich naphtha and low-aromatic naphtha through fractionation of natural gas. Current capacity stands at 15 kb/d with no announced expansionary plans in the forecast.

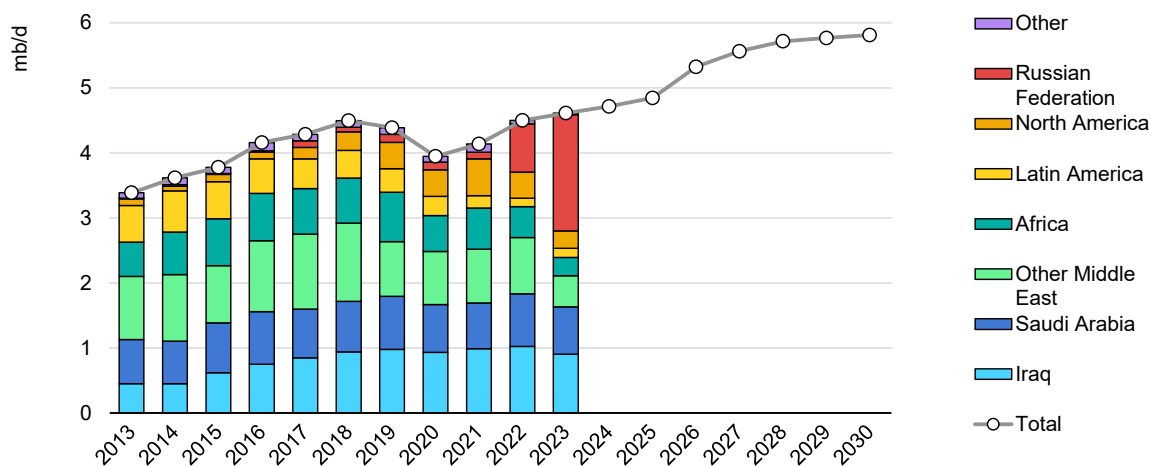
Although not included in our projections to 2030, future discussions surround the Ratnagiri Refinery, a joint venture project of HPCL, IOCL and BPCL, are still pending. Saudi Aramco and Abu Dhabi National Oil Company (ADNOC) have also expressed their intent to partner in this project and a MoU has been signed to this effect. However, the project, located in the Konkan region on western coast, has encountered challenges related to land acquisition. With an initial planned capacity of 1.2 mb/d, that number has since been revised down.

Chapter 4. Oil trade

India ranks as the world’s second largest net crude importer and sixth largest product exporter

As a modest crude producer but a major refiner, India depends on crude oil imports for nearly 90% of its refinery intake, having risen by 36% over the past decade to 4.6 mb/d. Crude imports have gotten heavier and increasingly sour over time as refinery capacity grew, boosting their share by 50% over the past decade. Combined imports of medium- and high-density crudes represented 63% of imports in 2023. Until 2021, the incremental heavy sour crude volumes came from the Middle East but subsequently from Russia, which also displaced supplies to some degree from all other regions. India remains a key East of Suez product exporter, helping to balance supply within the region as well as feeding exports to the Atlantic Basin. In 2023, the country was the world’s fourth largest exporter of middle distillates (gasoil, diesel and kerosene) and the sixth largest for overall products. As such, India played a key role in meeting European requirements following the embargo on imports of Russian oil.

Indian crude and condensate imports by origin



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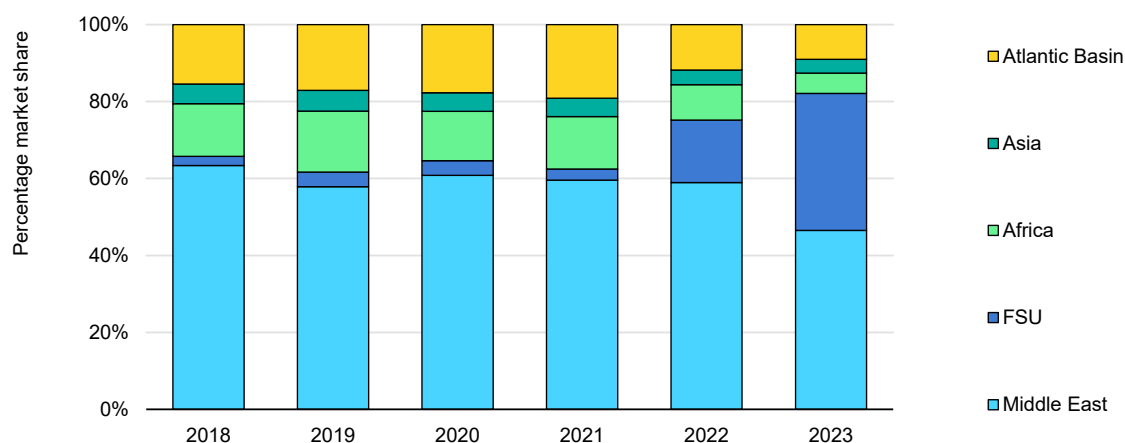
Source: IEA analysis based on data from Kpler.

Crude trade – Increasing exposure to Russia and the Middle East

With the steady growth in refinery capacity over the past decade, India has become the world's second largest crude oil net importer (4.6 mb/d in 2023) after China (10.6 mb/d) and well ahead of the third, South Korea (2.8 mb/d). The Jamnagar refining complex alone accounted for 25% of national crude imports in 2023, followed by Nayara's Vadinar refinery (11%). The country exports no crude. India is the fourth largest importer of heavy refinery feedstocks to saturate downstream conversion units, dominated by Jamnagar which is the world's biggest single importer, according to *Kpler*.

Until Russia's invasion of Ukraine, the Middle East accounted more than 60% of India's crude imports. However, Indian refiners subsequently shifted their mix to massively benefit from lower cost Russian barrels, of mostly medium sour Urals but also ample volumes of light sweet grades from the Pacific region. Russia's share of total import volumes rose from just under 3% in 2021 to nearly 40% in 2023 – at the expense of all other regions. The Middle East fell from 61% to 45%, West Africa from 12% to 4.5%, and Latin America from 4.5% to 3%.

Indian crude imports, 2018-2023



IEA. CC BY 4.0.

Source: IEA analysis based on data from *Kpler*.

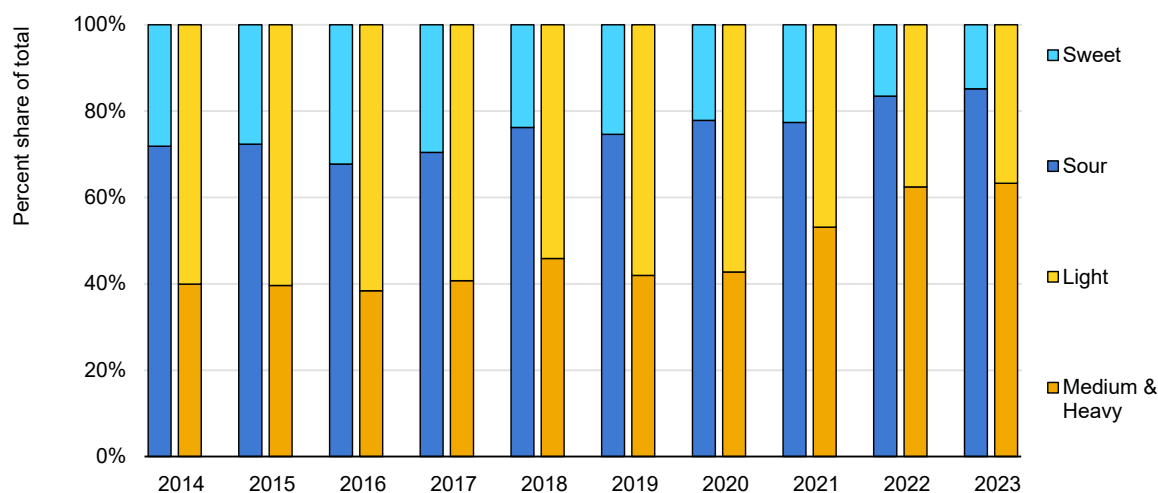
In the Middle East, exports to India did not all decline equally. Saudi exports remained stable and even rose slightly from 2021 to 2023 (reaching 710 kb/d), as did Qatar's (+40 kb/d). On the other hand, exports from the UAE dropped 170 kb/d to 260 kb/d, Oman's collapsed by 100 kb/d to under 10 kb/d, Iraqi volumes fell 80 kb/d to 900 kb/d, those from Kuwait lost 75 kb/d to 153 kb/d while Neutral Zone

exports decreased 26 kb/d to 28 kb/d. Other countries suffering big reductions include Nigeria (-180 kb/d to 125 kb/d) and the United States (-210 kb/d to 205 kb/d).

