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Inui Building, Kachidoki 11F,
1-13-1 Kachidoki,
Chuo-ku,
Tokyo, 104-0054 Japan

Tel : (813) 5144-8551
Fax : (813) 5144-8555
E-mail : master@aperc.or.jp (administration)
Website : https://aperc.or.jp/

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Foreword

The APERC Oil Report 2023 reviews recent changes and expected near term developments in APEC and global oil markets. The report looks back 22 years and forward 8 years to examine changes in oil consumption, production, trade flows, prices, and refining. The COVID-19 pandemic, government and corporate commitments to net zero, and the Russia-Ukraine conflict have caused changes along each of these dimensions of the oil market and the effects are likely to continue to reverberate.

APEC and global oil demand has rebounded from the unprecedented decline in 2020 caused by mobility restrictions associated with the COVID-19 pandemic, but the outlook for the next few years remains mixed. Oil consumption will increase in some APEC economies and decline in others. Similarly, future oil production trends will vary by economy causing changes in trade flows and import dependence.

Uncertainties about the pace of the energy transition have increased the risks associated with oil industry investments, including exploration, development, and refining. This and other uncertainties will likely contribute to continued volatility in the industry.

I hope the APERC Oil Report 2023 will provide policymakers across the APEC region with useful information on recent developments and the near-term outlook for oil markets. The report is also intended to assist in their efforts to improve the sustainability, security, and affordability of their economies' energy systems. This oil report is part of the APERC fossil fuel reports series, which are published annually.

I would like to express my sincere gratitude to the authors and contributors for their time and effort in writing and publishing this report. I am also grateful to APEC member economies for providing updated data through the APEC Expert Group on Energy Data and Analysis (EGEDA).

Dr. Kazutomo IRIE
President
Asia Pacific Energy Research Centre
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Authors and contributors

APERC

Nabih MATUSSIN
Thanan MARUKATAT
Phawida JONGSUWANWATTANA

Editor

Glen E. SWEETNAM
Munehisa YAMASHIRO

Design

Nabih MATUSSIN

Abbreviations and acronyms

Abbreviations

b/d	barrels per day
kb/d	thousand barrels per day
mb/d	million barrels per day

Acronyms

APEC	Asia-Pacific Economic Cooperation
APERC	Asia Pacific Energy Research Centre
CER	Canada Energy Regulator
CIS	Commonwealth of Independent States
EGEDA	Expert Group on Energy Data and Analysis
EI	Energy Institute
EV	Electric Vehicle
EIA	Energy Information Administration
EU	European Union
IEA	International Energy Agency
ICE	Internal Combustion Engine
NGL	Natural Gas Liquid
OECD	Organization for Economic Cooperation and Development
OPEC	Organization of the Petroleum Exporting Countries
WTI	West Texas Intermediate
USD	United States Dollar

APEC regional groupings

China (PRC)	
Northeast Asia (NEA)	Hong Kong, China; Japan; Korea; Chinese Taipei
Oceania (OCE)	Australia; New Zealand; Papua New Guinea
Other Americas (OAM)	Canada; Chile; Mexico; Peru
Russia (RUS)	
Southeast Asia (SEA)	Brunei Darussalam; Indonesia; Malaysia; the Philippines; Singapore; Thailand; Viet Nam
United States (US)	

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Summary and key trends

Demand

Global oil demand increased by 19 million barrels per day (mb/d) from 78 mb/d to 97 mb/d between 2000 and 2022, driven by strong demand growth in the non-OECD economies. APEC-wide demand rose by almost 9 mb/d between 2000 and 2022, in line with population and economic growth. China and Southeast Asia led the growth, while oil consumption declined in the United States and Northeast Asia.

Looking toward 2030, the APEC 8th Energy Demand and Supply Outlook projects that APEC oil demand will increase by 2.3 mb/d by 2030, with China and Southeast Asia leading the oil consumption growth. Oil demand in the United States and Northeast Asia is expected to decline over the same period.

The oil demand outlook for China is especially uncertain. The APEC Outlook calls for an increase of 2.0 mb/d in Chinese oil demand by 2030. This projection falls midway between the IEA and OPEC outlooks which expect Chinese demand in 2030 to increase by 1.7 and 2.9 mb/d, respectively.

Changes in the relative shares of various petroleum products can also be an important issue for product pricing and trade flows. Over the past two decades, global diesel consumption exhibited an annual growth rate exceeding that of gasoline by 5 percentage points, leading to a shift in the global mix of major petroleum products. In contrast, APEC's product mix has remained relatively stable over the last 20 years. In 2021, APEC's gasoline share was 10 percentage points higher and its diesel share was 5 percentage points lower than the global averages.

Supply

Global oil production (crude oil and NGLs) rose to 91.2 mb/d in 2022, with APEC and OPEC contributing 44% and 42% of the global production respectively. Production from the rest of the world contributed the remaining 14%.

Over the last two decades, APEC production grew by almost 9 mb/d, contributed largely by United States and Russia with growth of 7 mb/d and 2.5 mb/d respectively. Elsewhere, Other Americas and China's outputs only increased marginally, while Southeast Asia and Oceania's recorded declines during the same period.

The Southeast Asia region has experienced oil production declines over the past twenty years, with regional production falling by 0.8 mb/d between 2000 and 2022. Indonesia had the largest decline among the region member economies with a drop of 0.35 mb/d.

The APEC 8th Energy Demand and Supply Outlook projects an increase in APEC crude oil production of 2.8 mb/d between 2021 and 2030, of which United States contributes the most with 1.7 mb/d gain.

Trade

The increase in tight oil production in the United States and oil sands production in Canada contributed to a decline in APEC's oil import dependency. Crude oil dependency declined from 37% to 29% between 2010 and 2021, while petroleum products dependency decreased from 1% to -3% during the same period.

Russian crude oil and petroleum products exports have shifted to the Asian market, particularly China and India, where Russian imports have increased substantially between 2015 and 2022. Meanwhile, total Chinese crude oil imports dropped in 2022 for the first time in two decades, driven by increased domestic production and relatively weak economic activity due to continued COVID-19 measures.

Southeast Asia continued to be dependent on crude oil from the Middle East, although those volumes declined as the region purchased more crude oil from Africa and the United States.

Price

Brent and WTI crude oil prices were affected by several events between 2014 and 2022. Crude prices hit over USD 100 per barrel mark following the Russia-Ukraine conflict in February 2022.

Petroleum product prices were also affected by increased refining margins, including the US Gulf Coast gasoline and diesel crack spreads, increasing by 5-6 times their 4-year average (2018-2021). Sanctions on Russian petroleum product exports led to increased demand and tightened global refining capacity constraints and contributed to elevated petroleum product prices. Despite market adjustments, the June 2023 crack spreads remain 2-3 times higher than the 4-year average. The Singapore market exhibits a similar trend, albeit at lower levels. In June 2023, the Singapore gasoline and diesel crack spreads are approximately 40% and 60% higher than their respective 4-year averages.

Refining

Global refining capacity stood at 101.9 mb/d in 2022, with an approximate utilisation rate of 80%. Looking ahead, a net addition of 4.2 mb/d in refinery capacity is anticipated from 2023 to 2028, resulting in a total refining capacity of 106.1 mb/d in 2028.

Declining demand due to the COVID-19 pandemic drove the closure of less efficient refineries. Concurrently, China undertook initiatives to replace small-scale refineries with larger, integrated, and more complex facilities

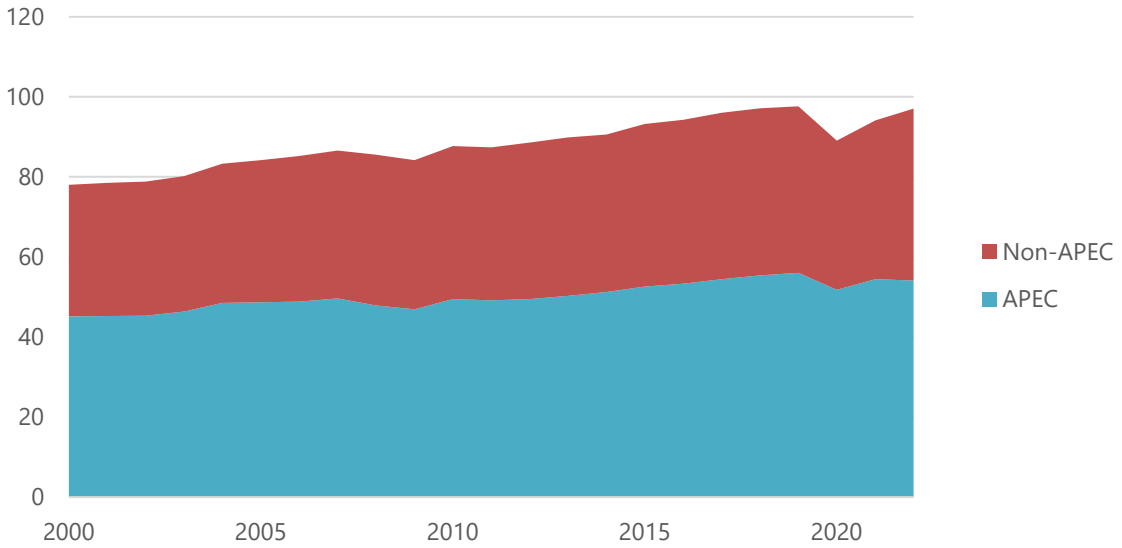
Chapter 1. Demand

1-1 Historical trend

1-1.1 Global and APEC's oil demand reaches pre-pandemic levels

Global oil demand (crude oil plus petroleum products, excluding biofuels) grew from 78 mb/d in 2000 to a peak of 98 mb/d in 2019, followed by a decline to 89 mb/d in 2020 due to the impact of the COVID-19 pandemic. Subsequently, demand rebounded to 94 mb/d in 2021 and 97 mb/d in 2022, which was primarily driven by strong demand growth in non-APEC economies (Figure 1-1).

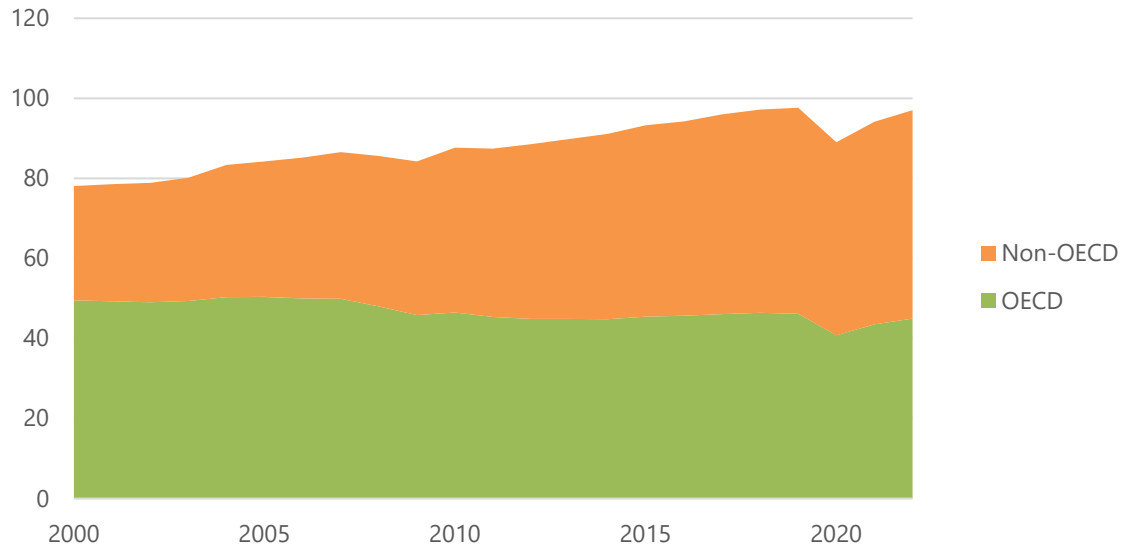
Figure 1-1: Global oil demand, APEC and non-APEC, 2000 – 2022 (mb/d)



Source: EGEDA (2023), EI (2023), IEA (2023)

From 2000 to 2022, non-OECD's oil demand recorded a substantial increase of 24 mb/d, propelled by robust economic expansion, particularly in the Asia-Pacific region. Conversely, OECD's demand decreased by 5 mb/d during the same period (Figure 1-2), driven by policies and efficiency improvements. Oil demand in the OECD economies peaked in 2005 at approximately 50 mb/d.

Figure 1-2: Global oil demand, OECD and non-OECD, 2000 - 2022 (mb/d)

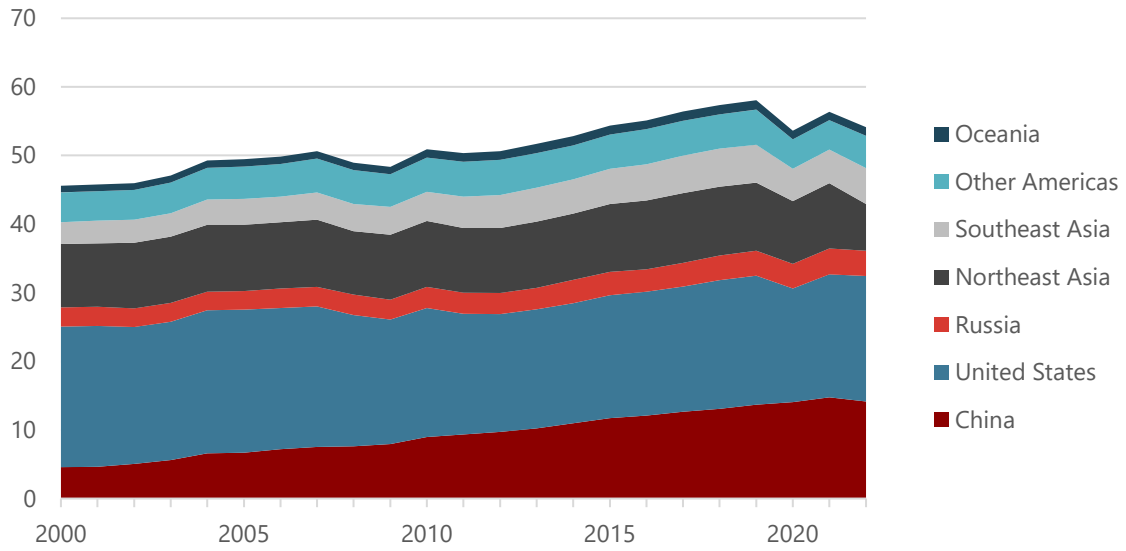


Source: EGEDA (2023), EI (2023), IEA (2023)

Total APEC's demand for crude oil and petroleum products rose by almost 9 mb/d between 2000 and 2022, a 19% increase, in tandem with population and economic growth, which increased purchasing power (Figure 1-3). China's oil consumption more than tripled with an increase of 9.5 mb/d. Southeast Asia's demand increased by over 2 mb/d, while Russia, Other Americas and Oceania also recorded smaller increases of 0.95 mb/d, 0.36 mb/d and 0.29 mb/d, respectively. On the other hand, United States, the world largest oil consumer, recorded a decrease of 2.2 mb/d during the same period. Demand in the Northeast Asia also declined by 2.4 mb/d.

Focusing on the last three years, economic recovery and resumption of air travels within the APEC region caused a modest increase in APEC's oil demand between 2020 and 2022. There was a significant gain of 10% or 1.68 mb/d of demand in the United States between 2020 and 2022. China's oil use grew only 0.7% or 0.11 mb/d over the same period due to continued COVID-19 lockdowns.

Figure 1-3: APEC's oil demand, 2000 - 2022 (mb/d)

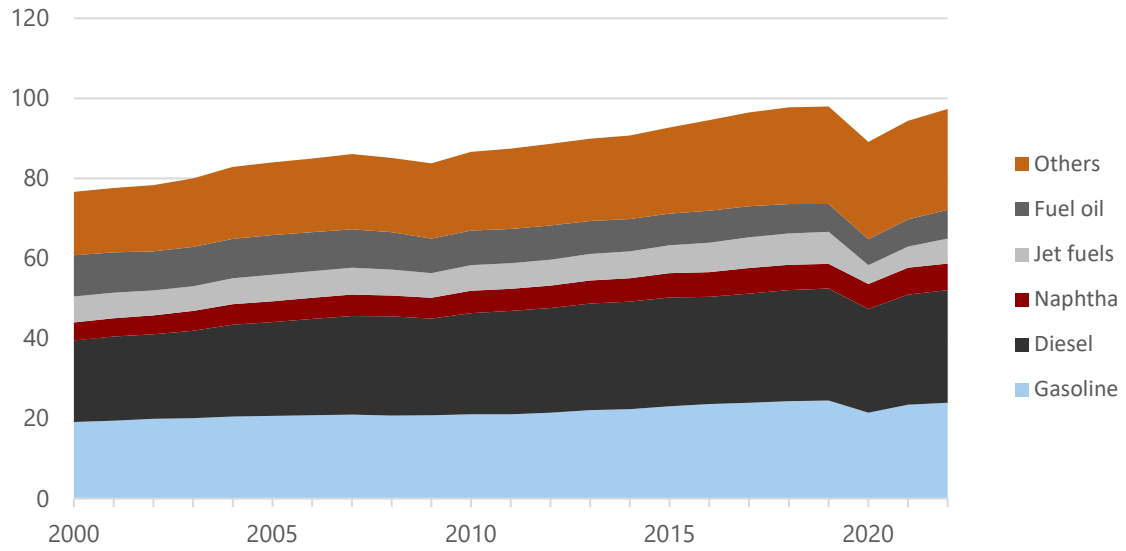


Source: EGEDA (2023), EI (2023)

1-1.2 Global petroleum products demand grows with evidence in the change in the mix ratio

An examination of the five primary petroleum products reveals notable increases in gasoline, diesel, and "others" consumption from 2000 to 2022 (Figure 1-4)**.** Other petroleum products include LPG and ethane, which are important petrochemical feedstocks in addition to fuel, was the fastest growing product type at average rate of 2.1% per annum. Global diesel consumption experienced a significant annual growth of 1.5%, reaching 28 mb/d, while gasoline exhibited a 1% annual growth, reaching 24 mb/d. The faster growth rate of diesel in comparison to gasoline led to a change in mix ratio between the two petroleum products. Jet fuel also demonstrated a 1.1% annual growth prior to 2019 but faced a drastic decline during the COVID-19 pandemic. Naphtha showed a robust growth rate exceeding 1.5% annually, driven by a strong demand for petrochemicals and plastics, even amidst the challenges of the COVID-19 pandemic. In contrast, fuel oil continued its decline, attributed to the ongoing trend of switching to cleaner fuels in the industrial, marine bunker, and power generation sectors. While petroleum product consumption in 2022 surpassed pre-pandemic levels, gasoline and jet fuel consumption are still below pre-pandemic levels.