With these recent shifts in the origin of India’s crude imports, the combined share of medium and heavy sour crudes in the import mix rose by a sharp 13% from 2021 to 62% in 2023. On the other hand, light sour crude imports fell 5% to 24% and sweet grades dropped by 8% to just 15%. Today, the Indian crude import barrel is 85% sour and 63% medium-heavy quality (sweet and sour combined).

The quality of the crudes imported reflects the flexibility of Indian refiners, with a capacity to run their refineries on the most difficult grades and even a preference for these grades in order to maximise refinery margins.

Indian crude Imports by quality



IEA. CC BY 4.0.

Source: IEA analysis based on data from Kpler..

The massive change in world oil trade flows following international embargoes on Russian energy exports is not expected to reverse in the foreseeable future. India rapidly became one of the principal buyers of the heavily discounted Russian crude, rising from almost nothing to 1.7 mb/d in 2023 (and reaching 2.2 mb/d in May 2023). India accounted for 36% of Russian crude oil exports in 2023, while Russia made up 38% of India’s crude imports. On the other hand, India doubled imports of Russian products from 70 kb/d to 130 kb/d in 2023 (mainly for fuel oils and feedstocks), but only amounted to 5% of Russia’s sales.

Product trade – modest importer but major exporter

India has consistently exported 1.2-1.3 mb/d of refined product since 2017 while importing a steadily rising volume of finished and unfinished product that reached 380 kb/d in 2023 (40% above 2017). Finished product imports are dominated by naphtha (72 kb/d in 2023), lubricants (37 kb/d) and gasoline (20 kb/d), as well as some bitumen (14 kb/d) and fuel oil (11 kb/d). The steady rise in imports reflects increased use of unfinished refinery feedstocks, amounting to 210 kb/d in 2023. Refiners have offset reduced access to heavy crude supply with imports of cracked and straight-run fuels as coker feed. They also import some 30 kb/d of carbon black feedstock.

The boost in unfinished product imports almost exclusively reflects increased use of heavy feedstocks by the Reliance Jamnagar refinery. The global shift to very low sulphur fuel oil for bunkers in January 2020 sharply undermined the value of high sulphur fuel oils, increasing their interest as a feedstock to saturate conversion units, and notably cokers. This was followed in April-May 2020 by the sharp pandemic driven drop in heavy crude availability as OPEC+ producers cut supply to balance the market. India's total feedstock imports doubled to 140 kb/d in 2020 and reached 210 kb/d in 2023.

India's combined exports of finished and unfinished products have remained quite stable at around 1.2-1.3 mb/d since 2017. Of the 1.25 mb/d of exports in 2023, the Jamnagar refining complex, which includes a merchant export refinery, accounted for 890 kb/d, Vadinar 130 kb/d and the new Mangalore refinery 100 kb/d. Middle distillates totalled 730 kb/d, of which diesel was 290 kb/d, gasoil 270 kb/d and kerosene 175 kb/d. Gasoline and blendstocks averaged 320 kb/d (245 kb/d and 75 kb/d respectively) and naphtha for another 123 kb/d.

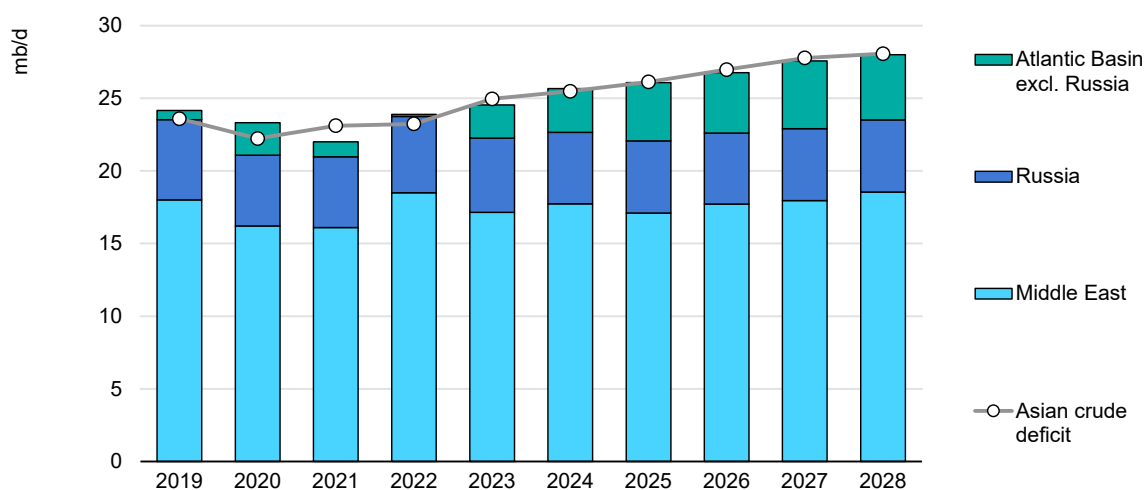
World product trade flows also shifted dramatically in response to G7 and EU embargoes on Russian oils, which came into effect during 2022 and early 2023. Russia previously accounted for large import shares of naphtha, gasoil and fuel oil in Europe as well as feedstocks in the United States. Replacement suppliers for these markets came from further afield, including the Middle East and Asia (notably India). Russian volumes in turn were rerouted to East of Suez, Türkiye, Africa and Latin America.

As a major exporter of middle distillates, India has played a key role in meeting European requirements following the 2023 embargo on imports of Russian oil. India also exports some 40 kb/d of fuel oil and 30 kb/d of heavy feedstocks. In 2023, Europe soaked up 225 kb/d of Indian gasoil and diesel exports versus around 120 kb/d on average in the previous five years and 140 kb/d in 2022.

India set to play an expanded role in global oil markets

Over the medium term, global trade of crude and products will expand, with India playing a major role. Continued demand growth in Asia will by far outpace increased crude exports 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. The growth in global crude production and exports will be dominated by the Atlantic Basin, excluding Russia. The Western Hemisphere will see its crude oil and condensate surplus increase by around 4.5 mb/d, as production rises in the United States, Brazil and Guyana and refinery activity falls with the contraction in transport fuel demand. The resulting slow rise in the call on OPEC supplies combined with new Middle Eastern refinery and splitter capacity hampers growth in the region’s crude and condensate exports. The Atlantic Basin crude surplus thus plays a critical role in meeting Asian, and notably Indian, crude demand over the forecast period. Product trade will see some growth in middle distillate flows from Asia to the Atlantic Basin, but light ends (notably naphtha and LPG) will move in the opposite direction to Asia, which concentrates demand growth.

World crude and condensate balances by region, 2019-2028



IEA. CC BY 4.0.

Source: IEA (2023), [Oil 2023](#).

Despite the extension of Asia’s baseload crude supply from existing Middle East flows to incorporate the near totality of Russia’s exports, Asian refiners will need still more volumes in the coming years. The projected Atlantic Basin net surplus will cover all Asian incremental import requirements. The majority of these flows will be medium and light sweet grades. These crudes dominate global supply growth while output of heavy qualities tend to decline. This will be detrimental for

complex refinery margins, potentially impacting India's refineries, and will support continued imports of refinery feedstocks to saturate conversion units.

Middle East crude and condensate exports rose to 17.7 mb/d in 2023, about 1.7 mb/d below their recent peak in 2018. Production cuts and the start up of new refinery capacity will limit regional export growth through 2030, with a notable impact on heavier sour grades. Middle East crude and condensate exports will remain close to the same level in 2030 as in 2022-23. Atlantic Basin refiners took about 10% of Middle East crude exports in 2023. Those volumes will likely persist in the coming years as complex refineries in the Atlantic Basin will be the last to close, sustaining requirements for heavier sour crudes.

The Asian crude and condensate supply deficit will rise by around 5 mb/d through 2030. Refinery and splitter throughputs increase by 3.9 mb/d (India +1.1 mb/d) while regional crude and condensate production falls (India -120 kb/d). India thus accounts for 1.2 mb/d of the incremental deficit and China for most of the remainder.

India's refinery crude intake will rise by 1.05 mb/d from 2023 to 2030 to 6.2 mb/d as new capacity starts up. Condensate splitting activity follows the trend in local production and is not supported by imports. With Indian crude production forecast to decline by 135 kb/d from 2023 to 2030, the country will boost its overall crude imports by 1.2 mb/d over this period.

Medium sour crudes have accounted for most of the growth in crude imports over the past decade, facilitated in part by the uptake of Russian Urals barrels. In fact, since 2019, medium sour crude uptake has increased faster (+1.4 mb/d) than overall crude imports (+0.2 mb/d). As a result, imports of almost all other grades have declined and were lower in 2023 than in 2019.