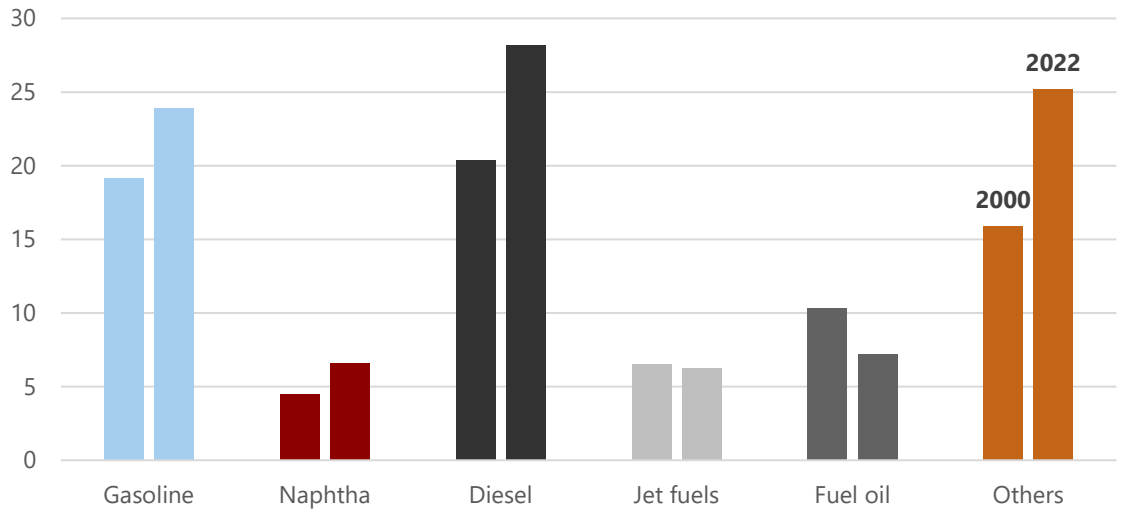
Figure 1-4: Global petroleum products demand, 2000 - 2022 (mb/d)



Source: EI (2023)
Note: Others partially include ethane and LPG

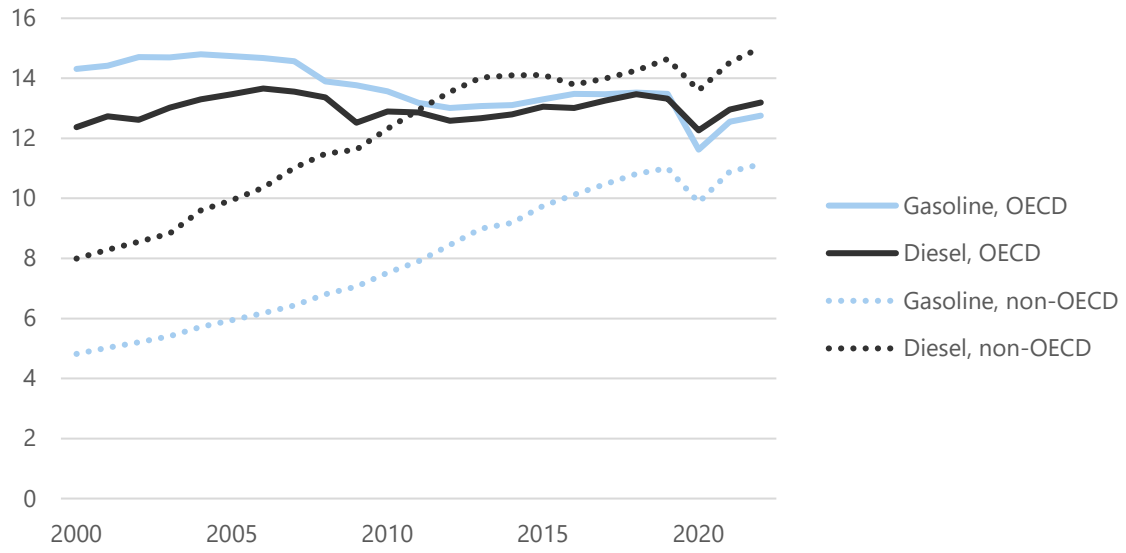
Figure 1-5 summarises changes in petroleum products consumption between 2000 and 2022. Global consumption of gasoline increased by 4.7 mb/d between 2000 and 2022, while diesel consumption registered a stronger increase of 7.8 mb/d in the same period. Jet fuel and fuel oil demands declined by 0.3 mb/d and 3.0 mb/d, respectively. Among OECD members, all petroleum products witnessed declines except for diesel (Figure 1-6). In contrast, non-OECD's gasoline consumption more than doubled from 4.8 mb/d to 11 mb/d. The non-OECD's diesel consumption surpassed OECD levels in 2011 with an annual growth rate of 2.9% between 2000 and 2022.

Figure 1-5: Global petroleum products demand, 2000 and 2022 (mb/d)



Source: EI (2023)

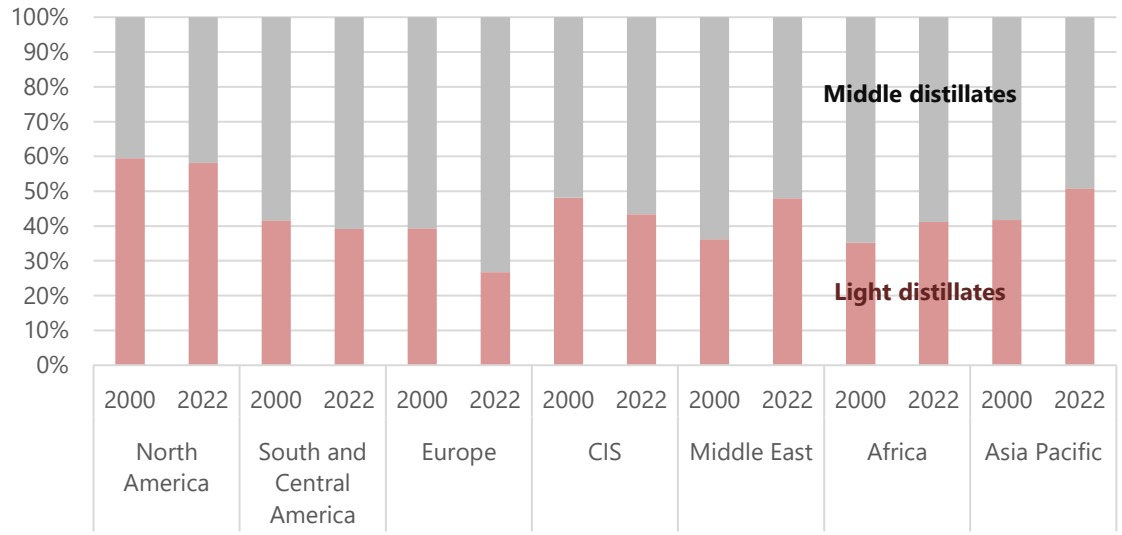
Figure 1-6: Global gasoline and diesel demand, OECD and non-OECD, 2000 - 2022 (mb/d)



Source: EI (2023)

From 2000 to 2022, there was a notable structural shift between the consumption of light distillates (mainly gasoline and naphtha) and middle distillates (mainly diesel and jet fuel) in some regions, particularly Europe and Asia-Pacific (Figure 1-7). In North America, the ratio of light distillates remained relatively constant, hovering around 60%. In contrast, the European share of light distillates declined from 39% in 2000 to 27% in 2022, primarily due to tax incentives favouring diesel vehicles and an increasing share of EVs. In the Middle East and Asia-Pacific regions, the ratio of light to middle distillates grew from 36% to 48% and from 42% to 51%, respectively, driven by high economic growth and increasing vehicle ownership.

Figure 1-7: Consumption ratio of light and middle distillates by region, 2000 and 2022 (%)



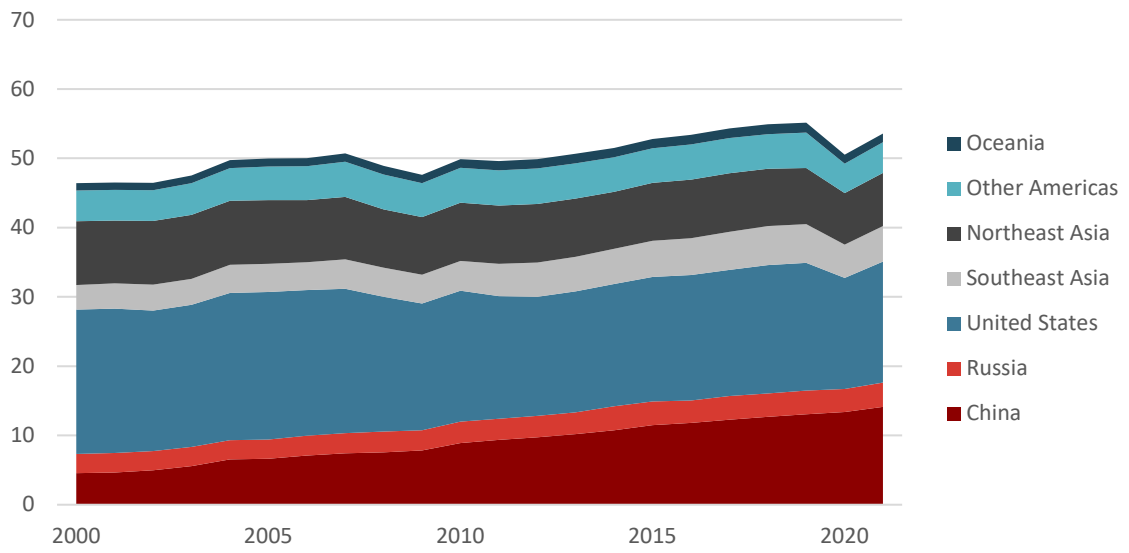
Source: EI (2023)
Note: Light distillates include gasoline and naphtha. Middle distillates include diesel and jet fuels.

1-1.3 China led the increase in APEC's petroleum products demand

APEC accounted for more than half of the global petroleum products consumption, reaching 54 mb/d in 2021. This continuous consumption growth was primarily propelled by China's dynamic industrialisation and increased transportation demands, resulting in its significant annual growth rate of 5.5% from 2000 to 2021. Total petroleum products consumption of China stood at 14 mb/d in 2021. Similarly, Southeast Asia and Russia experienced increases in consumption, but with a slower annual growth rate of 1.8% and 1.1%, respectively (Figure 1-8).

In contrast, the United States, the largest petroleum product consumer in APEC, maintained a consumption range between 16 and 21 mb/d, characterised by a declining trend. The onset of the COVID-19 pandemic exerted a discernible impact on United States' petroleum consumption, leading to levels below those observed prior to the pandemic. Likewise, petroleum product demand declined in Northeast Asia at an annual rate of 0.9%, mainly due to energy efficiency and fuel switching.

Figure 1-8: APEC's petroleum products consumption, 2000 – 2022 (mb/d)



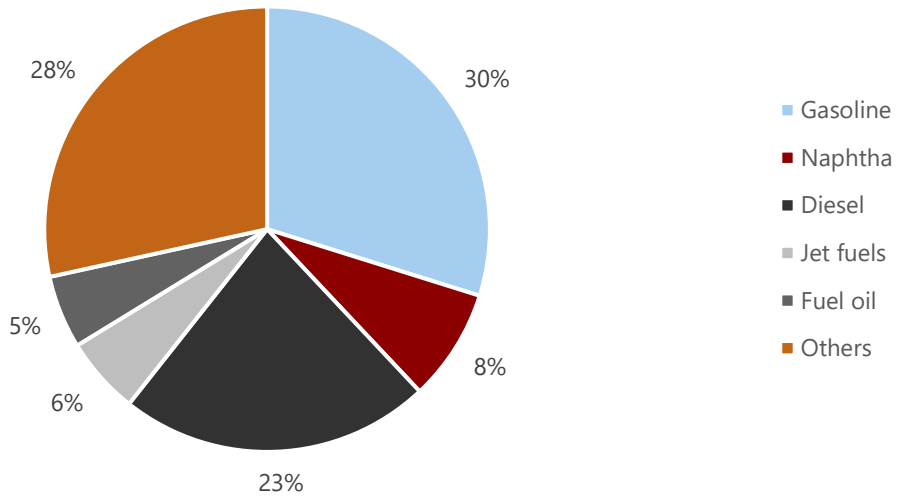
Source: EGEDA (2023) and APERC (2022)
Note: Petroleum product consumption includes international bunkers, transformation sector, losses and own use, and total final consumption

In 2021, the combined share of gasoline and diesel consumption in APEC exceeded 50% (Figure 1-9). While there had been a sustained uptrend in consumption, notably in China, the fuel mix of APEC's petroleum product consumption experienced marginal fluctuations, excepting the share of jet fuel that declined by more than 6 percentage points. Specifically, the share of gasoline, naphtha, and diesel in the consumption mix increased slightly by 1 to 3 percentage points. The jet fuel share, on the other hand, declined by less than 1 percentage point during the period.

Comparing APEC to global trends, APEC's petroleum products consumption patterns diverge

from global averages. In 2021, the share of gasoline consumption in APEC was higher than the global average by almost 10 percentage points, underscoring a pronounced preference for gasoline. Concurrently, the share of diesel was 5 percentage points lower than the global average. This trend can largely be attributed to the traditional dominance of gasoline-powered vehicles in the United States, contributing to a sustained higher demand for gasoline within the APEC region.

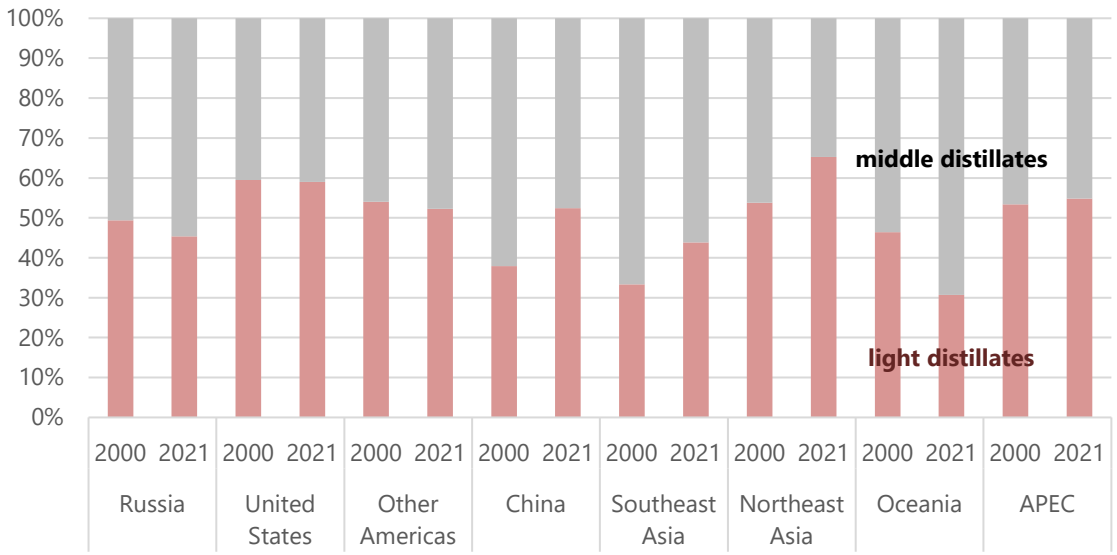
Figure 1-9: Share of APEC's petroleum products consumption, 2021



Source: EGEDA (2023)
Note: Others include kerosene, LPG, refinery gas, ethane, white spirit, lubricants, bitumen, paraffin waxes, petroleum coke and other products.

In 2021, APEC's consumption mix of light and middle distillates stood at 55% and 45%, respectively (Figure 1-10). This ratio had held almost constant compared with 2000. However, there were significant share changes in specific subregions. The consumption mix of light distillates in Russia, the United States, and Other Americas between 2000 and 2021 remained relatively constant, while in China, Southeast Asia and Northeast Asia, the light distillate share increased. Oceania is the only subregion that experienced a declining share of light distillates. If these trends continue, they could pose challenges to the refining sector in the future.

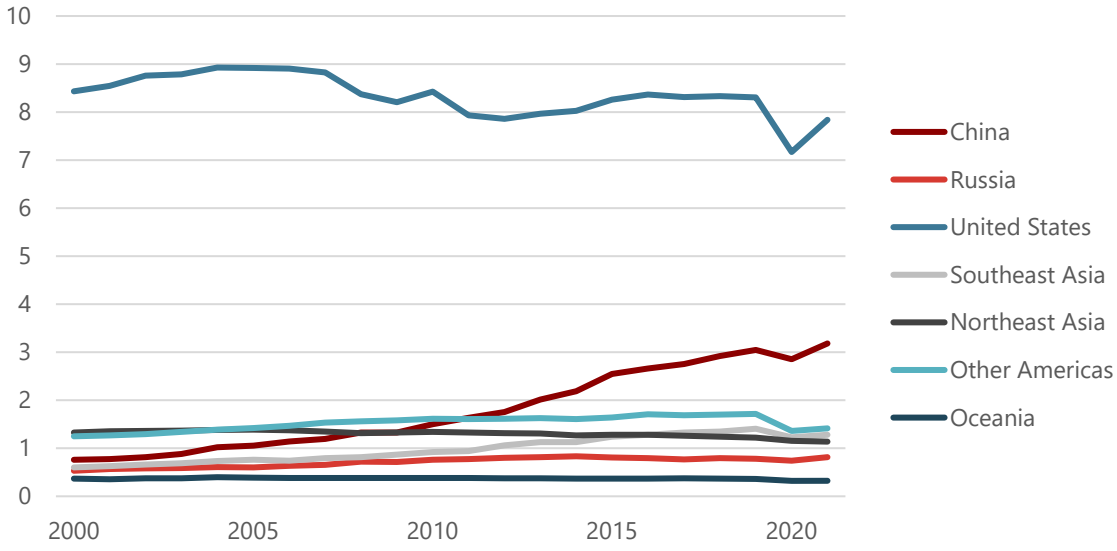
Figure 1-10: Consumption ratio of APEC's light and middle distillates, 2000 and 2021(%)



Source: EGEDA (2023)

APEC's gasoline consumption stood at 16 mb/d in 2021, with the United States accounting for 50% and China for 20% (Figure 1-11). Despite the United States' dominance in APEC's gasoline consumption, it experienced a negative growth of 0.3% annually from 2000 to 2021. In contrast, China exhibited robust growth in gasoline consumption, recording an annual growth of 7.1% during the period. Although the sales proportion of city cars in China declined, SUVs contributed to a rise in overall gasoline consumption. Additionally, Southeast Asia followed suit with a 2.0% annual growth, emphasizing the dynamic nature of gasoline consumption trends within the APEC region.

Figure 1-11: APEC's gasoline consumption, 2000 - 2021 (mb/d)

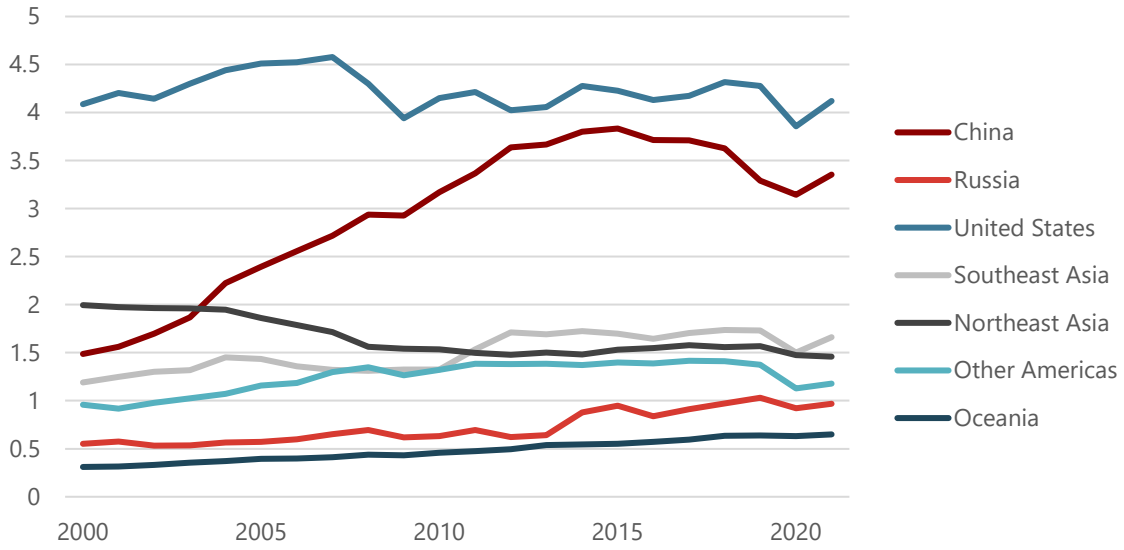


Source: EGEDA (2023)

APEC's diesel consumption grew at an average annual rate of 1.1% over 21 years, ultimately

reaching 1 mb/d (Figure 1-12). United States remains the largest consumer within the APEC, maintaining an average consumption of 4.2 mb/d. China sustained a continuous annual growth rate of 7% until 2015, after which its diesel consumption declined. The downward trajectory was affected by measures such as air pollution control, the scrappage of high-polluting vehicles, and the strengthening of fuel consumption standards. Consequently, China's diesel consumption has yet to surpass that of the United States. Northeast Asia stood out as the sole region experiencing a decline in diesel consumption between 2000 and 2021. Specifically, diesel vehicle emission control in Japan curbed the diesel consumption since 1996.

Figure 1-12: APEC's diesel consumption, 2000 - 2021 (mb/d)



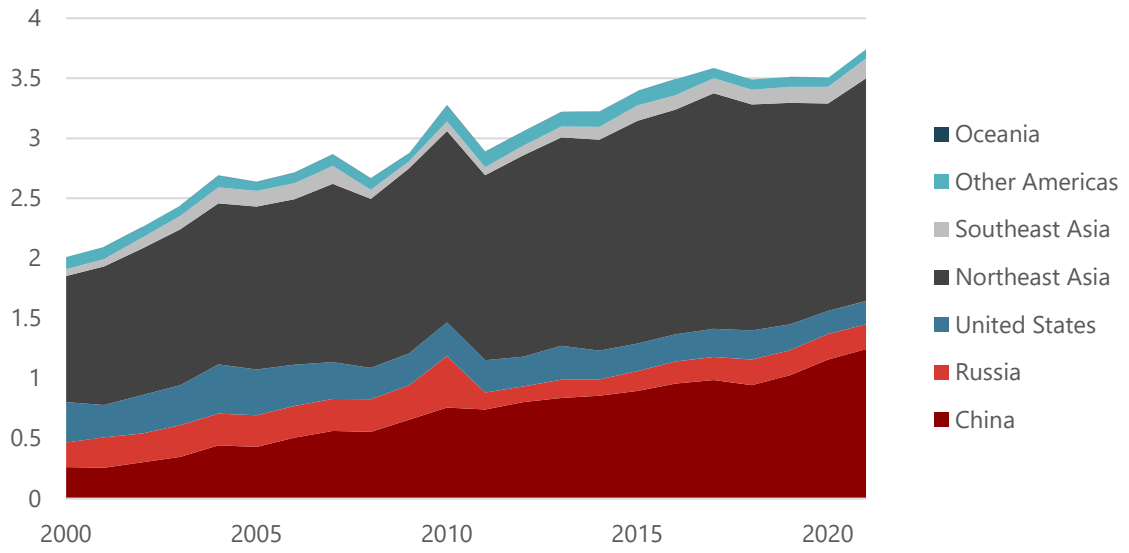
Source: EGEDA (2023)

1-1.4 China and Korea were at the heart of petrochemical dominance

For the past two decades, Northeast Asia has been the dominant user of naphtha – a crucial feedstock in the petrochemical industry – accounting for over half of APEC's naphtha demand. Its demand grew by 0.81 mb/d between 2000 and 2021, of which most of the growth came from Korea (0.48 mb/d) and Chinese Taipei (0.33 mb/d). Elsewhere, China also more than quadrupled its naphtha demand between the same period, growing by 0.98 mb/d (Figure 1-13).

The non-energy sector performed relatively well throughout the pandemic compared to other oil-consuming sectors, driven by strong petrochemical demand. Between 2020 and 2021, APEC-wide naphtha demand grew by 0.24 mb/d, with China, Korea and Chinese Taipei collectively recording an increase of 0.21 mb/d.

Figure 1-13: APEC's naphtha demand for non-energy sector, 2000 - 2021 (mb/d)



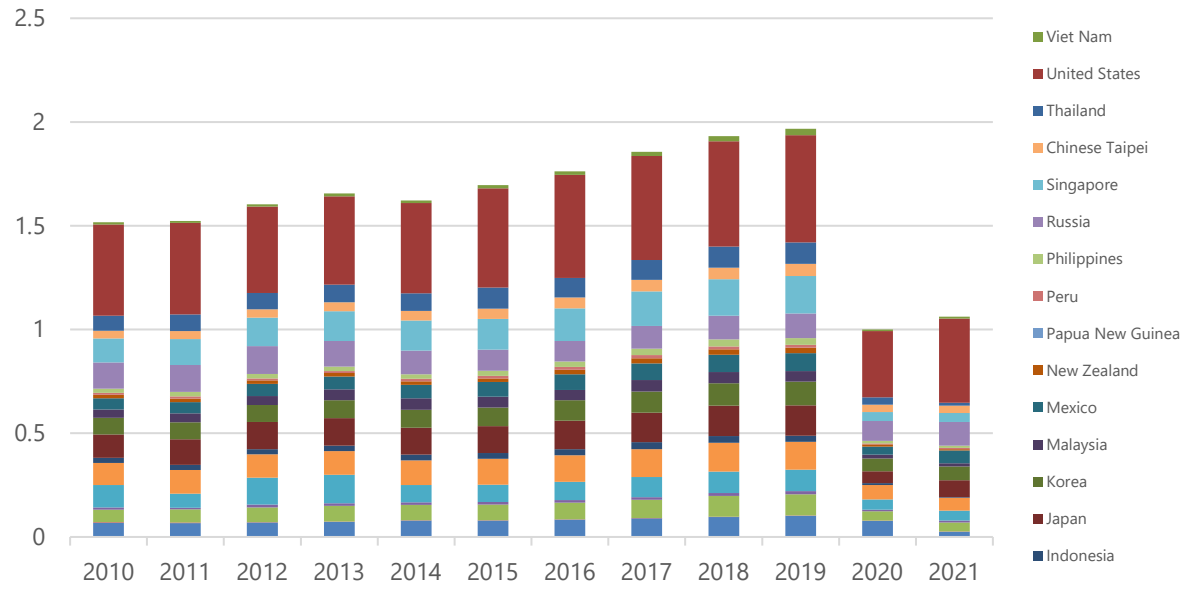
Source: EGEDA (2023)

The significant growth in naphtha demand in APEC was attributed to new and/or expanded cracking capacity in China and Korea as well as higher utilisation rates – possibly driven by the surge in demand for single-use plastics and packaging during the COVID-19 pandemic. In addition, following the rollout of mass vaccination programs across Asia economies, Korea giant petrochemical companies imported more volumes of naphtha to boost production of polypropylene – a major component for medical device manufacturing. In addressing disruptions in imports of naphtha from Russia due to the ongoing Russia-Ukraine war, Korea recently announced the elimination of a 0.5 percent import tariff through the end of 2023. This move was designed to alleviate cost pressures for naphtha-intensive companies, as well as to ensure sustained growth and competitiveness of Korea's petrochemical industry amid the market dynamism.

1-1.5 Aviation demand was still below pre-pandemic levels, while maritime activities recovered

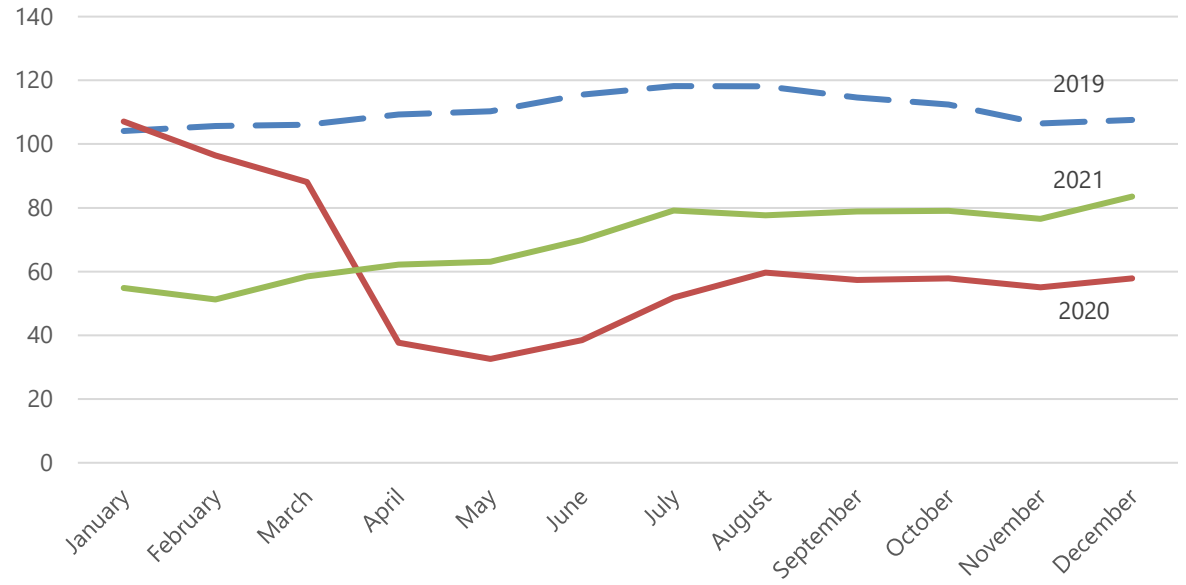
Global passenger air travels were hit profoundly by the pandemic, with monthly year-over-year declines of as much as 70% in 2020 relative to 2019 (Figure 1-15). For APEC, the total annual decline in jet fuel consumption was almost 1 mb/d. Despite continued travels restrictions due to emergence of Omicron variant in 2021, air traffic movement strengthened modestly in 2021, with jet fuel consumption increasing by 6% or 0.06 mb/d within the APEC region (Figure 1-14).

Figure 1-14: Aviation demand in APEC, 2010 – 2021 (mb/d)



Source: EGEDA (2023)

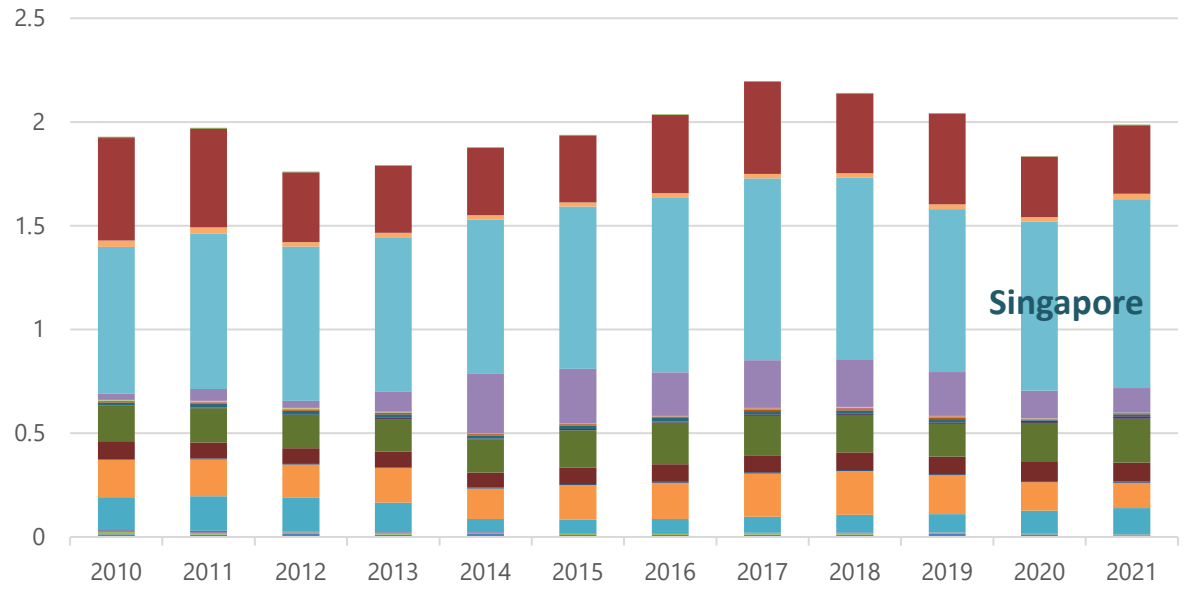
Figure 1-15: Weekly global air travelstravels, 2019 - 2021 (million seats flown)



Source: OAG (2023)

In contrast, maritime trade was less affected by the pandemic, with APEC-wide bunker fuel demand contracting only 10% or 0.21 mb/d in 2020. Singapore, the world's largest bunkering port, was even less affected with its bunker fuel demand increasing by 4% in 2020, despite the worldwide 4% decline in international maritime shipments (Figure 1-16).

Figure 1-16: Maritime demand in APEC, 2010 - 2021 (mb/d)

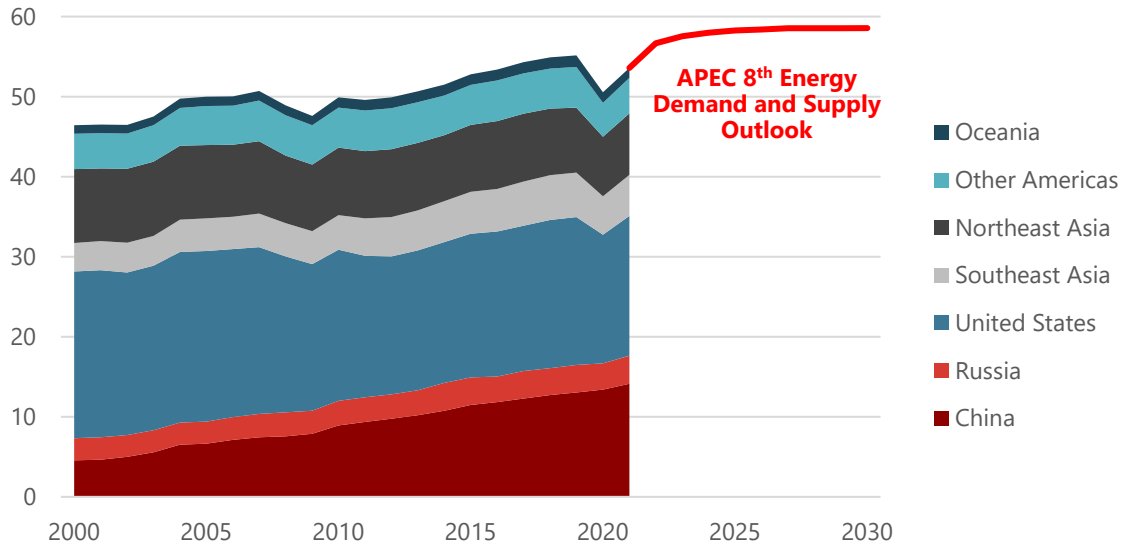


Source: EGEDA (2023)

1-2 Outlook

1-2.1 Developments in APEC

Figure 1-17: APEC's petroleum products demand outlook, 2000 - 2030 (mb/d)

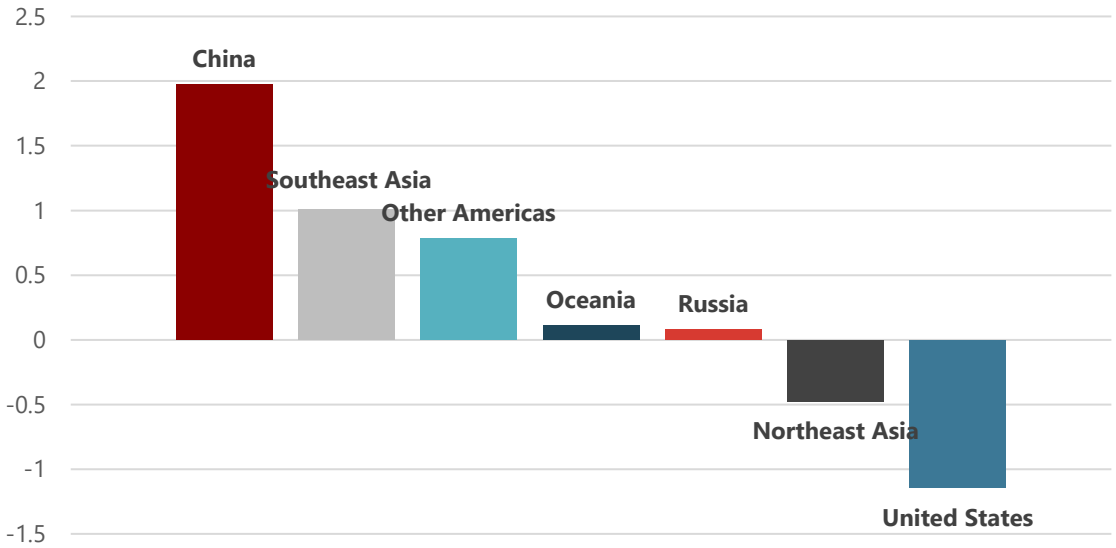


Source: APERC (2022), EGEDA (2023)

The APEC 8th Energy Demand and Supply Outlook projected APEC's petroleum products demand to grow at 0.4% annually throughout the medium term, reaching 58.5 mb/d in 2030 (Figure 1-17). China will experience a sustained rise in consumption until the mid-2030s and then expect to witness its decrease in the later years. The United States is anticipated to

demonstrate a decreasing trend due to significant fuel efficiency improvements in the transport sector and electrification. The outlook for Southeast Asia is continued growth in consumption, Oceania and Other Americas are anticipated to plateau, and Northeast Asia is expected to decline. Consequently, the overall growth in APEC's consumption is characterised by a moderate upward trend.