Rising crude imports through 2030 will maximise medium and heavy sour barrels to the extent that they are available, given that the refinery capacity increases represent a similarly complex configuration to the national average. However, the evidence today suggests that incremental supply of these grades could be limited. Refiners will turn to other grades that are more abundant, such as light sour and light sweet crude where India's imports have fallen by 700 kb/d since 2019. In the end, the choice of crude will be determined by the margin it delivers for the refiner. If an overabundance of light sweets undermines their price, they may be the most economic choice for even a complex refiner.

India and Asian refiners in East versus West product balances

The steady rise in throughputs over the past decade has enabled Indian refiners to meet local demand growth while sustaining unflagging product exports of 1.3 mb/d since 2017. India has become a key East of Suez product exporter, helping to balance regional supply while feeding exports to the Atlantic Basin. The country's refiners compete with those in the Middle East who are also expanding capacity and increasing their exportable product surpluses. Our trade analysis 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.

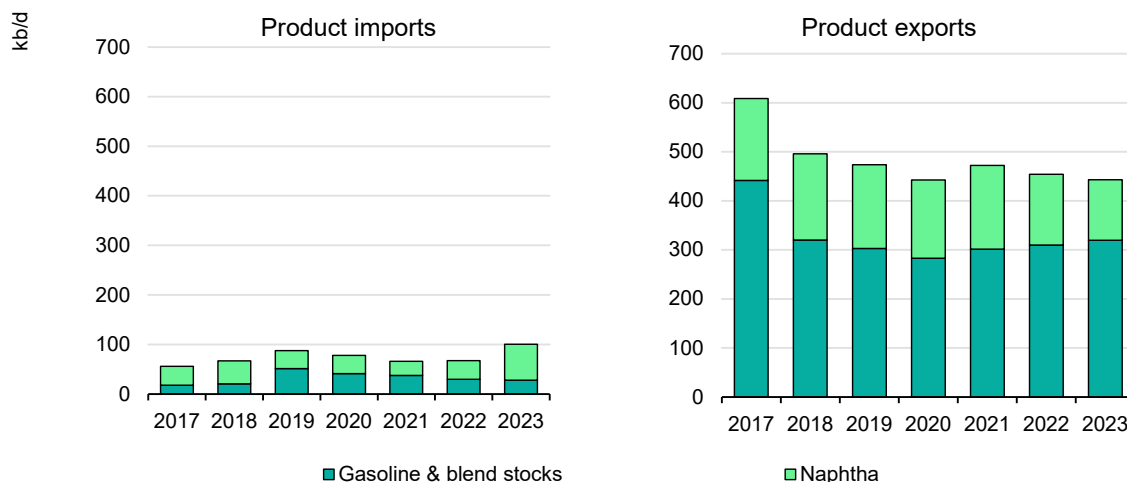
Light-ends balances and trade

Competing suppliers chase Asian buyers

Asia's continued petrochemical build out sustains massive deficits in LPG and naphtha. The Indian naphtha surplus is expected to remain between 100 kb/d and 150 kb/d through the end of the decade. The vast majority of exports today come from Jamnagar, with significant volumes also exported by Mumbai and Chennai. A lighter overall crude supply could lead to slightly higher naphtha exports. Similarly, the increased overhang in the gasoline market could provide an incentive to convert less naphtha to gasoline components, boosting naphtha exports.

The East-West split in the naphtha market reflects the preponderance of Asian importers, notably China, that drive vast petrochemical industry requirements. Feedstock exporters are more broadly based and include the Middle East, Russia, Europe, North America and India. Growth in Asian petrochemical activity over the forecast period and in the regional naphtha deficit contrasts with the limited export increases from the Middle East, the United States and India. This implies ample potential to move appropriate molecules from the gasoline pool to the naphtha pool if the economics allow it.

Indian imports and exports of light distillates, 2017-2030

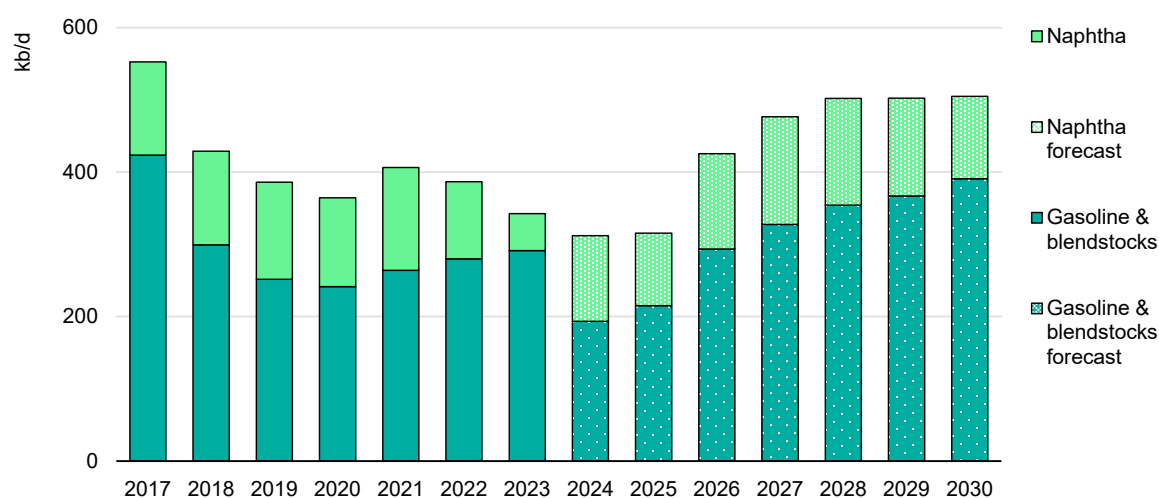


IEA. CC BY 4.0.

Source: IEA analysis based on data from Kpler.

India’s principal gasoline exporter is the Reliance Jamnagar refinery (260 kb/d out of 320 kb/d in 2023, including blending components). Other refiners have developed supply to more or less match steady growth in Indian gasoline demand. Modest imports of blending components reflect some independent blending operations as well as marginal supply optimisation. Jamnagar’s merchant export position will remain relatively steady. As output from new refineries outstrips the pace of demand growth, Indian gasoline exports are expected to rise by 180 kb/d to over 390 kb/d from 2023 to 2030.

Indian net exports of light distillates, 2017-2030



IEA. CC BY 4.0.

Source: Kpler and IEA calculations.

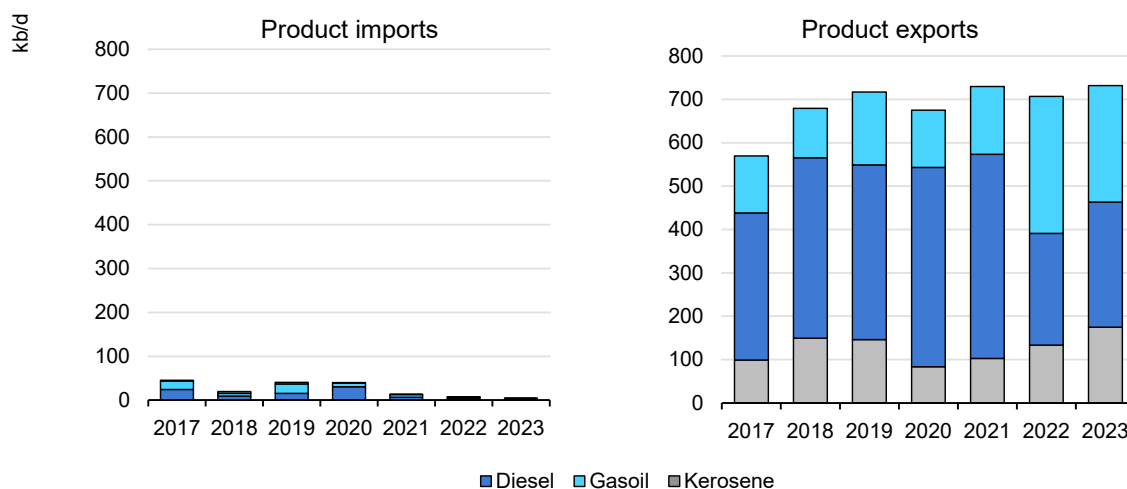
The modest development in exports is coherent with global gasoline demand growth that slows and flips into contraction over the decade, dominated by the Atlantic Basin but also China. With a global gasoline market surplus, poor economics will force refiners to dump undervalued naphtha or aromatics molecules 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.

Middle distillate balances and trade

Surplus Indian barrels continue to move West

Global middle distillate markets, including jet fuel, kerosene, gasoil and diesel, remain roughly balanced through the end of the decade. Net importing regions (Atlantic Basin excluding Russia, East Africa and Other Asia including OECD Asia Oceania) see their deficit widen by around 1 mb/d over the forecast period, of which 800 kb/d in East of Suez. Net exporting regions roughly match this development, increasing their overall surpluses.

Indian imports and exports middle distillates, 2017-2030



IEA. CC BY 4.0.

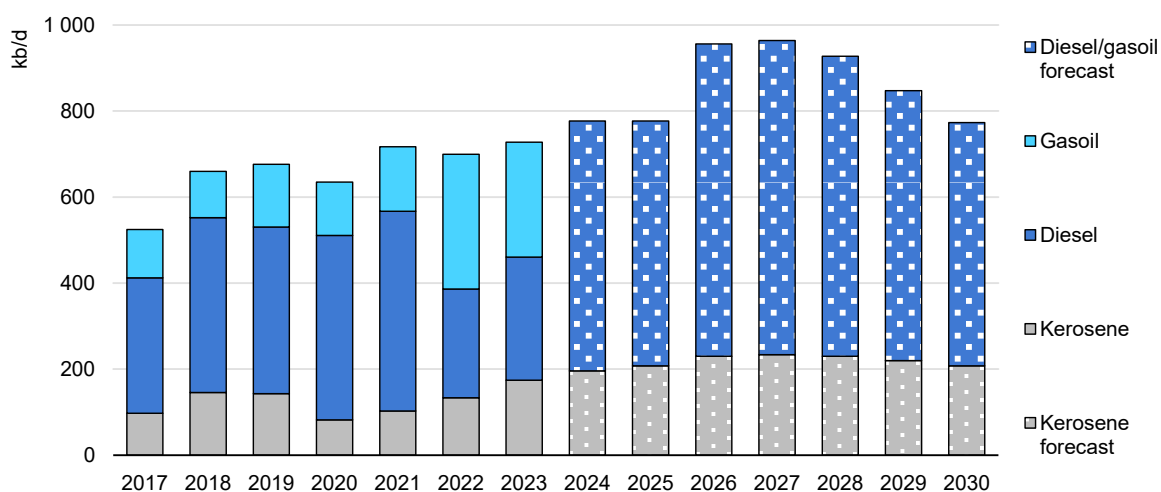
Source: Kpler.

The Atlantic Basin’s unrelenting middle distillates deficit (aggravated by G7 and EU sanctions on Russia) matches rising East of Suez surpluses, partly thanks to India’s exports. Since early 2023, increasing exports from India and the Middle East have moved west to European and G7 buyers in the Atlantic Basin to offset foregone Russian cargoes now moving to other destinations in Latin America, Africa and Asia. Indian exports to Europe rose from 205 kb/d in 2022 to 315 kb/d

in 2023 while exports fell to Asia and to the Americas. The increase included diesel (85 kb/d to 145 kb/d), gasoil (50 kb/d to 80 kb/d) and jet fuel (70 kb/d to 90 kb/d).

The Atlantic Basin middle distillate deficit rises over the next six years (+200 kb/d) as production lost with falling refinery throughputs and adjustments in product yields exceeds the decline in overall demand. The widening supply shortfall will compete with that for Other Asia (excluding China) to attract barrels from East of Suez exporters, including China, the Middle East and India.

Indian net exports of middle distillates, 2017-2030



IEA. CC BY 4.0.

Source: Kpler and IEA calculations.

Indian net middle distillate exports will rise by around 220 kb/d to 950 kb/d from 2023 to 2027 as growth in refinery capacity outstrips growth in domestic demand. Once refinery activity stabilises, demand rapidly catches up with supply to reduce the surplus to 770 kb/d, just 40 kb/d above its 2023 level. Kerosene net exports rise from 175 kb/d in 2023 to a peak of 230 kb/d around 2028 before falling to 210 kb/d at the end of the decade. Combined gasoil and diesel net exports rise from 550 kb/d in 2023 to a high of 730 kb/d by 2028 then drop to 560 kb/d by 2030.

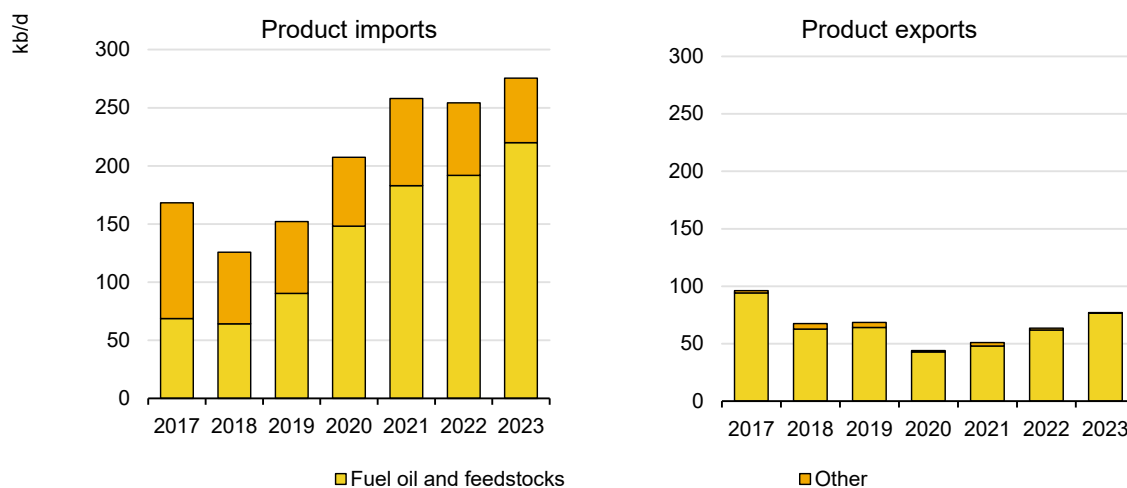
Fuel oil balances and trade

India remains a consistent fuel and feedstock importer

Global fuel oil balances remain tight, in part due to a lack of incremental exports of heavy sour crude as well as rising refinery complexity. Increased Middle East supplies, due to new refinery capacity, just keep pace with Asia’s persistent and almost unchanged fuel oil deficit while the Atlantic Basin surplus narrows due to falling refining activity and more conversion units. Key drivers for global fuel oil

balances include Russia, which remains the principal source of fuel oil exports, and Other Asia, notably Singapore and South Korea, that are the dominant importers, covering their bunkering requirements. These change very little over the course of the outlook as shipping has made limited progress in developing bunkering alternatives, while Russia has no significant upgrading projects underway to reduce fuel output.

Indian imports and exports fuel oil, feedstocks and other products, 2017-2030



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Source: IEA analysis based on data from Kpler.

Since March 2022, Russian exports of fuel oil and heavy refinery feedstocks, including straight-run fuel oil or SRFO and vacuum gasoil or VGO, shifted almost entirely to the east, requiring increased flows from East of Suez to balance the Atlantic Basin. In 2023, these exports from Russian amounted to around 1 mb/d, of which 15% went to the Atlantic Basin (vs around 50% in 2022), 20% to China (vs 7%), 20% to the Middle East (vs 11%), 15% to India (vs 11%), 15% to Malaysia (vs 12%), and 8% to Singapore (vs 2%).

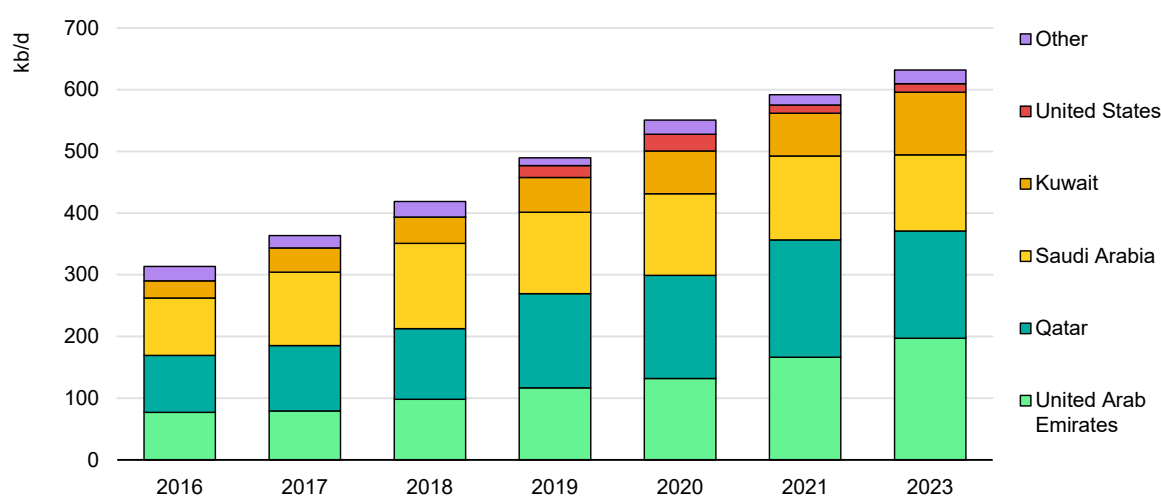
India is both an importer (220 kb/d in 2023) and exporter (80 kb/d) of fuel oils and heavy feedstocks. Most import volumes go to the Jamnagar refinery (180 kb/d), which also plays a dominant role in exports (35 kb/d). Other export refineries include Mumbai (10 kb/d) and the new Mangalore Refinery (7 kb/d).