Figure 1-18: Change in oil demand in APEC, 2021 – 2030 (mb/d)

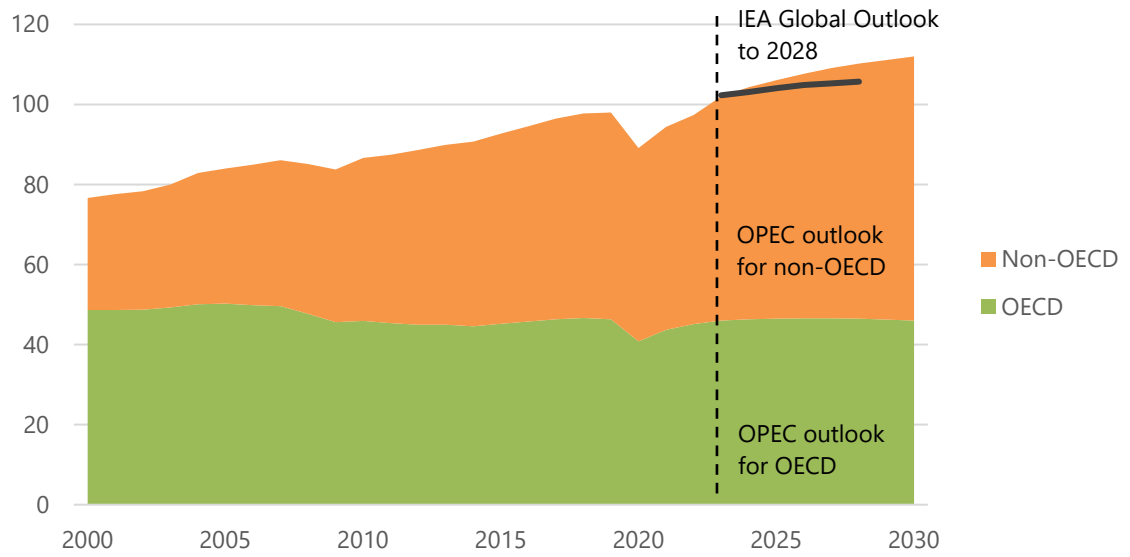


Source: APERC (2022)

In terms of volumetric change, APEC's total oil demand is expected to increase by 2.3 mb/d in 2030 relative to 2021 levels (Figure 1-18). Most of the demand gains will originate in China, with an increase of 1.9 mb/d. Southeast Asia and Other Americas are also expected to experience increased oil demand by 1 mb/d and 0.8 mb/d, respectively. On the other hand, the United States and Northeast Asia are two subregions forecasted to have lower oil demand by 2030, declining by 1.1 mb/d and 0.5 mb/d, respectively.

1-2.2 Global outlooks

Figure 1-19: Global petroleum products consumption, 2000 – 2030 (mb/d)

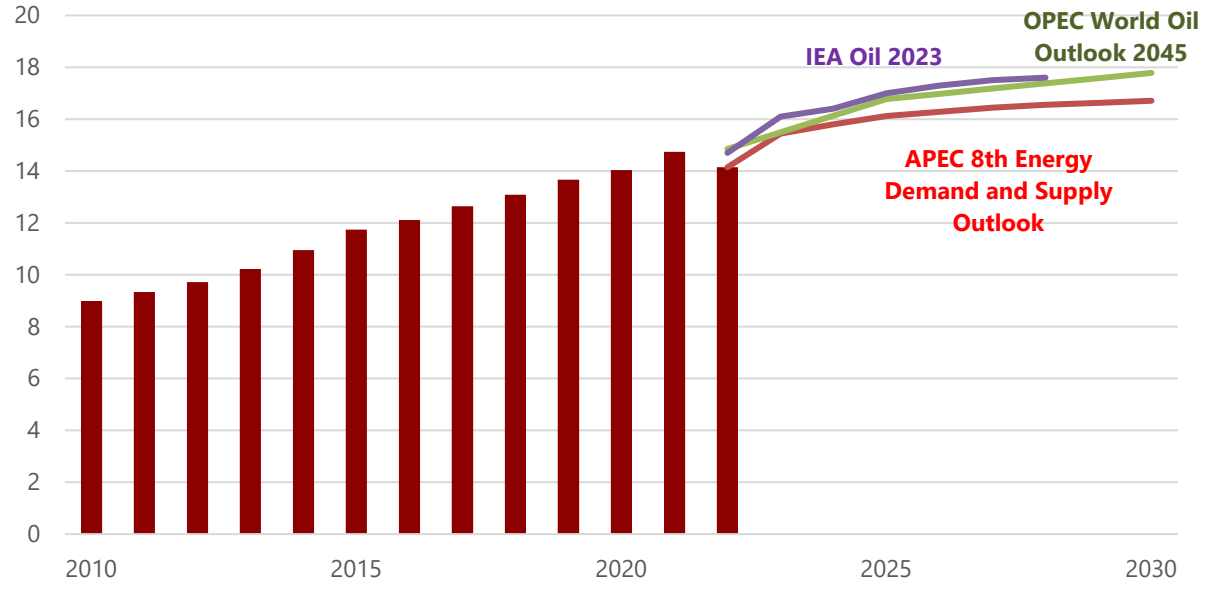


Source: EI, IEA, OPEC (2023)

OPEC anticipates that petroleum products consumption will reach 112 mb/d in 2030 (Figure 1-19). Notably, between 2022 and 2030, there is an unparalleled surge in consumption with a 2% increase projected for OECD and a substantial 26% increase for non-OECD members. Growth in OECD is expected to level off and turn negative after 2025, which is less dramatic than IEA's estimation of an even earlier peak in 2023. The IEA's comparative low petroleum products consumption is attributed to robust energy transition policies aimed at reducing emissions, improving efficiency, fuel switching from oil to electricity and gas, increasing penetration of EVs, and adopting alternative fuels for non-road transports. In contrast, China and India emerge as the primary contributors to increasing global oil consumption, with India surpassing China as the latter experiences a slowdown in economic growth over time. India's rise in population, a shift to cleaner fuels, and increasing vehicle stocks will play significant roles in shaping this consumption pattern.

1-2.3 Divergent views on China's demand outlook

Figure 1-20: Demand outlook in China, 2010 - 2030 (mb/d)



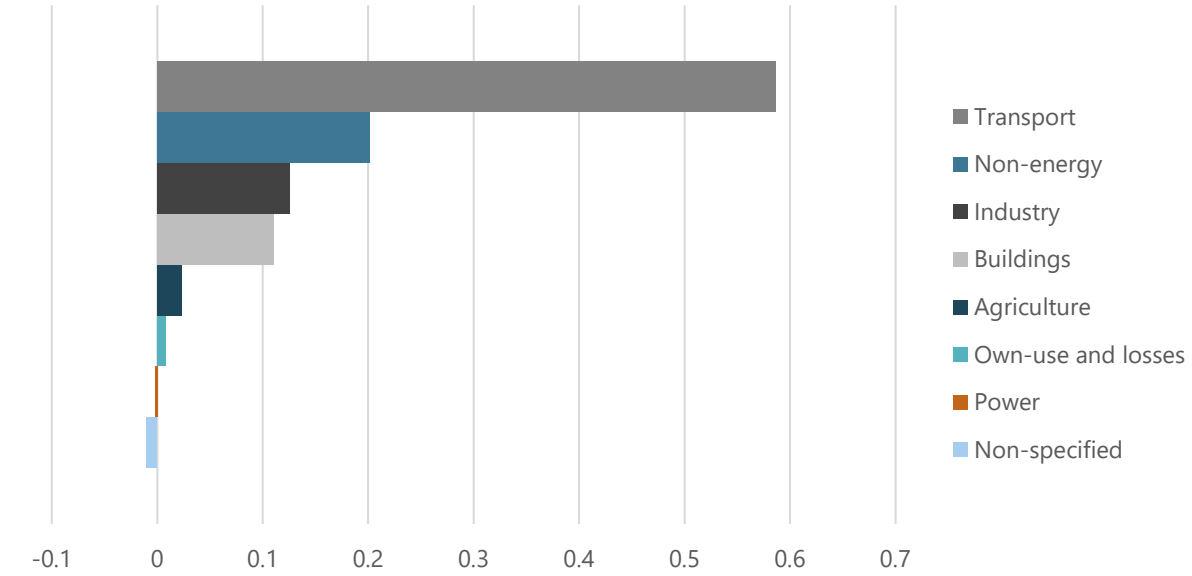
Source: EGEDA, APERC, IEA, OPEC (2023)

China's demand is projected to increase steadily over the medium term, reaching between 16 and 18 mb/d by around 2030s (Figure 1-20). Both APERC and IEA are relatively bearish with oil consumption peaking in 2030, due to slower economic growth coupled with accelerating adoption of electric vehicles. In contrast, OPEC has a more bullish outlook, forecasting China demand to reach almost 19 mb/d by 2045. The current large fleet of conventional vehicles would mean that the share of EVs in the total vehicle stocks would still be low between 2021 and 2030, albeit rising sales of EVs. In addition, demand for jet fuels is expected to remain robust in the long run.

1-2.4 Transport sector drives Southeast Asia's future oil demand

Southeast Asia is becoming a key driver for global energy demand given rapid growth in its economy and population. Oil continues to be integral in meeting the energy demand growth in most of the sectors, with transport sector accounting for more than half of the demand growth between 2021 and 2030. The sector oil usage in the region is expected to expand by 0.59 mb/d, with the number of conventional passenger light vehicles stocks estimated to reach almost 63 million by 2030. Elsewhere, rapid industrialisation across the region will see substantial growth in oil demand for industry and non-energy (petrochemical) sectors of 0.13 mb/d and 0.20 mb/d respectively by 2030 (Figure 1-21).

Figure 1-21: Change in sectoral oil demand in Southeast Asia, 2021 - 2030 (mb/d)



Source: APERC (2022)

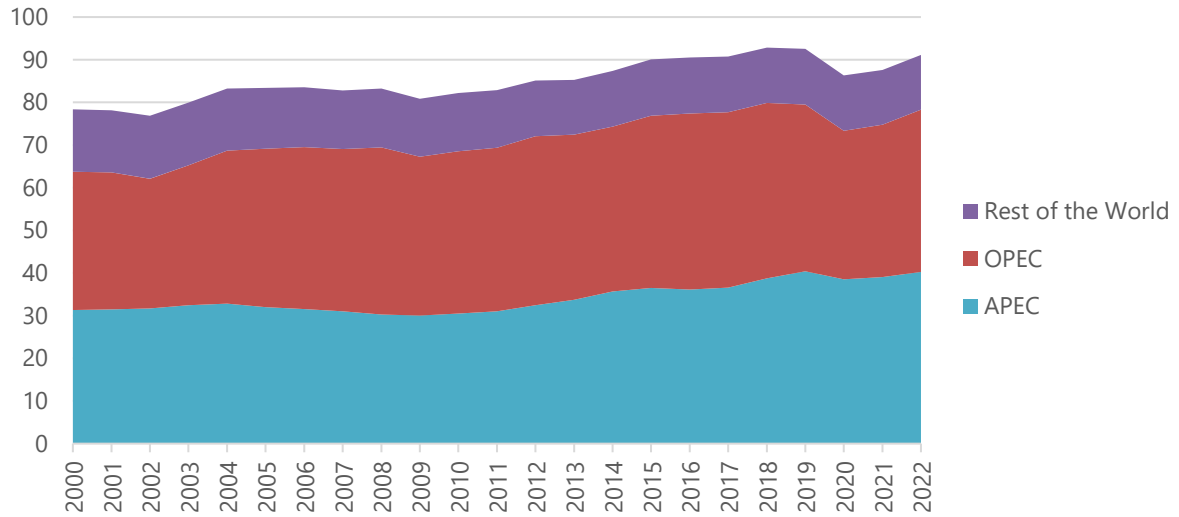
Chapter 2. Supply

2-1 Historical trend

2-1.1 Significant historical growth in APEC's oil production

Global oil production rose from 77.8 mb/d in 2000 to 91.2 mb/d in 2022, with non-APEC (OPEC and rest of the world) accounting for more than half of the world output in 2022. Of this, OPEC members contributed 42% of the world output, led by Saudi Arabia and Iraq which produced above 12 mb/d and 4.5 mb/d respectively. However, production from the rest of the world has been on a declining trend since 2000 (Figure 2-1).

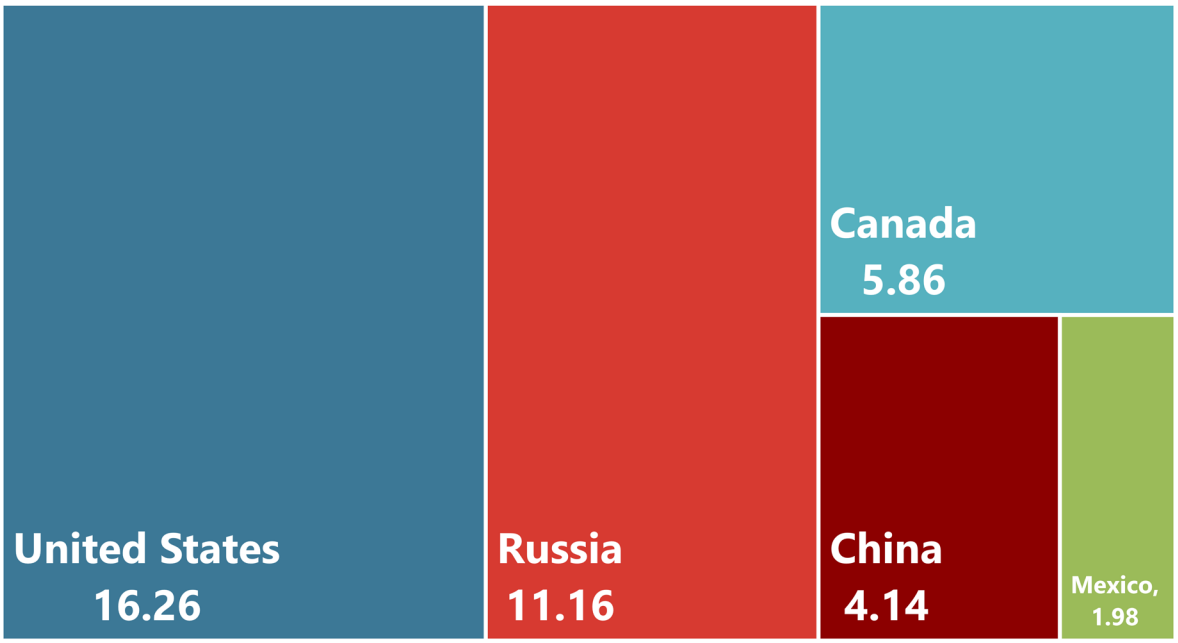
Figure 2-1: Global oil production, 2000 - 2022 (mb/d)



Source: EGEDA, EI (2023)
Note: Includes NGLs

On the other hand, the APEC region contributed 44% of the global production in 2022, with main producers being United States, Russia, Canada, China, and Mexico (Figure 2-2). Between 2000 and 2022, APEC's production grew by almost 10 mb/d, contributed largely by United States and Russia with increases of 7 mb/d and 2.5 mb/d, respectively. Other Americas and China's production increased only marginally, while Southeast Asia and Oceania recorded declines in the same period.

Figure 2-2: Main oil producers in APEC, 2022 (mb/d)



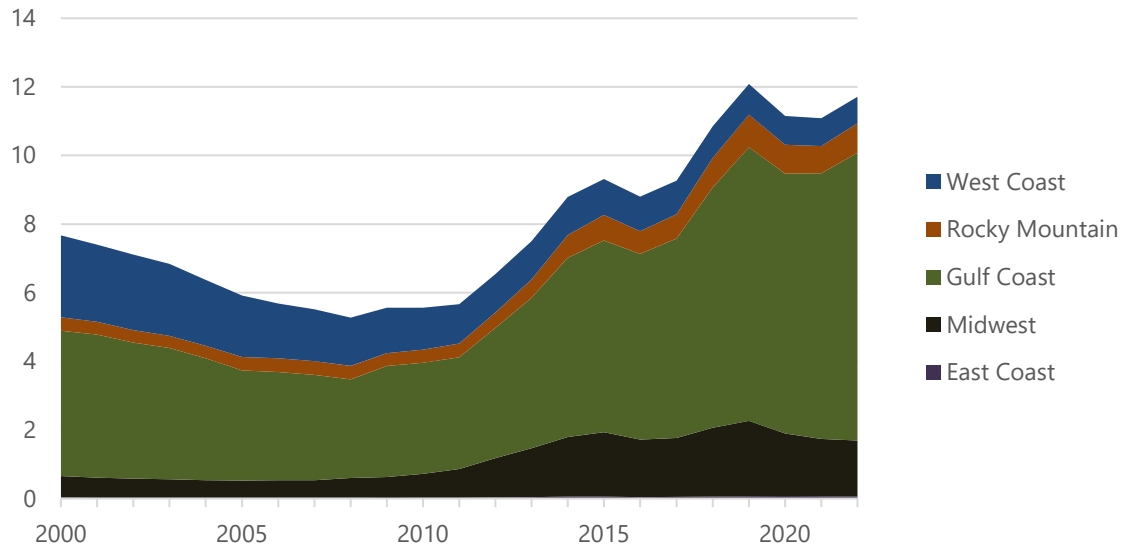
Source: EI (2023)
Note: Includes NGLs

2-1.2 The Shale Oil Revolution drives output growth in the United States

The remarkable growth in APEC's production between 2000 and 2022 was largely attributed to the oil industry in the United States. The shale oil revolution enabled U.S. companies to produce from tight oil formations – which account for more than 30% of the overall United States production – through the integration of hydraulic fracturing and horizontal drilling methods. The new technologies have also helped the United States surpass Russia and Saudi Arabia to become the world's largest oil producer each year since 2018.