Through the end of the decade, India's net trade of fuel oil and feedstocks will continue to be dominated by the Jamnagar refinery's net feedstock import requirements, amounting to 150-180 kb/d. The residual net fuel imports reflect an imbalance of around 25 kb/d in domestic fuel oil markets that is not expected to change significantly over the course of the decade. This means that India's overall net fuel and feedstock imports should persist at around 180 kb/d over the coming years, with little variation.

LPG balances and trade

India's increasing LPG imports are driven by strong demand growth and limited domestic production. In 2017, India became the second largest seaborne LPG importer, after China, but ahead of other large importing nations such as Japan, according to data from *Kpler*. Imports have doubled from 310 kb/d in 2016 to 630 kb/d in 2023. Middle Eastern countries, including the UAE, Saudi Arabia, Qatar and Kuwait, are key suppliers, while the United States has provided 10 kb/d annually in recent years. Notably, imports from UAE increased by 120 kb/d between 2016 and 2023, covering 30% of the country's growth.

Indian LPG imports by origin, 2016-2023



IEA. CC BY 4.0.

Source: IEA analysis based on data from *Kpler*.

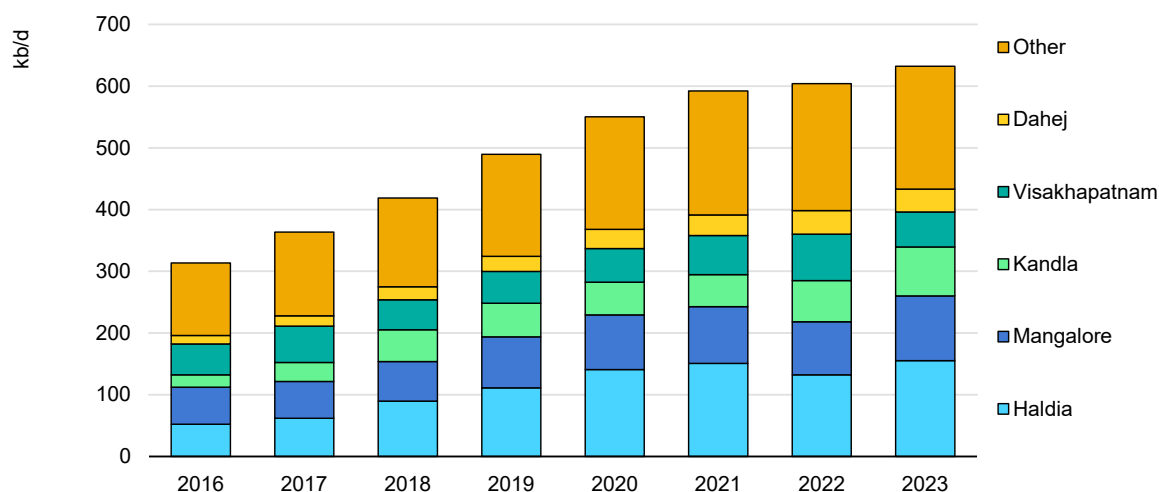
At the same time, the share of spot purchases from the UAE has gone up significantly. In 2018, spot cargoes accounted for 40% of imported volumes and by 2023 these volumes increased to 70%. This is more in line with imports from Qatar, which have largely been dominated by spot purchases (88% spot cargoes in 2023). However, this contrasts with Saudi Arabia, which seems to prefer term contracts. In contrast to growth in Chinese LPG demand, which has been met by supplies from Iran and the United States, India has not significantly diversified its suppliers, with the largest share still from the UAE.

India exports up to 30 kb/d of LPG, mainly to Bangladesh. IOCL and Beximco LPG established a joint venture in 2020 for LPG commerce in Bangladesh, as well as transporting LPG to Northeastern India through Bangladesh's territory.

Haldia is the country's largest LPG import terminal. It feeds the 1 598 km, 110 kb/d Paradip-Haldia-Barauni-Motihari LPG Pipeline, which was partially commissioned in 2017. It was extended to Muzaffarpur in 2023 and the expansion to Motihari is

expected to be commissioned in 1Q2024. LPG is supplied from connected refineries at Paradip, Haldia and Barauni but the additional volumes are imported at Haldia. Mangalore is the largest LPG port on the west coast. The 365 km Mangalore-Hassan-Mysore-Bangalore LPG Pipeline, which has a capacity of 100 kb/d, came into service in 2016. Further expansion is expected in the Northwestern area after the 260 kb/d Kandla-Gorkhpur LPG pipeline is commissioned.

Indian LPG imports by terminal, 2016-2023



IEA. CC BY 4.0.

Source: IEA analysis based on data from Kpler.

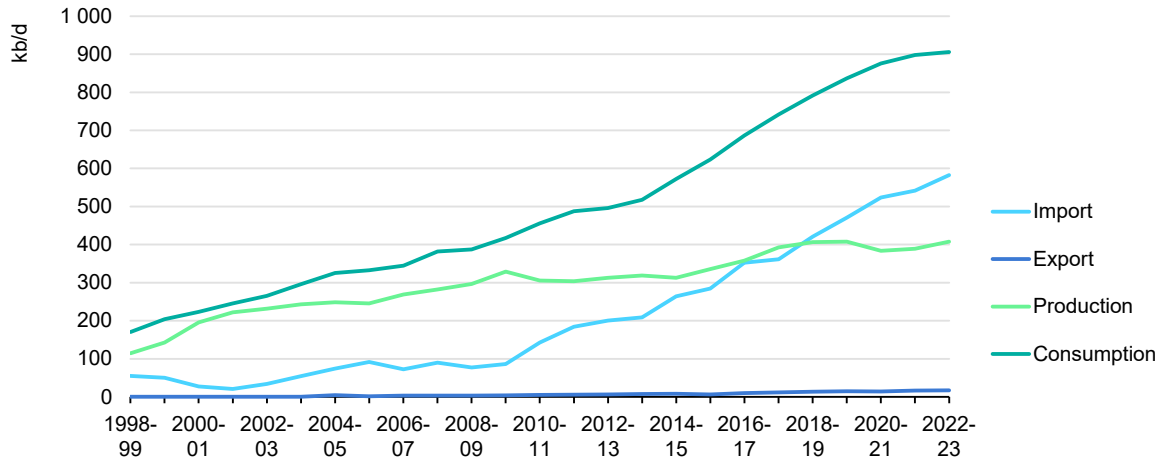
India has been promoting LPG use for clean cooking, shifting from traditional biomass, through the Pratyaksh Hanstantrit Labh (PAHAL) scheme since 2015 and Pradhan Mantri Ujjwala Yojana (PMUY) since 2016. As of 2023, PAHAL had subsidised 290 million people for LPG refills, and PMUY had provided free LPG connections to 96 million households faster than planned. LPG consumers increased from 166.3 million households in April 2016 to 314 million households in April 2023. The government aims to support a further 7.5 million households through PMUY Phase 2 by FY 2025/26. As of 1 January 2024, LPG has reached a total 320 million households with 100 million PMUY connections.

LPG pipeline networks have been expanding to provide gases to inland areas. As of September 2023, the total length of major LPG pipelines was over 5 000 km, according to PPAC. The total designed capacity is 13.7 mtpa, or 440 kb/d, with a 75.1% utilisation rate in the first half of FY2023.

In addition, the world's longest LPG pipeline is being built between Kandla and Gorakhpur. The 2 800 km project, a JV between IOCL (50%), BPCL (25%) and HPCL (25%), was started in 2019 but faced multiple delays due to the Covid pandemic and availability of materials. Once completed, LPG is expected to be

provided to 22 bottling plants in Gujarat, Madhya Pradesh and Uttar Pradesh. The maximum capacity is 8.25 mtpa, or 260 kb/d, which is about 30% of the country’s current demand. The first phase of the project is expected to be commissioned by June 2024.