Significant portion of the United States output has been coming from the Gulf Coast, which contributed more than 70% of the total production in 2022. The two largest producers within the Gulf Coast comprise Texas – home to the Permian Basin – and New Mexico, which produced approximately 4.9 mb/d and 1.6 mb/d in 2022, respectively. Elsewhere, North Dakota in the Midwest, which has been producing oil and gas since 1951, yielded about 1 mb/d in the same year (Figure 2-3). The state has risen to become one of the United States' main producers, owing to the adoption of horizontal drilling and hydraulic fracturing in the Bakken-Three Forks formation.

Figure 2-3: Crude oil production in the United States by district, 2000 - 2022 (mb/d)

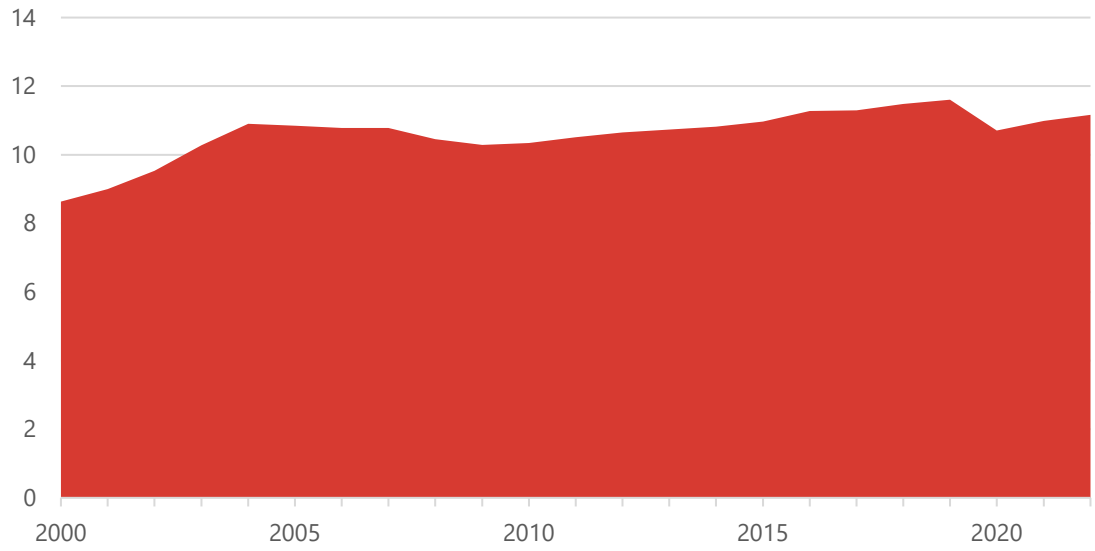


Source: EGEDA, EIA (2023)

2-1.3 Russia production remained steady

Russia was the world's largest oil producer in 2010 when it produced more than 10 mb/d, surpassing both Saudi Arabia and the United States. Since then, its yearly growth has been modest, given that major private companies in Russia have worked to enhance output from existing fields. Between 2010 and 2022, Russia's output has remained above 10 mb/d, with the 2022's production recorded at 10.8 mb/d (Figure 2-4).

Figure 2-4: Oil production in Russia, 2000 - 2022 (mb/d)

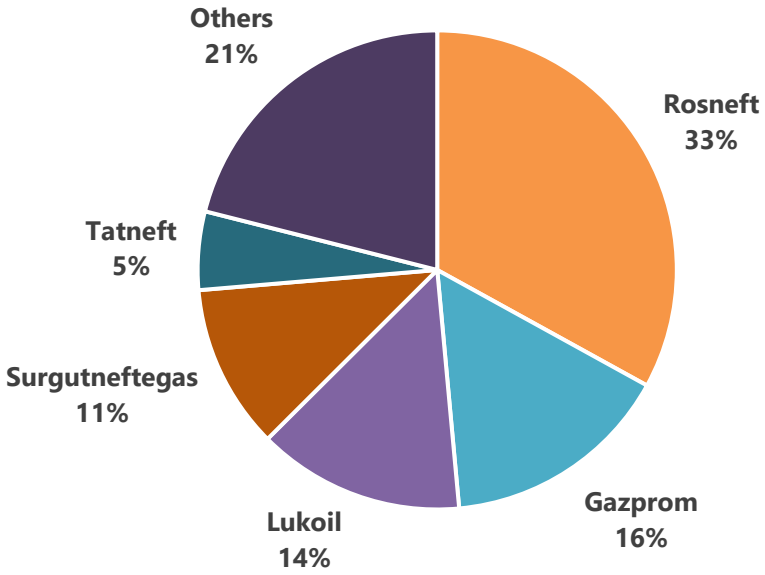


Source: EGEDA, EI (2023)

Russia is home to seven major oil-bearing basins, of which Western Siberia basin is the largest.

More than 70% of Russia's total output originates from those basins. As of 2021, Rosneft was the largest oil producer, accounting for 33% of the total Russian output (Figure 2-5).

Figure 2-5: Oil production share in Russia by company, 2021

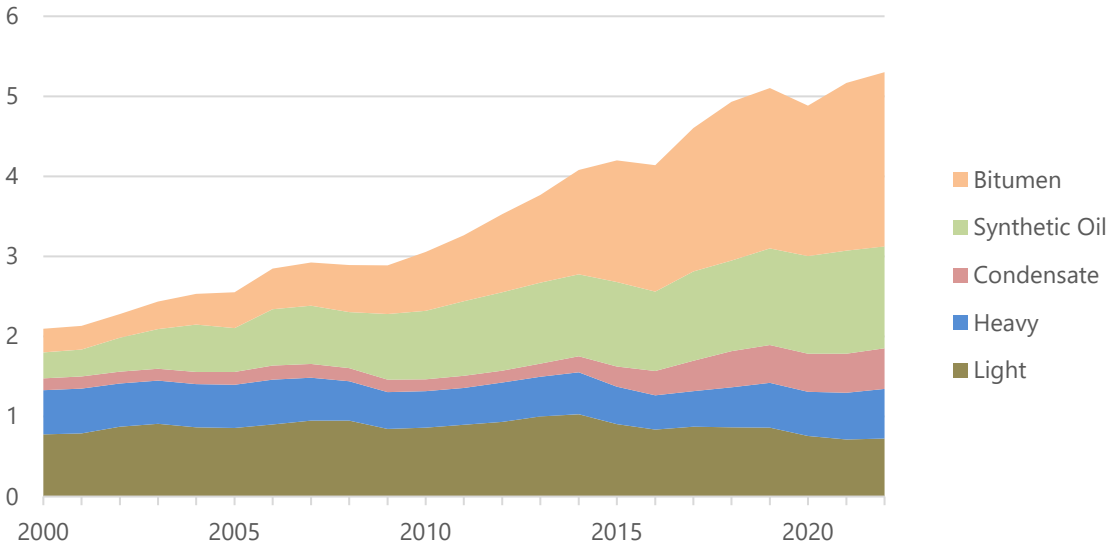


Source: EIA (2023)

2-1.4 Considerable growth in Canada oil sands production

Canada's total crude oil output more than doubled between 2000 and 2022, due largely to the more than tripling of production from oil sands and condensates (Figure 2-6). In 2022, the oil sands contributed to about 65% of Canada's overall output, with two-fifths of the oil sands upgraded to synthetic oil. Alberta is home to over 80% of Canada's oil production, thanks to significant volumes of bitumen in three major oil sands area: Athabasca, Cold Lake, and Peace River.

Figure 2-6: Crude oil production in Canada by type, 2000 - 2022 (mb/d)

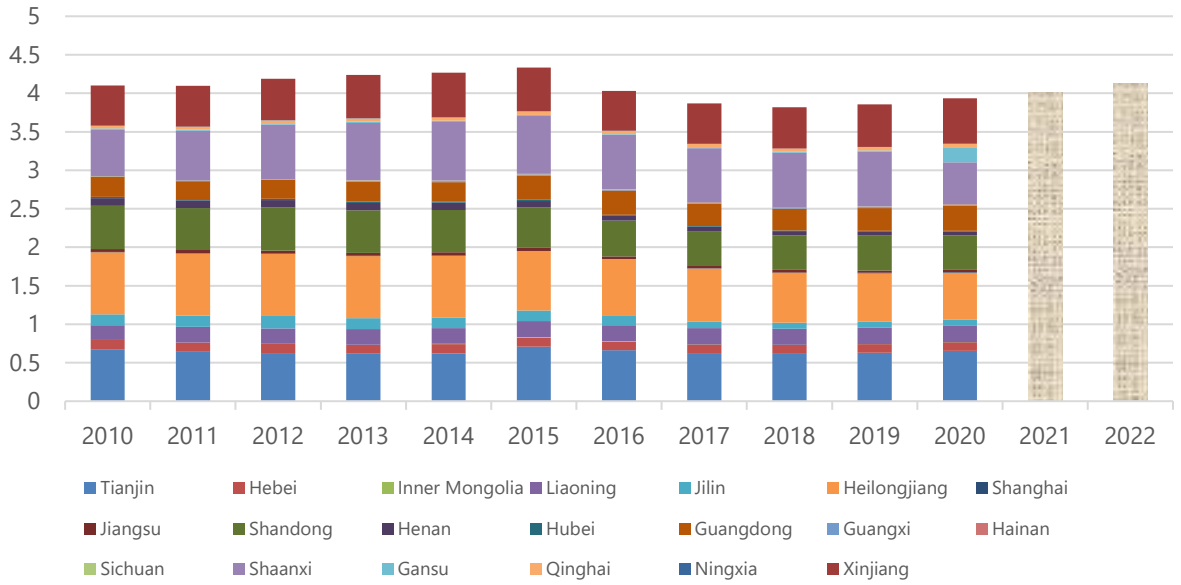


Source: EGEDA, CER (2023)

2-1.5 Gradual rebound in China domestic crude production

China's domestic crude oil output reached its peak in 2015, when the economy produced over 4.3 mb/d, after which it declined steadily until 2018 to 3.8 mb/d (Figure 2-7). One of the main reasons was the aging of China's major fields, including the Daqing field in Heilongjiang province, which has long been the economy's most important source of crude. Its output fell by over 124 000 b/d between 2015 and 2016 – the largest fall among all fields. In addition, China was turning its attention abroad, with investments in oil-producing economies such as Angola and South Sudan, further limiting its domestic focus. State-owned operators also reduced their spending on exploration and drilling, in light of the 2014 – 2016 global oil price crash.

Figure 2-7: Crude oil production in China by province, 2010 – 2022 (mb/d)



Source: EGEDA, National Bureau of Statistics (2023)
Note: 2021 and 2022 provincial data are not yet available.

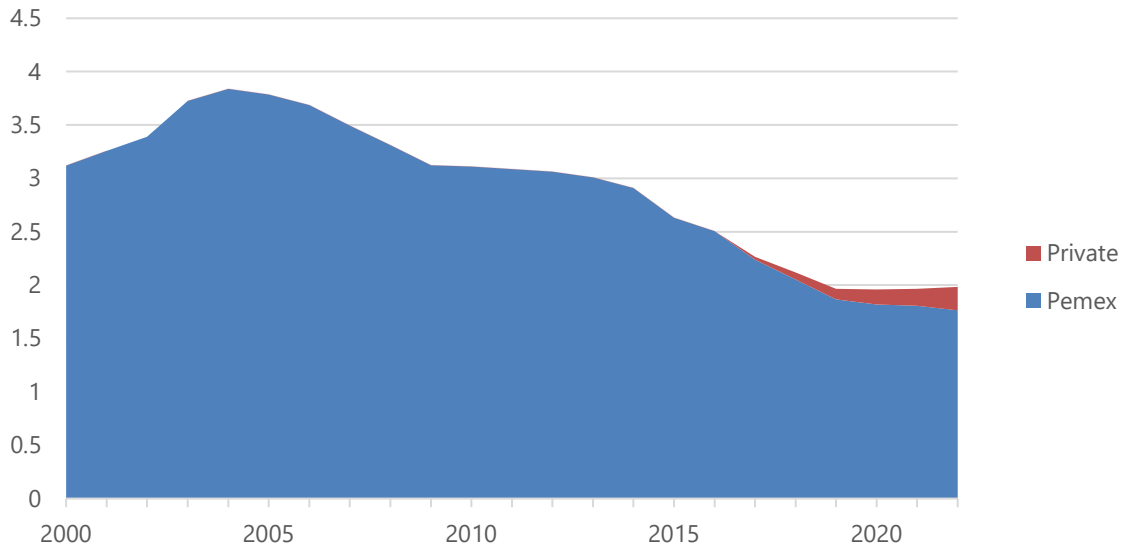
The economy has been able to reverse its production decline, given significant efforts made by China National Petroleum Corp. (CNPC), China Petroleum & Chemical Corp. (Sinopec) and CNOOC Ltd. From 2018 to 2022, production grew by 8% or 314 000 b/d by 2022. Much of this increase came from the Gansu province, where the CNPC was able to extract over 196 000 b/d in 2022 from the Changqing oilfield. In addition, the Bohai offshore oilfield has overtaken Daqing field as China's largest yielding oilfield in 2021, hitting over 602 000 b/d.

Alongside the momentum above, China is also exploring unorthodox methods to increase its production, mainly through converting its rich coal resources into oil (coal-to-liquid process) and tapping into shale deposits. The economy now houses the world's largest single indirect coal-to-liquid demonstration project located in Ningxia, which can convert over 20 million tonnes of coal into 4 million tonnes of oil products per annum (approximately 80 000 b/d).

2-1.6 Private companies influential in stabilising Mexico's production

Mexico's oil production has been dominated by government owned Petróleos Mexicanos (Pemex), which has been a major source of revenue for the economy. Despite its dominance, production has been declining for nearly 20 years (Figure 2-8), primarily due to decreased output from shallow-water fields in the Sureste basin located in southern Mexico. To address the decline, Mexico amended its constitution in 2013 for the first time since 1938 to allow participation of foreign and private companies in its oil and gas industry. As of 2022, these private companies account for more than 10% of Mexico's total production.

Figure 2-8: Oil production in Mexico by operator, 2000 - 2022 (mb/d)



Source: EGEDA, CNH (2023)

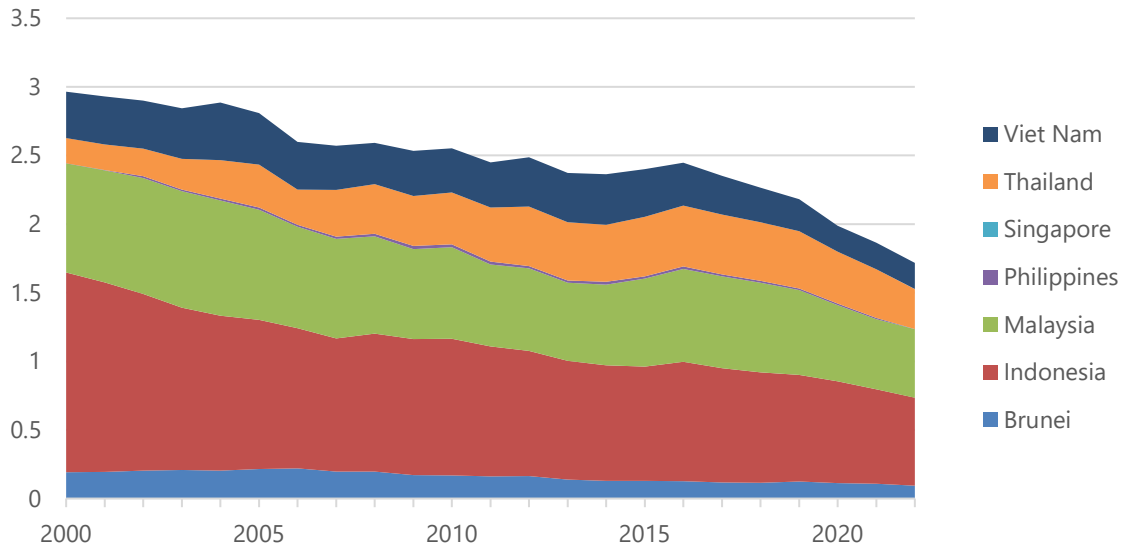
The three largest private producers, Eni, Petrofac and Hokchi Energy, collectively accounted for almost 0.05 mb/d in 2022 sourced from privately-operated El Golpe, Santuario, Hokchi, Amoca and Mizton oilfields. In addition, Pemex also has begun producing crude from the Quesqui field in other sections of the Sureste basin, which has helped compensate for the decline in the output from the shallow-water fields in the basin.

2-1.7 Lack of discoveries and maturing fields driving down production in Southeast Asia

Southeast Asia has been experiencing production declines over the past twenty years, with regional production falling by almost 1.3 mb/d between 2000 and 2022 (Figure 2-9). Every economy in Southeast Asia has suffered production declines, with Indonesia having the largest volumetric decline of 0.81 mb/d, followed by Malaysia (0.29 mb/d), Viet Nam (0.15 mb/d), Thailand (0.11 mb/d) and Brunei (0.10 mb/d).

These declines are generally due to maturing oilfields and lack of new discoveries. Indonesia, the largest producer in the region, has only been able to exploit 22 out of its 60 basins. Most of these unexplored basins are in the less-developed regions in Sulawesi, Kalimantan, and Papua. Given limited existing infrastructure, exploiting these basins and bringing oil to the surface would entail high cost. Consequently, Indonesia's current reserves to production ratio is approximately 10 years.

Figure 2-9: Oil production in Southeast Asia, 2000 - 2022 (mb/d)



Source: EGEDA, EI (2023)

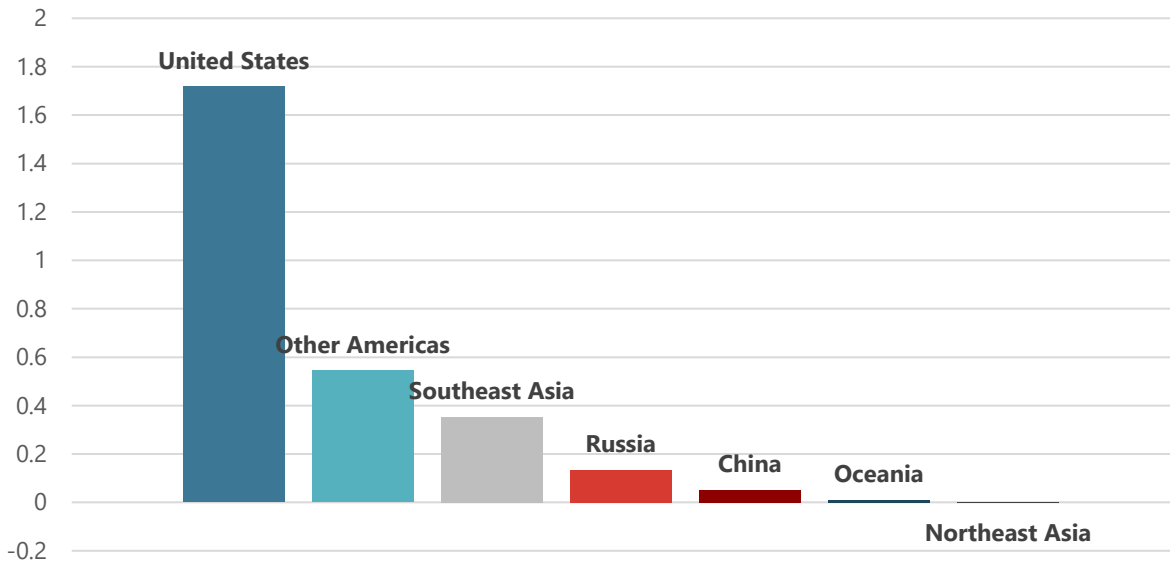
2-2 Outlook trend

2-2.1 Developments in APEC

APEC's crude oil production is expected to grow modestly through 2030 with an increase of 2.8 mb/d from 2021 levels. The United States' shale (tight)[1] oil development will be the main driver of medium-term supply increases in the region. Other Americas will contribute most other barrels, driven by oil sands production and increased private companies' investments in Canada and Mexico, respectively. Optimisation of existing fields in the Southeast Asia will also see some growths in barrels, while Russia's production is also set to grow albeit at a slower pace (Figure 2-10).

[1] The US Energy Information Administration uses shale or tight oil interchangeably.

Figure 2-10: Growth in APEC crude oil production, 2021 – 2030 (mb/d)



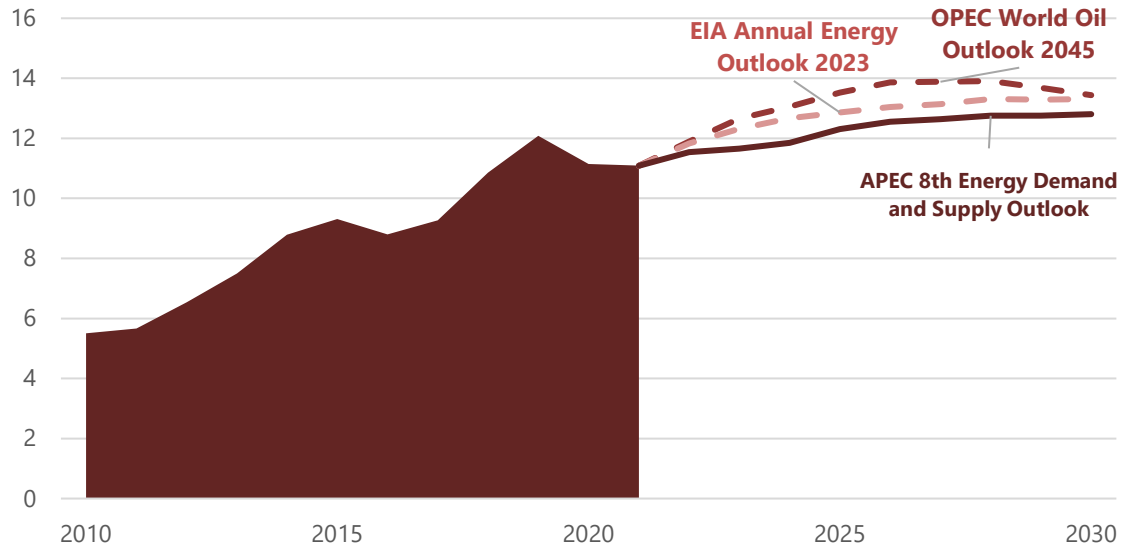
Source: APERC (2022)

2-2.1.1 Shale oil remains influential in the future of the United States' oil industry

The United States remains the largest source of crude oil production increase within APEC and non-OPEC platforms. Depending on various forecasts as shown below (Figure 2-11), the production in 2030 is expected to reach over 13 mb/d, driven significantly by shale oil. While EIA and APERC projections follow the same pattern of production stabilisation through 2030s, OPEC estimates production to peak before 2030s and then decline gradually in the absence of new projects.

A lion's share of tight oil output is projected to come from the Permian Basin, supplemented by production from the Eagle Ford and Bakken. The recent USD 60 billion acquisition of Pioneer Natural Resources by ExxonMobil could help the industry realise the higher production target.

Figure 2-11: Crude oil production outlook in the United States, 2010 - 2030 (mb/d)

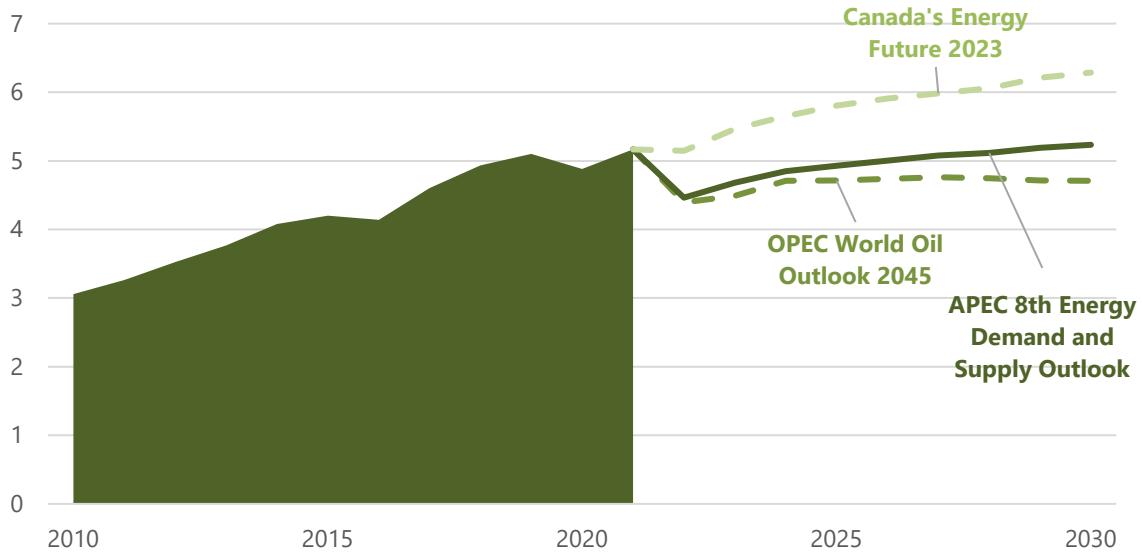


Source: EGEDA (2023), APERC (2022), EIA (2023), OPEC (2023)

2-2.1.2 Canada underpins Other Americas growth

Canada's production is expected to hold steady between 2021 and 2030 on the back of significant increase in oil sands production. Overall production is expected to reach between 4.7 and 6.3 mb/d in 2030, with oil sands output having the dominant share compared to conventional crude and tight oil (Figure 2-12). Most of the oil sands contribution is expected from capacity expansions and debottlenecking of pipelines at existing plants, which would likely circumvent the significant opposition by environmental groups that Canadian industry faces in developing new greenfield projects and expanding oil sands resources.

Figure 2-12: Crude oil and oil sands production outlook in Canada, 2010 - 2030 (mb/d)



Source: EGEDA (2023), APERC (2022), CER (2023), OPEC (2023)

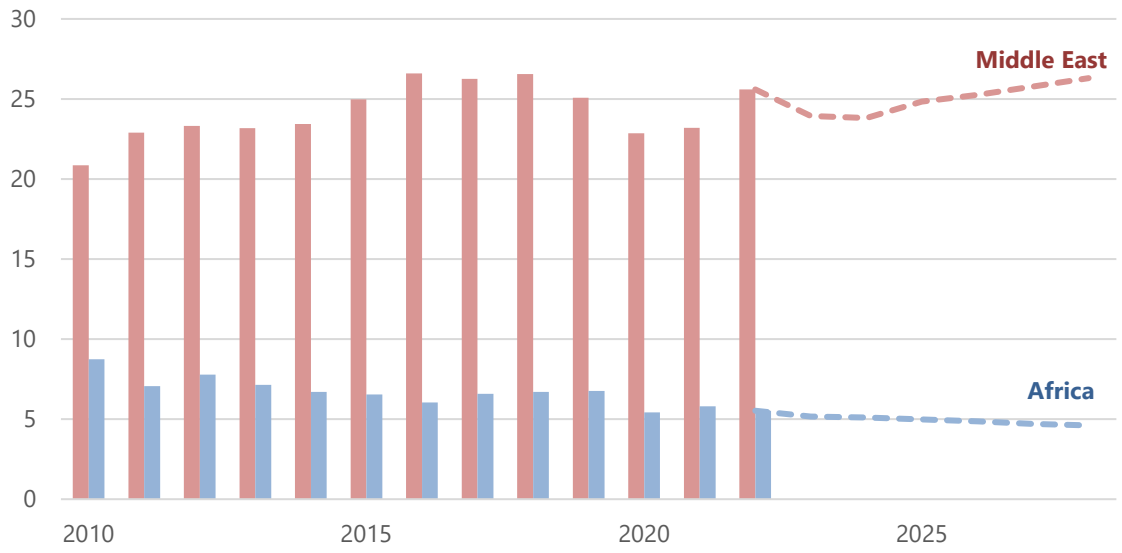
2-2.2 Developments outside APEC

2-2.2.1 Production growth concentrated in the Middle East

Within the OPEC bloc, Middle East's production is expected to grow by over 0.70 mb/d in 2028 from 2021 levels, with Saudi Arabia, Iraq and the United Arab Emirates contributing most of the incremental production. Saudi Arabia, the world's second largest producer, is expected to scale its output to over 11 mb/d in 2028 by utilising its spare capacity, coupled with Saudi Aramco's aspiration to expand its production capacity to 13 mb/d by 2027. Boosted by its low-cost resource base and safe operating environment, the United Arab Emirates is also striving to increase to 3.6 mb/d by 2028 after reaching its record-breaking level of 3.3 mb/d in 2022 (Figure 2-13).

The production contribution from the Middle East is expected to compensate for the significant decline in African barrels between 2022 and 2028. Operational and technical issues in Angola as well as regulatory and underinvestment problems in Nigeria will cause Africa to produce 0.92 mb/d less in 2028 than in 2021, despite modest gains in Libya.

Figure 2-13: Africa and Middle East's crude oil production, 2010 - 2028 (mb/d)

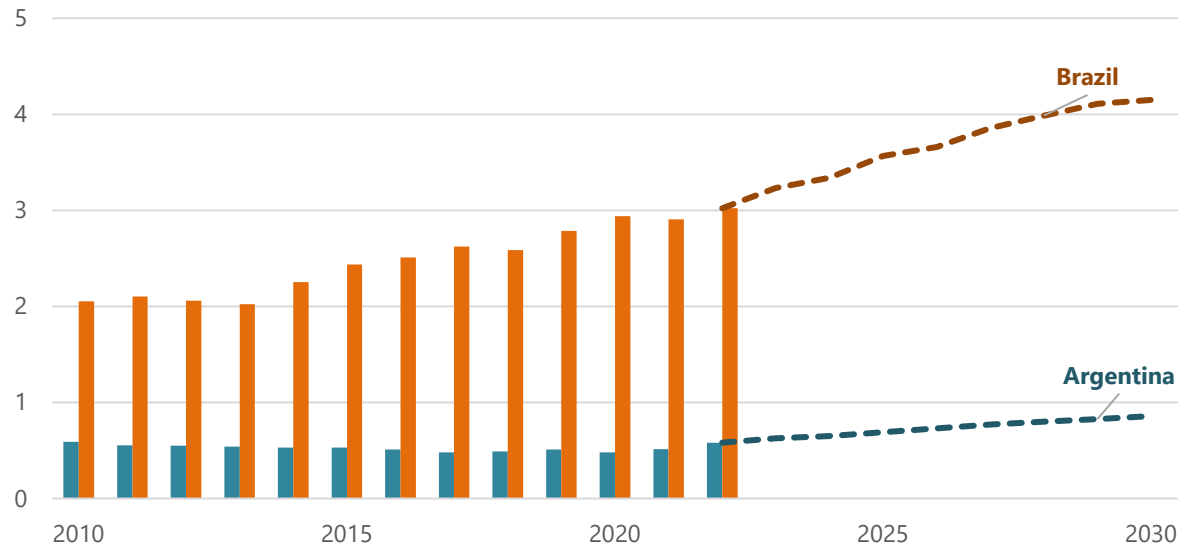


Source: EI (2023), IEA (2023)

2-2.2.2 Elsewhere, Argentina and Brazil ramp up production

Total crude production from Argentina and Brazil is expected to reach over 5 mb/d in 2030, with Brazil production growing by 1.1 mb/d between 2022 and 2030 (Figure 2-14). Petrobras is expected to contribute more than 70% of Brazil's growth, with several major oil companies contributing the remainder. The large offshore Santos Basin, located in the south Atlantic Ocean, is slated to be the main source of Brazil's growth. Meanwhile, Argentina's significant growth is expected to be sourced from the vast Vaca Muerta shale field in the Neuquén Basin.

Figure 2-14: Argentina and Brazil's crude oil production, 2010 – 2030 (mb/d)



Source: EI (2023), OPEC (2023)

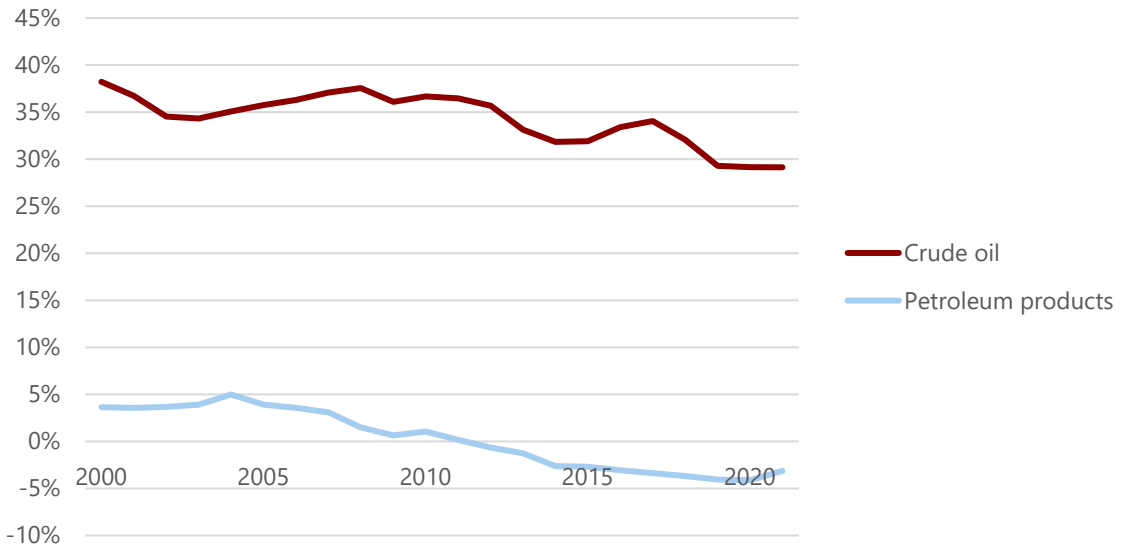
Chapter 3. Trade

3-1 APEC's crude oil and petroleum products import dependence trend declining

Over the last two decades, APEC's import dependence on crude and products has generally shown a declining trend. Crude oil dependency fell from 38% to 29% between 2000 and 2021, while petroleum products dependency decreased from 4% to -3% during the same period (Figure 3-1). There was a brief increase in crude import dependence between 2015 and 2017 due to slower domestic production activity in the United States brought about by lower oil prices during the 2014 – 2016 global oil price crash.

The surge in domestic tight oil output in the United States and rising oil sands production in Canada drove the decline in APEC's import dependence, despite seeing China's net imports increasing by more than seven-fold between 2000 and 2021.

Figure 3-1: APEC's crude oil and petroleum products import dependence, 2000 – 2021 (%)



Source: EGEDA (2023)

3-2 Russia crude shifted to Asia market

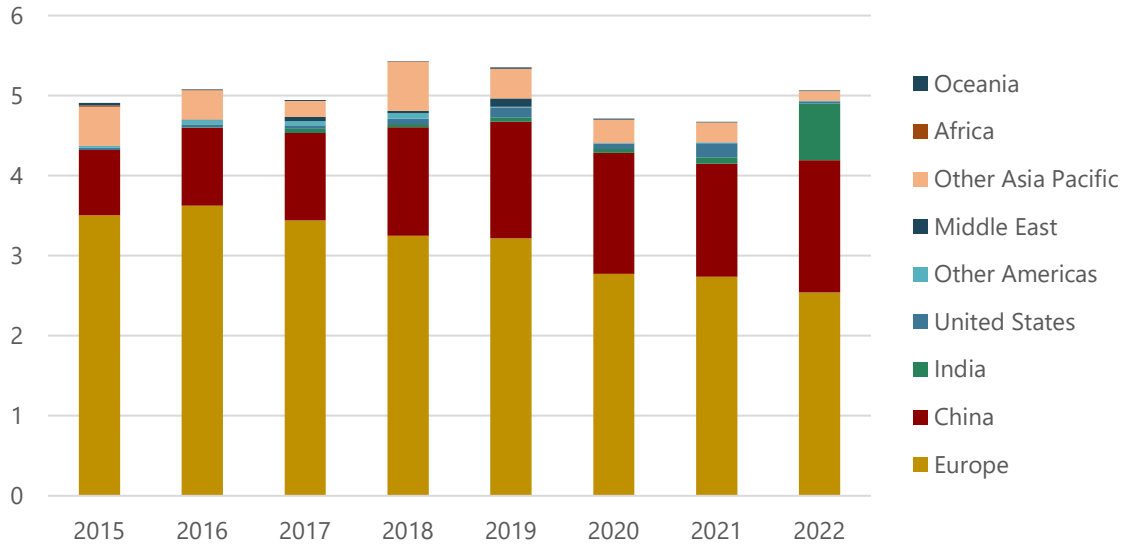
Russia's crude oil export activity remained strong between 2015 and 2022 (Figure 3-2), with Europe being the largest recipient of Russia oil. While embargoes by the G7 and the European Union on Russia oil did not take effect until the end of 2022, European share of Russian crude fell from 60% in 2015 to just 44% in 2022, as some European refiners opted for sweeter grade crudes from the United States. The surplus Russian barrels have since been absorbed by China, who is the largest consumer of such crude outside Europe, as well as India.