LPG balance in India, 1998-2023

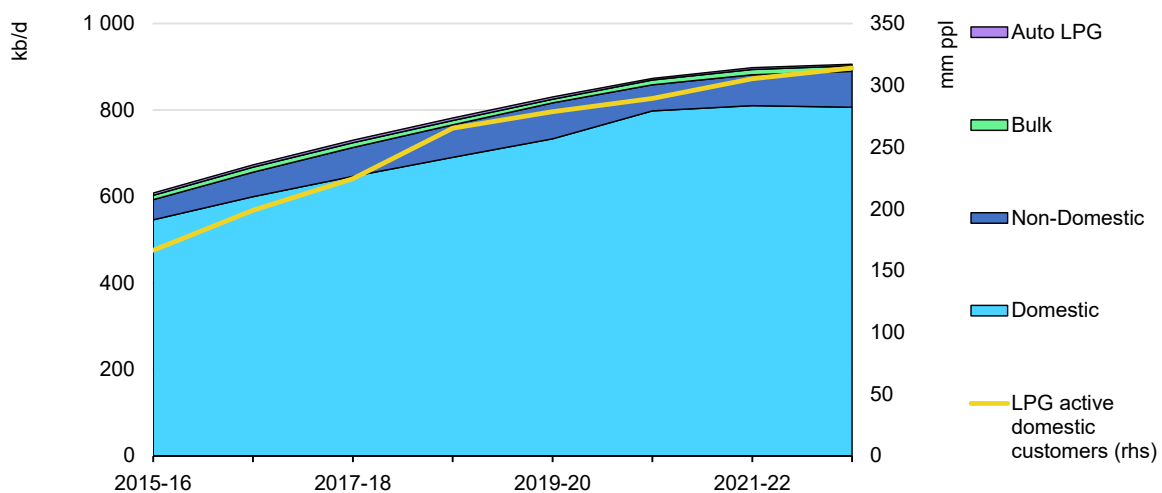


IEA. CC BY 4.0.

Source: PPAC.

Koyali refinery and Bina refinery, located along this pipeline, will supply some LPG but additional imports will be required from terminals such as Kandla, Dahej and Pipavav.

Indian LPG demand type and number of domestic use customers, 2015-2022



IEA. CC BY 4.0.

Source: PPAC.

However, the Indian LPG market is sensitive to prices. Since 2015, the government has been asking wealthy families to voluntarily give up their cooking gas subsidies in order to help more poor families and 11.3 million people joined this initiative. Nevertheless, due to the lack of funds after the pandemic, the government limited subsidies to PMUY beneficiaries only. To secure financial resources for agriculture, the government attempted to raise the LPG import duty from 5% to 15% starting in September 2023, exempting state-owned enterprises' imports for domestic use. However, this policy was reversed due to strong opposition from the private sector after Saudi Arabia increased contract prices. In the medium to long term, Asian and Middle Eastern petrochemical LPG demand will extend Asia's deficit. The opportunity remains for India to secure additional supplies from the Atlantic Basin, at affordable prices.

Chapter 5. Biofuels

Biofuels key in India's push to decarbonise transportation

Biofuels will play a major role in India's efforts to decarbonise its transportation and heating sectors as well as enhance its energy security policy with affordable energy supplies. The country is already a large biofuel producer and consumer due to high-level political support, concerted policy implementation, and an abundance of feedstocks. India is now the world's third largest producer and consumer of ethanol thanks to the more than a sixfold production increase over 2016-2023. From 2023-2030, it has the potential to nearly triple consumption and production by removing roadblocks to higher ethanol blends and diversifying biofuel use to replace diesel and jet fuel. However, monitoring costs, feedstock sustainability and deploying more supportive policies, including for other biofuels beyond ethanol, will be important.

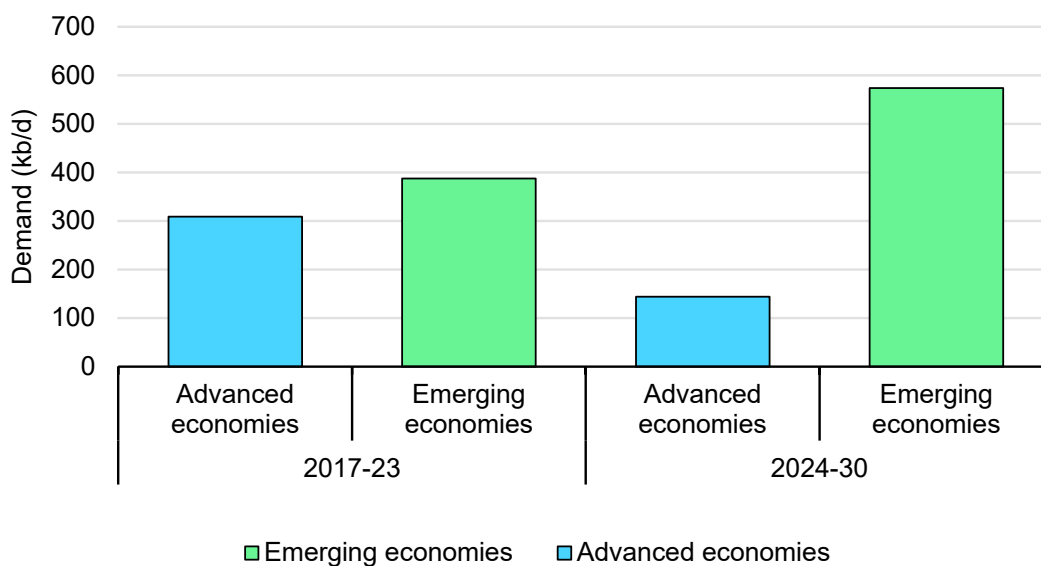
Based on the current policy framework, ethanol supply is projected to increase from 90 kb/d in 2023 to 200 kb/d by 2030, with additional potential post 2030. Biodiesel production is also expected to increase, from marginal levels at present to around 90 kb/d by 2030.

As part of its G20 presidency, India proposed and helped launch the [Global Biofuel Alliance](#) (GBA) in September 2023 that aims to bring countries together to expand and create new markets for sustainable biofuels (see [Biofuel Policy in Brazil, India and the United States: Insights for the Global Biofuel Alliance](#)). The sharing of best practices, technical support and capacity building that the GBA will provide is an important addition to international efforts to expand sustainable biofuel production and consumption.

Biofuel use is accelerating, led by emerging economies

Global biofuel demand is set to expand by 720 kb/d from 2023 to 2030, a significantly faster pace of growth than the previous six-year period. Total biofuel demand rises 24% to 3.7 mb/d by 2030.

Biofuel demand growth by fuel (left) and economy type (right), main case, 2017-2030



IEA. CC by 4.0.

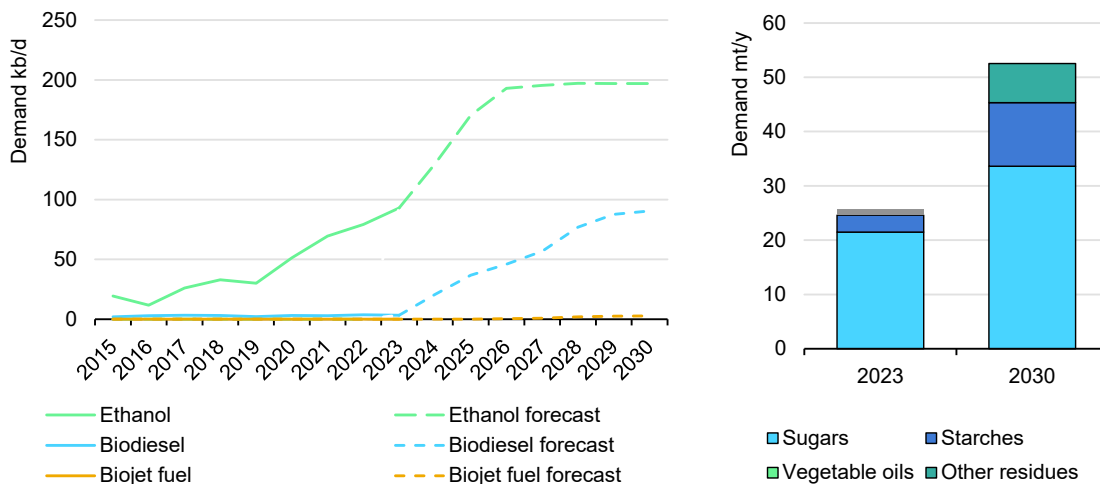
Source: IEA (2023), [Renewables 2023](#).

Most new biofuel demand comes from emerging economies, especially Brazil, Indonesia and India. All three countries have robust biofuel policies, rising transport fuel demand and abundant feedstock potential. Ethanol and biodiesel use expand the most in these regions. Although advanced economies, including the European Union, the United States, Canada and Japan, are also strengthening their transport policies, growth is constrained by factors such as rising EV adoption, vehicle efficiency improvements, high biofuel costs and technical limitations. Renewable diesel and bio-jet fuel are the primary growth segments in these regions.