China doubled its import from just 0.8 mb/d to over 1.6 mb/d between 2015 and 2022, facilitated by the East Siberia-Pacific Ocean (ESPO) pipeline and the Atasu-Alashankou pipeline

in Kazakhstan. In February 2022, Rosneft signed a decade-long contract with China's CNPC which would enable China to continue receiving 0.20 mb/d of Russian crude. In addition, Rosneft also exports Russian crude via seaborne trade from its far eastern port of Kozmino.

Russian exports to India, the world's third largest oil importer, also soared from negligible barrels to over 0.7 mb/d between the same period, taking advantage of the massive 40% discount on Urals barrels relative to the Brent crude price. Prior to Russo-Ukrainian war, India was not a significant buyer of Russian crude, as its crude was mainly sourced from the Middle East and Nigeria.

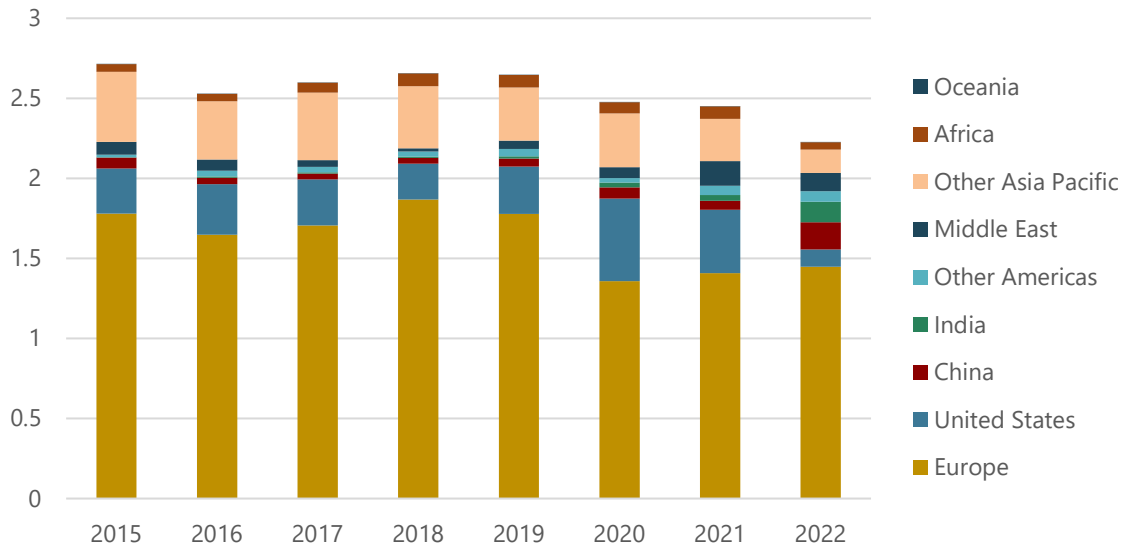
Figure 3-2: Russia's crude oil exports, 2015 – 2022 (mb/d)



Source: EI (2023), EGEDA (2023)

The export of Russian petroleum products abroad has been in the declining trend from 2.7 mb/d to 2.2 mb/d between 2015 and 2022 (Figure 3-3). Most of these products, comprising mainly diesel, flowed into Europe albeit in declining trend. China more than doubled its imports, reaching 0.71 mb/d in 2022. India also imported around 0.13 mb/d in 2022, a massive increase of more than 70 times relative to 2015 levels.

Figure 3-3: Russia's petroleum products exports, 2015 - 2022 (mb/d)

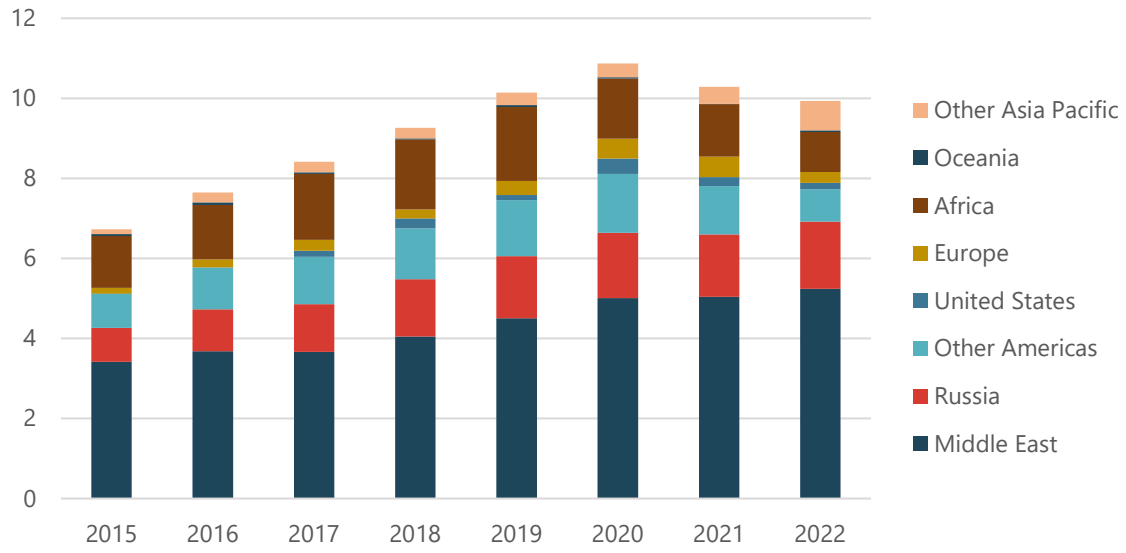


Source: EI (2023), EGEDA (2023)

3-3 China's crude oil imports dropped for the first time

Crude oil imports to China increased by 3.2 mb/d between 2015 and 2022, with Middle East's crude contributing to about half of China's total crude import (Figure 3-4). However, import volume declined for the first time in 20 years, from 10.9 mb/d in 2020 to 10.3 mb/d in 2021, and then declined further to 9.9 mb/d the year after. The reason for this drop could be attributed to the increase in domestic production over the recent years, as mentioned earlier, in addition to the strict COVID-19 control measures that dampened oil demand. China gained a further 0.36 mb/d and 0.34 mb/d of crudes from Middle East and Other Asia Pacific regions between 2021 and 2022, respectively. In contrast, inflow of crudes from Other Americas, United States, Europe, and Africa registered declines.

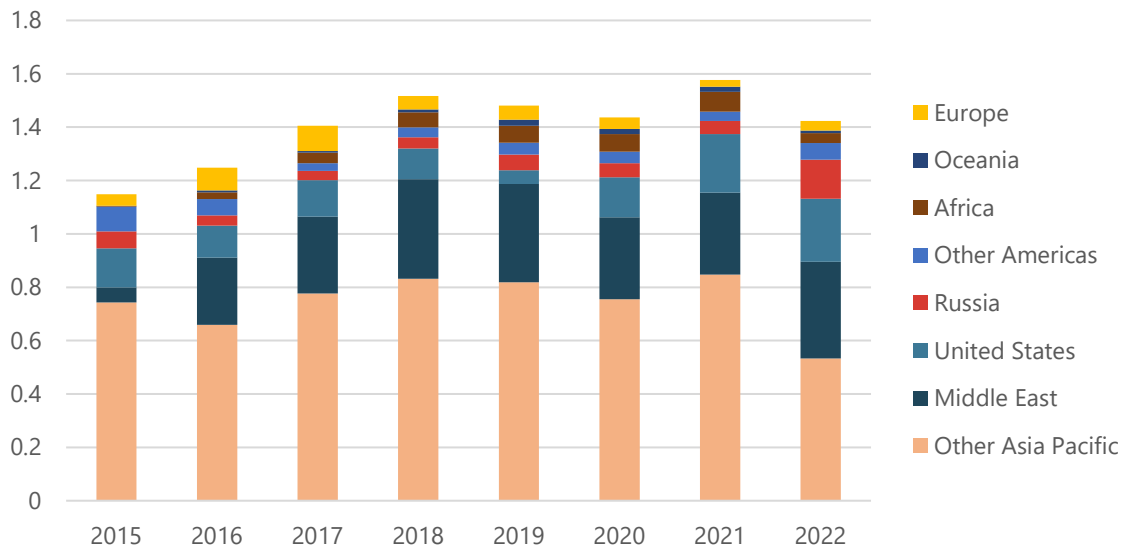
Figure 3-4: China crude oil imports, 2015 – 2022 (mb/d)



Source: EI (2023), EGEDA (2023)

Petroleum products imports rose from 1.2 mb/d in 2015 to 1.42 mb/d in 2022, with Other Asia Pacific's products being a major source of imports (Figure 3-5). However, since 2015, the share of petroleum products from Other Asia Pacific has been on a declining trend. This is due to China's increased demand for Middle East fuels, which surged more than sixfold during the same period, rising from 0.05 mb/d to 0.4 mb/d. Other notable development includes China doubling its purchase of Russian products in 2022 from 2015 levels.

Figure 3-5: China petroleum products imports, 2015 - 2022 (mb/d)

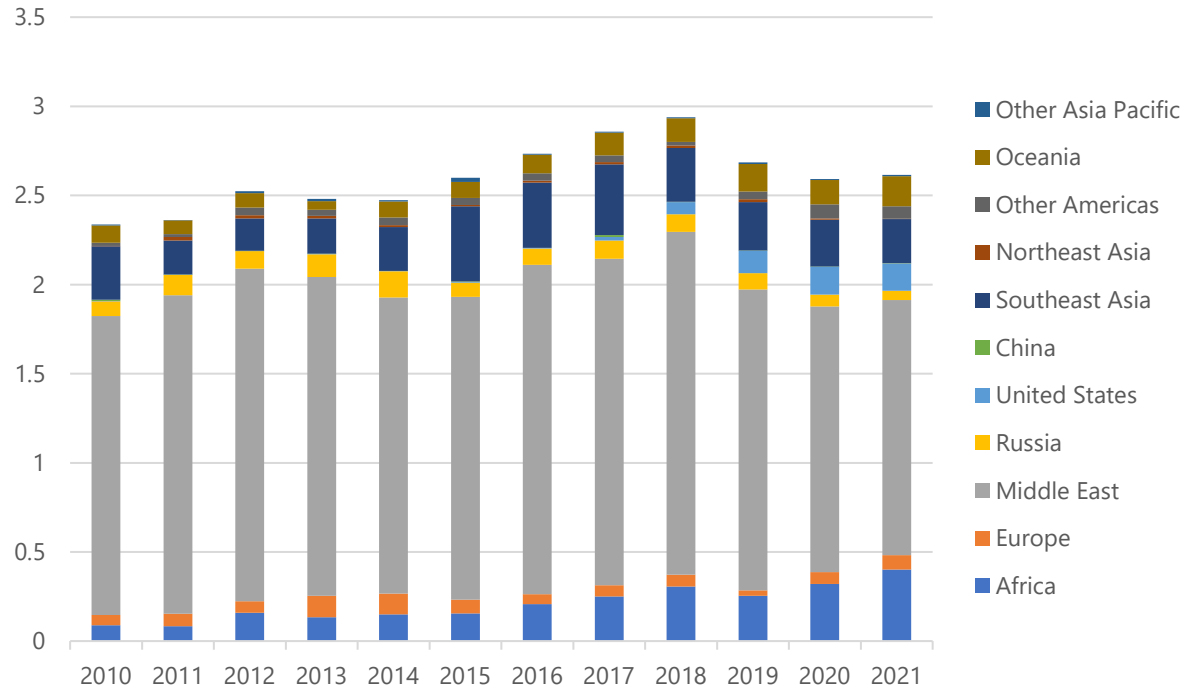


Source: EI (2023), EGEDA (2023)

3-4 Southeast Asia dependable on Middle East's crude

Crude oil from the Middle East has been the major source of Southeast Asia's imports over the last decade. Despite the dominance, influx of the sour-grade crude has been weakening as the Southeast Asia purchased more crudes from Africa and the United States. Inflow of African crude into Southeast Asia more than quadrupled between 2010 and 2021, most of which were sourced from Angola and Nigeria (Figure 3-6). The share of United States' crude imports also rose significantly from negligible to 6% between the same period, with Singapore and Thailand being the largest recipients of United States' lighter and sweeter crude.

Figure 3-6: Southeast Asia crude oil imports, 2010 – 2021 (mb/d)



Source: EGEDA (2023), UN Comtrade (2023)

Chapter 4. Price

4-1 Chronology of crude oil prices

4-1.1 2014 - 2016

The collapse of oil prices between 2014 and 2016 was one of the sharpest since the World War II, driven by significant imbalance between supply and demand, in addition to geopolitical circumstances and a shift in policies by OPEC (Figure 4-1).

The boom in shale oil production in the United States was one of the key drivers in global supply growth in the first half of 2014, leading to subsequent collapse of price in the next half by as much as 44%. The growth in the economy's crude production accounted for almost half of the global growth between 2010 and 2014, despite having an insignificant share of less than 6 percent of global output. Advancement in hydraulic fracturing (fracking) technology as well as efficiency and productivity gains, coupled with declining production costs, were key factors that had helped the United States triple its output from the Eagle Ford and Bakken basins.

Weakening economic activity resulted in a fall of oil demand. China, the world's largest oil importer, shook the global financial market by devaluing its Yuan currency, heightening fears its economy was in its worse shape than generally assumed. Similar growth fears in other oil-dependent economies such as Brazil, Venezuela and Saudi Arabia also resulted in weak growth for global oil demand, further sending prices lower.

4-1.2 2016 - 2019

The rebound in demand for oil in the aftermath of the previous shocks propped up oil prices between 2016 and 2018, with both Brent and Urals crudes reaching over USD 80 per barrel in September/October 2018, and WTI crude settling at over USD 70 per barrel in the same month. Prices however declined considerably in November, with Brent and WTI falling to USD 64.75 per barrel and USD 56.96 per barrel respectively. Trade frictions between China and the United States left Chinese refiners worrying about the import tariff imposed by the United States, causing China to temporarily suspend crude imports, resulting in oversupply of crude in the market.

Following OPEC's decision to cut its output by 1.2 mb/d from January 2019 onwards, coupled with sanctions on Iran and Venezuela, prices moved back into an upward trend, with Brent and WTI settling at USD 71.23 and USD 63.86 per barrel respectively in April of that year. The continued China-United States trade frictions resulted in the price falling to USD 59.04 and USD 54.81 per barrel for Brent and WTI crudes, respectively, in August. However, prices turned bullish towards the end of 2019, with Brent and WTI crudes reaching USD 59.88 and USD 67.31 per barrel, respectively.

4-1.3 2020 - 2021

The COVID-19 pandemic prompted governments worldwide to impose lockdowns and travels restrictions which significantly impeded economic activities caused a drastic reduction in global oil demand. With the Brent and WTI crude prices already hovering over USD 50 per barrel mark in February 2020, Russia and Saudi Arabia were engaged in a price war as OPEC and non-OPEC failed to reach a consensus on production cuts, causing the price to crash by more than half in the following month. Brent crude fell to USD 32.01 per barrel while WTI settled at only USD 29.21 per barrel. The ongoing pandemic further weakened the oil demand, pushing crude prices to below USD 20 per barrel in both crude benchmarks, with the WTI crude even briefly touching negative USD 37 per barrel – the first negative price in the history of oil prices – the day before the May contract expired. Prices began to recover at the end of 2020 following mass vaccination campaigns, easing of lockdowns and gradual resumption of aviation travels. By December 2020, Brent and WTI crudes settled at USD 49.99 and USD 47.02 per barrel respectively.

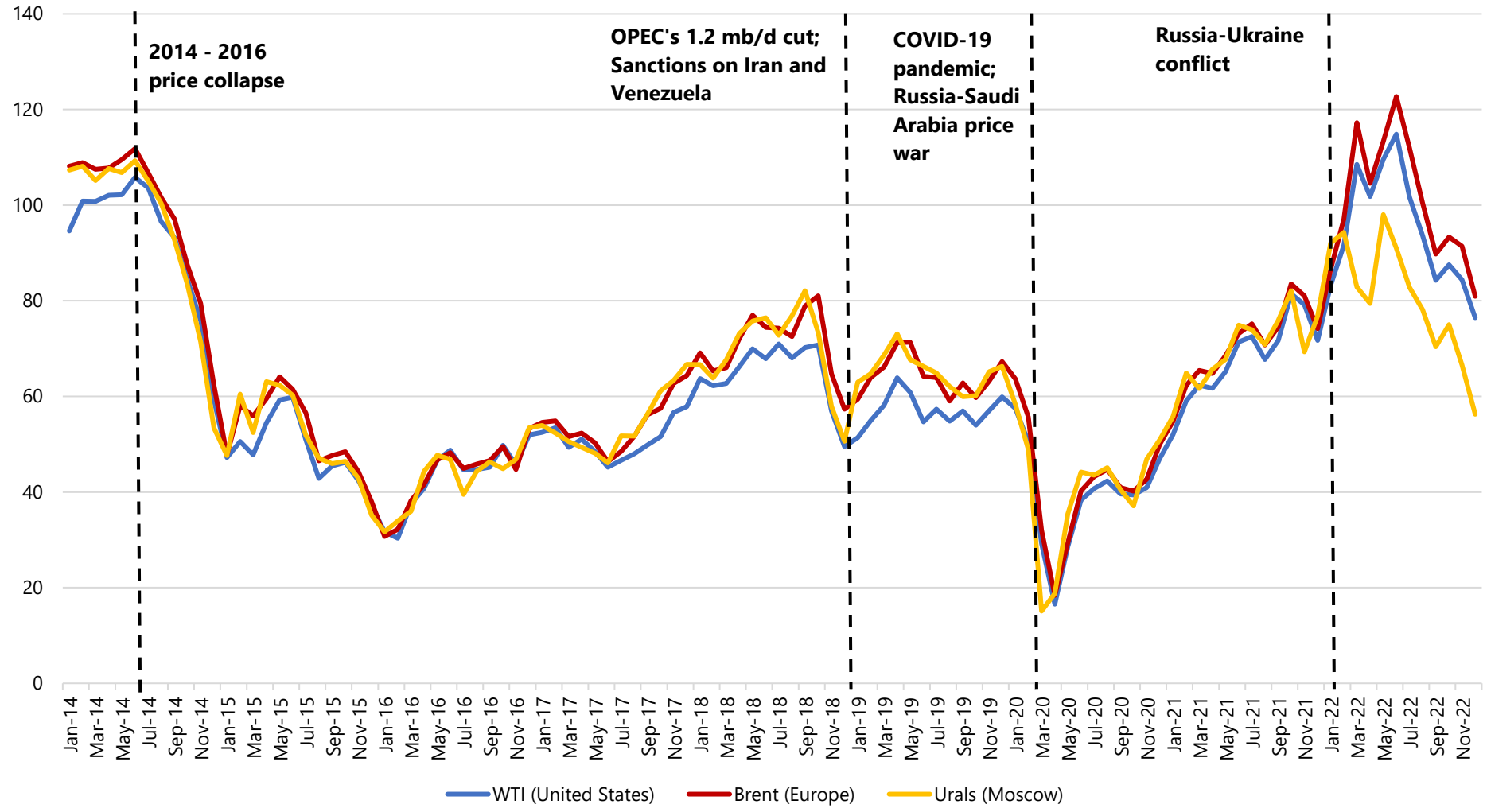
Throughout 2021, improvement in prices continued with advancement of vaccination campaigns and economic recovery, which saw global demand outpacing crude supply. At the end of 2021, Brent and WTI crudes settled at USD 74.17 and USD 71.71 per barrel.