Indian biofuels boosted by strong policies

In 2018, India released its National Policy on Biofuels which set blending targets for ethanol at 20% and biodiesel at 5% by 2030, feedstock requirements for different fuels and laid out the responsibilities of 11 ministries to co-ordinate government actions. Beyond blending targets, India established guaranteed pricing, long-term ethanol contracts, and technical standards and codes. Financial support for building new facilities and upgrading existing ones was also provided. Buoyed by its success, the government moved the 20% volume blending target for ethanol forward by five years to fiscal year 2025/2026, which was enshrined in an updated National Policy on Biofuels in 2022. More than 4 500 retail outlets have already started storing and selling E20.

Indian biofuel consumption in the accelerated case 2015 to 2028 (left) and feedstock demand (right)



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Notes: Biofuels consumption data is from [Renewables 2023](#). Assuming India achieves 20% ethanol blending by 2025/26, India is on track for 5% biodiesel blending by 2030 and to achieve 2% biojet blending for international flights by 2030.

Supported by these policies, ethanol for blending in gasoline production and demand nearly tripled between 2018 and 2023 and now stands at near 12%. Sugar cane provides most ethanol production, with the remainder from food grains such as maize and surplus rice stocks determined by the Food Corporation of India. To diversify feedstocks beyond sugar cane, India provides separate pricing for maize-based ethanol and includes ethanol produced from agricultural residues such as cotton stalks, wheat straw, rice straw, bagasse and bamboo.

Achieving 20% ethanol blending on average across India will require increasing the fleet of vehicles capable of accepting higher ethanol blending levels. India is encouraging flex-fuel vehicles and retrofits are possible for older vehicles, including two-wheelers. In addition, a greenhouse gas (GHG) measurement and reporting requirement would help India assure and improve GHG reductions from biofuel use in the transport sector. It will also need to continue to diversify feedstocks to help avoid shortages, which it experienced at the end of 2023.

Biodiesel production in India stands at less than 1% of diesel demand. The country has established targets, feedstock requirements and initiatives to establish used cooking supply chains, and its oil marketing companies have published expressions of interest for biodiesel produced from used cooking oil. Nevertheless, biofuel production remains low and additional supports will likely be required to increase production and use. The IEA estimates biodiesel produced from used cooking oil could displace 2.5% of diesel use.

India has other opportunities to expand biodiesel for use in diesel vehicles and biojet fuel as a replacement for jet fuel. The government has already established a 5% biodiesel target by 2030. This would require almost 90 kb/d of biodiesel, according to IEA estimates. Mobilising production will require a similar mix of policies that has been provided for ethanol, including production support, guaranteed pricing and feedstock support, especially for mobilising residue oils like used cooking oil and vegetable oils grown on marginal land.

Biojet fuel is another growth area. On 25 November 2023, the Ministry of Petroleum and Natural Gas (MoPNG) announced indicative blending targets of 1% by 2027 and 2% by 2028 for international flights leaving India. We estimate this would require nearly 3 kb/d of biojet fuel, likely to come from residue or vegetable oils grown on marginal land. However, future growth could come from other technologies such as alcohol-to-jet using ethanol and gasification technologies whereby agricultural, forestry and municipal solid waste can be converted into jet fuel.

Indian biomass use and supply potential

India's estimated available organic, solid feedstocks stood at over 1 Bt in 2022, including feedstocks for biomethane. Ethanol production from agricultural residues can also make up for crop-based ethanol production during years with less surplus agricultural production. Expanding biodiesel, renewable diesel and biojet fuel remain important pathways since gasoil/diesel and jet fuel combined represented 35% of India's demand in 2022 and this share is expected to expand by a further 32% between 2023-2030. Biomethane made from organic wastes and residues is also already used in the transport sector under the Sustainable Alternative Towards Affordable Transportation scheme. As of January 2024, 52 compressed biogas and biogas plants have been commissioned under the initiative.

Chapter 6. Implications for energy security

As India's oil demand and net imports continue their strong upward trajectory through the end of this decade, the resilience of the country's emergency response system will become ever more important. India already has plans to bolster its strategic oil reserves and is actively promoting biofuels and energy efficiency measures to reduce domestic oil use and imports.

From the most recent available data, the IEA estimates that Indian oil stocks amounted to 243 mb, of which 26 mb was held at strategic petroleum reserves (SPR) sites and 218 mb by industry. This equates to 66 days of net imports, based on IEA methodology. Indian oil import requirements will rise rapidly toward 2030 and beyond. Consequently, India should consider enhancing its capacity to respond to possible oil supply disruptions by implementing and strengthening its SPR programmes and improve its oil industry's readiness. The IEA is ready to support such efforts and work much more closely with India in ensuring security in oil and other sources of energy.

Estimate of latest stock levels		
Stock Category	Million Barrels (mb)	Net Imports (days)
SPR sites	26 mb	6.9 days
Industry Stocks	218 mb	58.8 days
JODI data	165 mb	44.6 days
Not covered by JODI	53 mb	14.2 days
Total	243 mb	66 days

Sources: JODI-Oil World Database, Kayrros and IEA calculations.

Current oil stockholding situation in India

Strategic petroleum reserves

India's SPR has a total capacity of 39.1 mb and currently holds [26 mb](#) of crude oil in its storage sites. The government has plans to boost these volumes in the coming years.

The Ministry of Petroleum and Natural Gas (MoPNG) regulates the entire value chain of the oil sector, including stocks of crude and petroleum products. The Indian Strategic Petroleum Reserves Limited (ISPRL) was formed in 2004 as a wholly-owned subsidiary of the Oil Industry Development Board (OIDB) under the MoPNG to implement and manage the country's strategic stocks.

India officially decided to establish an SPR in January 2004, entirely in the form of crude oil. In 2006, India's [Integrated Energy Policy](#) recommended creating emergency oil stocks equivalent to 90 days of oil imports.

In 2008, the government approved the construction of underground rock caverns in three locations, with a total capacity of 39.1 mb. The construction of the three sites was completed by 2018 and all the caverns were fully filled in 2020.

In August 2021, India started selling volumes to state refiners, to lower global crude prices and create space in caverns for use by private and international companies under joint stockpiling agreements. In addition, the government announced in [November 2021](#) that 5 mb of crude oil is to be released from their SPR in parallel with other countries' SPR release, including the United States. As a result, ISPRL sold 5.5 mb to Mangalore Refinery and Petrochemicals Ltd from the Mangalore site and 3.2 mb to HPCL from the Vishakhapatnam site [between August 2021 and February 2022](#). It is reported the remaining crude oil in the SPR was 26 mb, including oils owned by ADNOC.

In [April 2023](#), ISPRL asked for an expression of interest to buy 2.2 mb of Basrah Light crude oil from the Vishakhapatnam storage site. The delivery was to be done in three months from the date of agreement, but no announcement of the sale has been made public so far.

In 2018, the government selected two locations for building an additional 47.7 mb of SPR capacity. The Phase II would be developed according to a public-private partnership (PPP) model, with a tender for building storage facilities. The status and timeline of Phase II is unknown, with the larger of the two planned sites apparently on hold due to land disputes and an alternative site is reportedly being selected.

The Union Cabinet on 8 July 2021 approved ISPRL to maintain 50% storage capacity filled at all times, which would be strategic in nature. ISPRL can lease up to 30% of its crude reserves and trade up to 20% of crude oil capacity under Phase I of the SPR. In the event of any emergency, the government will have the first right to take all the crude in the storage sites.

Storage sites and recent updates

Phase I – status of existing sites

The construction of the three sites that comprise the first phase of India's SPR programme was completed by 2018. By 2020, all the caverns were fully filled, holding roughly 39 mb of crude oil. Starting from 2021, however, the government started leasing some capacity to state-run MRPL and HPCL. The federal government also allowed the ISPRL to trade oil equivalent to 20% of the overall SPR capacity in the India markets. As part of its plan to create space in caverns for use by private and international companies under joint stockpiling agreements, and in an effort to lower global crude prices, the government sold oil to state refiners from October 2021.

Phase I Site	Total SPR capacity			Estimated use of SPR capacity			
	Million Tonnes (MT)	Million Barrels (mb)	Net imports (days)	Leased caverns (mb)	Leased by	ISPRL caverns (mb)	Total (mb)
Visakhapatnam (Vizag)	1.3	9.8	2.6	2.2	(HPCL)	7.6	9.8
Mangalore	1.5	11.0	3.0	7.7	(ADNOC, MRPL)	3.3	11.0
Padur, Karnataka	2.5	18.4	5.0	13.8	(ADNOC, Aramco)	4.6	18.4
Total all sites	5.3	39.1	10.6	23.7		15.5	39.1
<i>(in days net imports)</i>				6.4		4.2	10.6

Source: ISPRL

Joint stockpiling agreements with private players to fill the SPR include a deal with ADNOC signed in January 2017 to store 5.86 mb at Mangalore and another agreement signed in November 2018 to store 9.2 mb at Padur. An agreement with Saudi Aramco followed in October 2019 for 4.6 mb at Padur. Lastly, HPCL agreed to lease 2.2 mb of capacity for its 166 kb/d refinery at the Vizag site from August 2021 and with MRPL to lease 2.2 mb of capacity at Mangalore.

ISPRL is implementing [feasibility studies](#) for Phase 1 extension at Mangalore. It was approved to acquire land at Mangalore Special Economic Zone to construct an SPR site for an estimated 11-14.7 mb.

India approved a budget of 50 billion rupees (about USD 610 million) to replenish its strategic crude oil stocks in the 2023/24 fiscal year. However, it is reported to have been cancelled in January 2024, in anticipation of a drop of crude oil prices. Furthermore, the budget also allocated 5.1 billion rupees for the construction of additional strategic storage capacity.

Phase II – Initial planned sites and status

Notwithstanding a budget allocation for construction of the projects in the 2023/24 fiscal year, land acquisitions have not yet been confirmed. [At Padur](#) (18.4 mb), the land is expected to be acquired by March 2024. At Chandikhol (29.4 mb), the government of Odisha has been advised to consider alternative sites and ISPRL investigated three sites near Chandikhol and Sidha Gumph Hill. In July 2023 a report was shared with the government of Odisha in order to reach an agreement to proceed.

In a [parliamentary committee report](#) published in March 2023, the Ministry of Petroleum and Natural Gas explained that the project could be completed in six years after the start of construction. On this basis completion would be in 2030, in the most optimistic scenario.

Phase II Site	SPR capacity additions		
	Million Tonnes (MT)	Million Barrels (mb)	Net imports (days)
Chandikhol	4.0	29.4	7.9
Padur, Karnataka	2.5	18.4	5.0
Total additions	6.5	47.7	12.9

Source: ISPRL

Recent developments

A report by a [parliamentary committee](#) in December 2023 suggested that Indian refineries may be asked to set up strategic storage capacity, with each amounting to around 2-3 days of net imports at five to six locations. If agreed, this could rapidly boost India's overall strategic oil stock holdings by between 10-18 days of imports.

The same report recommended that the ministry looks at “options to increase the strategic storage capacity in the country with a future demand in 2040 and work progressively to achieve them”.

The report also stated that in addition to the Phase I stocks of about 9.5 days of oil net imports, oil marketing companies (OMCs) have storage facilities for crude oil and petroleum products for 64.5 days. By the report's own calculations, current Indian capacity for storage of crude oil and petroleum products amount to around 74 days of net imports.

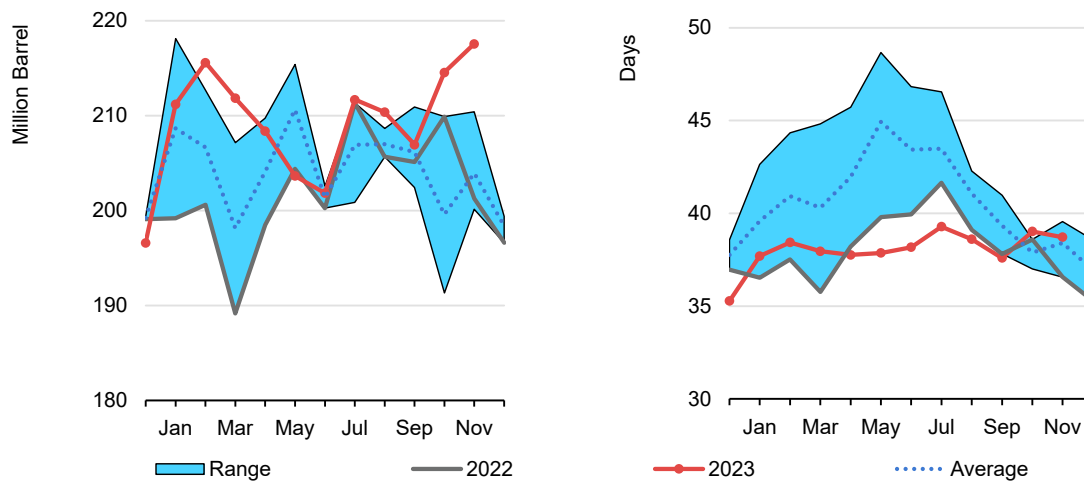
Industry stocks

As of the end of November 2023, industry stocks in India were estimated at 217.6 mb, near a record high. Even though, this covers 38.7 days of forward demand, slightly above the 2020-2022 average, as their demand has been steadily increasing. To ensure stable oil supply, it will be necessary to secure a sufficient amount of commercial inventory in addition to the SPR.

According to the *JODI-Oil World Database*, India held 165 mb of industry stocks. These include storage tanks at refineries and, since May 2020, coverage has been expanded to include stocks at depots and terminals from PSU refineries. Therefore, they exclude private or joint-venture inventories outside of their refineries, and the SPR. Product inventories were assessed at 115.1 mb, the highest in the available data. Reflecting current domestic demand, gasoil/diesel accounted for 40%.

Satellite data from *Kayrros* show observed crude oil stocks stored in floating-roof tanks were 102.5 mb at the end of November 2023, 52.6 mb more than reported to the *JODI*. The difference may include private/JV inventories at terminals and other stocks not covered by *JODI*.

Indian total oil industry stocks (in million barrels and days of forward demand)



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Notes: The data cover only after May 2020 when *JODI-Oil World Database* changed the coverage. Days of forward demand are based on forecast demand over the next three months.

Sources: *JODI-Oil World Database*, *Kayrros* and IEA calculations.

Annex

Abbreviations and acronyms

ADNOC	Abu Dhabi National Oil Company
BCPL	Bharat Petroleum Corp. Ltd
CDU	crude distillation unit
CPCL	Chennai Petroleum Corp. Ltd
DGH	Directorate General of Hydrocarbons
DSF	Discovered Small Field
E20	petrol blended with 20% ethanol
EOI	expression of interest
EU	European Union
EV	electric vehicle
FAME	Faster Adoption and Manufacturing of Electric Vehicles
FCC	fluid catalytic cracker unit
FID	final investment decision
FOB	free on board
FY	fiscal year
G20	Group of Twenty
G7	Group of Seven
GBA	Global Biofuel Alliance
GDP	gross domestic product
GHG	greenhouse gas
GST	government sales tax
HELP	Hydrocarbon Exploration Licensing Policy
HMEL	HPCL-Mittal Energy Ltd
HPCL	Hindustan Petroleum Corp. Ltd
HRRL	HPCL Rajasthan Refinery Ltd
IEA	International Energy Agency
INR	Indian Rupee
IOC	international oil company
IOCL	Indian Oil Corp. Ltd
ISPRL	Indian Strategic Petroleum Reserves Ltd
KG	Krishna-Godavari Basin
LDV	light duty vehicle
LNG	liquefied natural gas
LPG	liquefied petroleum gas
MoPNG	Ministry of Petroleum and Natural Gas
MRPL	Mangalore Refinery and Petrochemicals Limited
NGL	natural gas liquids
NOC	national oil company

NRL	Numaligarh Refinery Ltd
OALP	Open Acreage Licensing Program
OECD	Organisation for Economic Co-operation and Development
OIDB	Indian Oil Industry Development Board
OIL	Oil India Limited
ONGC	Oil and Natural Gas Corp. Ltd
OPEC	Organization of the Petroleum Exporting Countries
P1	proven reserves
P2	proven reserves + probable reserves
PAHAL	Pratyaksh Hanstantrit Labh, clean cooking programme
PDH	propane dehydrogenation
PMUY	Pradhan Mantri Ujjwala Yojana, clean cooking programme
PPAC	Petroleum Planning and Analysis Cell
PPP	public-private partnership
PSU	public sector undertaking refineries
SPR	strategic petroleum reserves
SRFO	straight-run fuel oil
SUV	sport utility vehicle
TCO	total cost of ownership
UAE	United Arab Emirates
ULSD	ultra-low sulphur diesel
USD	United States dollar
VGO	vacuum gasoil
WCS	Western Canadian Select crude

Units

\$bn	billion US dollars
Bt	billion metric tonnes
kb/d	thousand barrels per day
km	kilometre
km ²	square kilometre
mb	million barrels
mb/d	million barrels per day
mboe	million barrels of oil equivalent
mm ppl	million people
Mt	million metric tonnes
Mt/yr	million metric tonnes per year
mtpa	million metric tonnes per annum

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