4-1.4 2022: Oil hit highest in 7 years driven by Russia-Ukraine conflict

The Russia-Ukraine conflict in February 2022 drove the crude price to its highest level since 2014, with Brent and WTI crudes hitting over USD 117 and USD 108 per barrel the month after, respectively. Prior to the conflict, prices of both benchmarks were already at over USD 90 per barrel mark, driven by declines in United States' crude inventories, as well as production cuts in North Dakota due to bitterly cold temperatures during Winter Storm Elliot.

The first six months of 2022 saw a general increase in the price amid tight supplies from sanctions on Russian supplies, which stimulated withdrawals from storage to meet the demand from rising economic activity following the easing of pandemic-related restrictions. Brent and WTI crudes rose to USD 122.71 and USD 114.84 per barrel respectively in June. From June onwards, prices were generally on the bearish side due to concerns about the declining economic activities globally, especially in China, reaching below USD 80 per barrel mark in September. Prices edged up slightly due to OPEC+ reducing their output by 2 mb/d. (Figure 4-1).

Figure 4-1: Crude oil prices, 2014 - 2022 (USD per barrel)



Source: EIA (2023), Investing (2023

4-2 Petroleum products crack spreads for the US Gulf Coast and Singapore's markets

Petroleum product crack spread is the difference between a specific product price and crude oil price. It is an indicator of the market condition of each specific petroleum product, in particular, the supply and demand conditions. This section explores gasoline and diesel crack spreads in two key petroleum product wholesale markets of APEC, namely US Gulf Coast and the Singapore markets.

In early 2019, the US Gulf Coast experienced a significant downturn in gasoline crack spreads, reaching their lowest point and briefly turning negative. This decline had been ongoing since mid-2018, contrasting with the relatively stable diesel crack spreads during the same period. High oil prices and high gasoline inventories were contributing factors to the decline in the gasoline crack spread. Following the low crack spreads and the shutdowns of the refineries, the US Gulf Coast crack spreads started to pick up and surpassed their 4-year averages at around middle of 2021 before experiencing a sharp spike when geopolitical conflicts emerged.

The Russia-Ukraine conflict played a pivotal role in escalating global petroleum product crack spreads. Sanctions on Russian oil product exports disrupted the oil market, intensifying constraints on global distillation capacity and causing a surge in petroleum product prices. Furthermore, unprecedented increases in natural gas prices led many consumers to seek alternatives such as diesel, contributing to the increase in already elevated prices. This, in turn, resulted in a notable rise in product crack spreads across the US Gulf Coast and other markets.

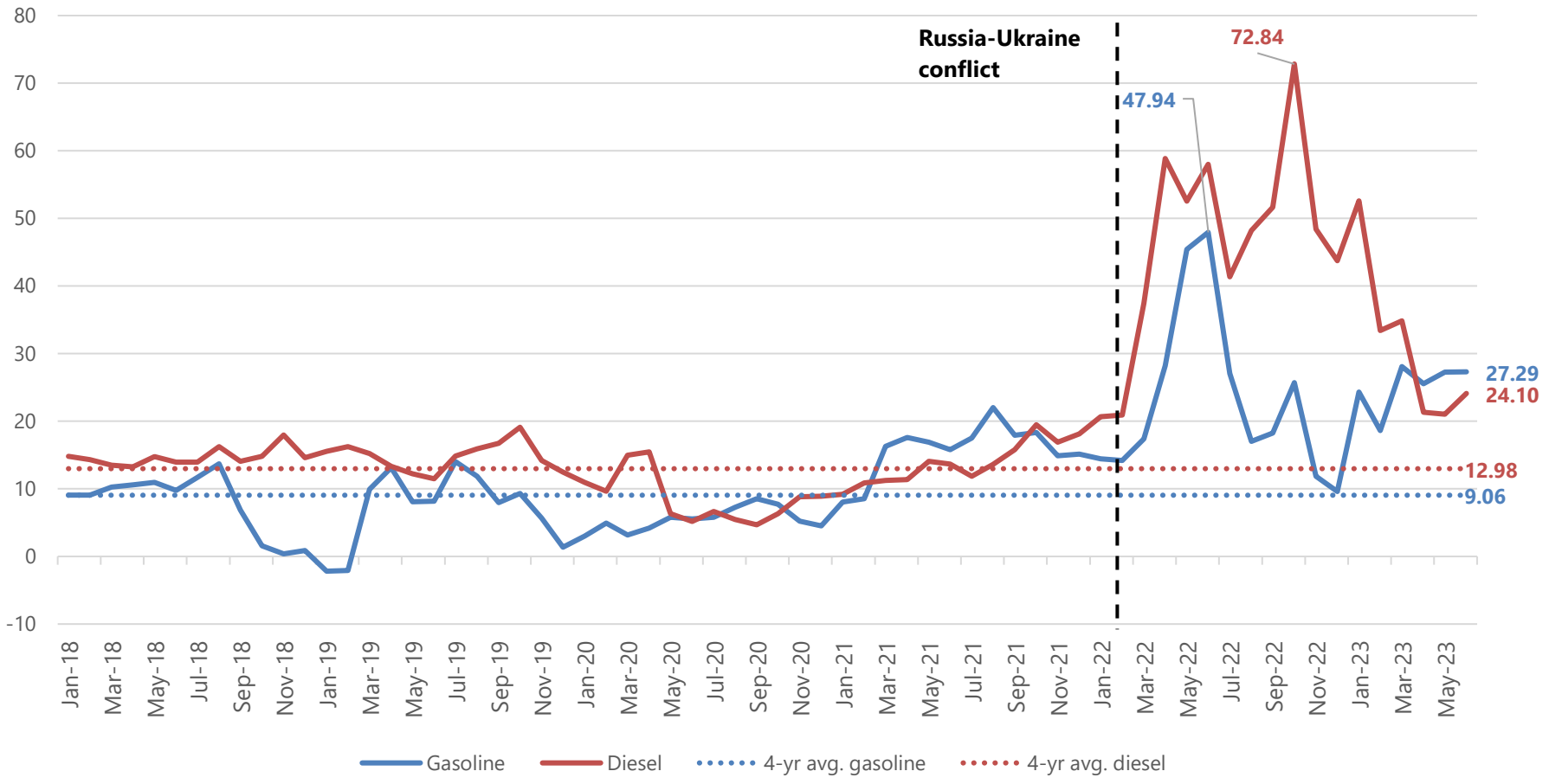
At its peak, the US Gulf Coast crack spread for gasoline soared to over 5 times its 4-year average of USD 9.06 per barrel (2018 – 2021), while diesel reached nearly 6 times its average, USD 12.98 per barrel. Although diesel crack spreads in 2023 decreased from their 2022 highs, they remained above historical averages. The substantial surge in US Gulf Coast diesel crack spread was driven in part by export demand of diesel from the United States to Europe as its market tightened amid the Russia-Ukraine conflicts. This surge was further influenced by recent reductions in refinery capacity and already-high utilisation in the United States' refinery sector. In the latter part of 2022, the gasoline crack spread decreased in response to declined demand following the end of the driving season in the United States. Despite reaching lower levels after the peak of conflicts, crack spreads for both gasoline and diesel remained notably higher than their 4-year averages. As of June 2023, the US Gulf Coast crack spread was about triple its average for gasoline, and double for diesel.

Singapore's crack spreads partly reflected trends of those in the US Gulf Coast, as well as market conditions in Asia, particularly the Chinese market. Over a 4-year period from 2018-2022, Singapore's average crack spreads were notably lower than those of the US Gulf Coast, standing at USD 8.71 per barrel for gasoline and USD 10.74 per barrel for diesel.

In 2019, Singapore's gasoline crack spread dipped below its average from the release of gasoline exports by China, while diesel remained relatively stable, slightly higher than its average. Subsequently, there was a shift in dynamics as the gasoline crack spread in Singapore increased, while diesel experienced a decrease, maintaining a level around USD 5.00 per barrel. The Russia-Ukraine conflict exerted upward pressure on both crack spreads, albeit with a

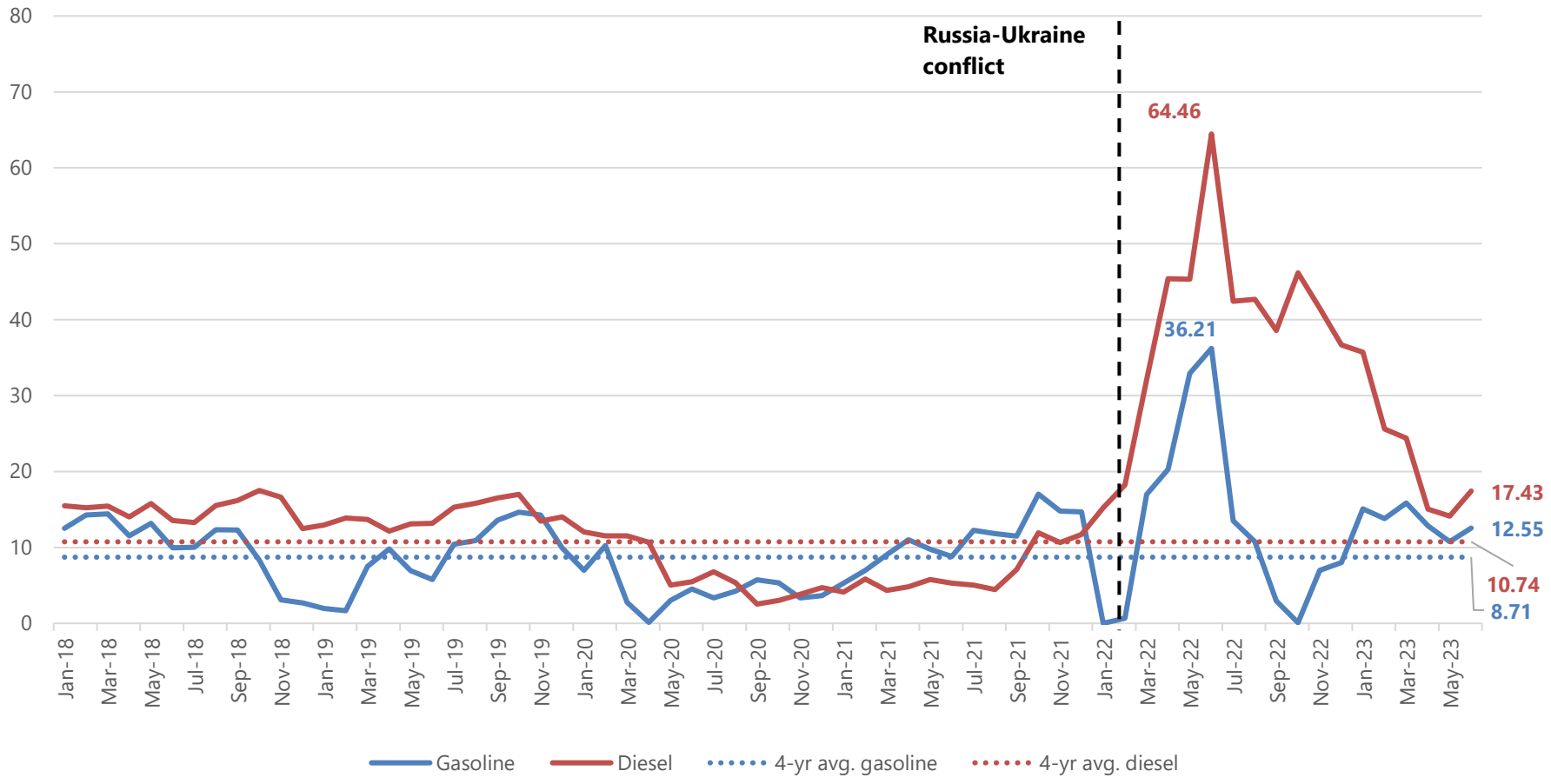
milder impact compared to the US Gulf Coast market. Gasoline reached its peak at USD 36.21 per barrel, and diesel at USD 64.46 per barrel. Nevertheless, an excess of petroleum products by the end of 2022 resulted in a decrease in spreads, especially approaching zero USD per barrel for gasoline, attributed to additional exports from China to the Asian market. As of June 2023, the gasoline and diesel crack spreads in Singapore were slightly elevated, standing at 44% and 62% higher than their respective averages.

Figure 4-2: Monthly crack spread in the US Gulf Coast market, January 2018 - June 2023 (USD per barrel)



Source: EIA (2023)
Note: The crack spread is calculated based on the differences in spot prices between US Gulf Coast gasoline or diesel and Europe Brent crude oil.

Figure 4-3: Monthly crack spread in the Singapore market, January 2018 - June 2023 (USD per barrel)



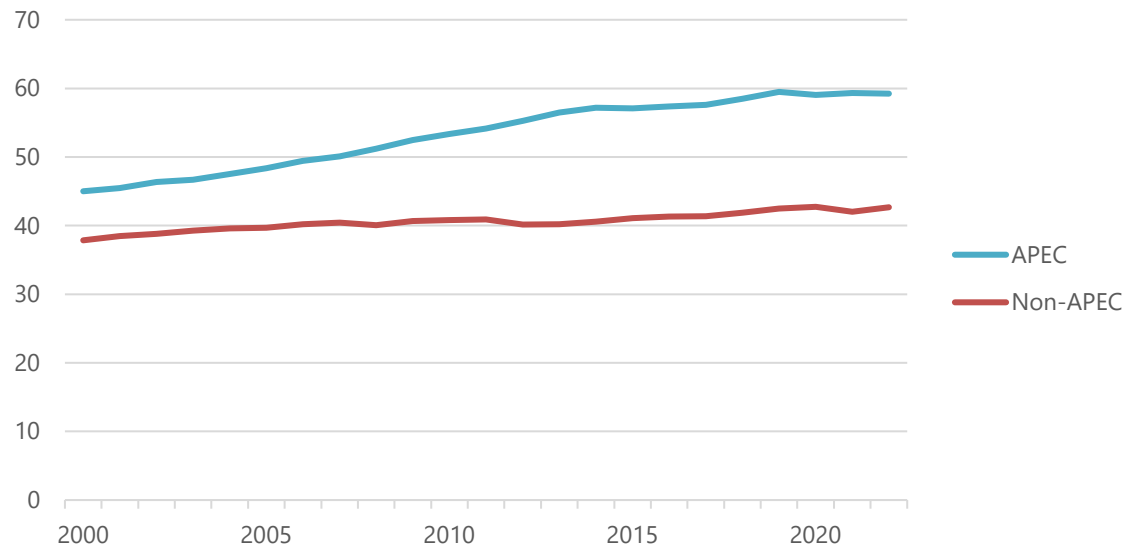
Source: IEA (2023)
Note: The crack spread is calculated based on the differences in spot prices between Singapore gasoline or diesel and Dubai crude oil.

Chapter 5. Refining

5-1 Global refining capacity continues to rise, operating at an 80% utilisation rate

In 2022, the global petroleum refining capacity reached 101.9 mb/d, with APEC contributing approximately 55%, marking a 5 percentage points increase from the 2000 level (Figure 5-1). The United States led in refining capacity at 18 mb/d, followed by China at 17 mb/d and Russia at almost 9 mb/d. The considerable increase in net additional refining capacity within APEC was predominantly attributed to China, while India took the lead for non-APEC members. Notably, Viet Nam experienced an exceptional surge in refining capacity expansion, surpassing 45 times its 2000 level to reach 0.4 mb/d in 2022. The first refinery, Dung Quat Refinery, was completed in 2009. Subsequently, the Viet Nam government's effort to promote foreign direct investment resulted in the establishment of the Nghi Son refinery in 2018, which is the economy's second oil refinery with a capacity of 0.2 mb/d. Sponsored by PetroVietnam, Kuwait Petroleum Europe, Idemitsu Kosan, and Mitsui Chemical, this joint venture reflects the economy's effort in response to increasing energy demand while providing a strategic measure to diminish reliance on imported petroleum products.

Figure 5-1: APEC and non-APEC petroleum refining capacity, 2000 – 2022 (mb/d)



Despite the prevailing net upward trajectory in refining capacity, the petroleum refinery sector witnessed significant shutdowns in recent years due to the COVID-19 pandemic. The pandemic led to a substantial decline in the demand for petroleum products. These challenging market conditions, characterized by declining demand and refinery overcapacity, posed significant hurdles for less efficient refineries. Most of these challenges materialised in refinery shutdowns during the pandemic, particularly in the United States, Northeast Asia, Other Americas, and Oceania. On the other hand, the Chinese government has intensified regulatory measures since 2018, imposing restrictions on crude oil quota trading and initiating the phase-down of small-scale, independent refineries. This strategic move aims to promote the development of

integrated and complex-scale refineries and improve the efficiency of its refining sector.

Figure 5-2: APEC subregional refinery capacity, 2000, 2019 and 2022 (mb/d) and growth rate

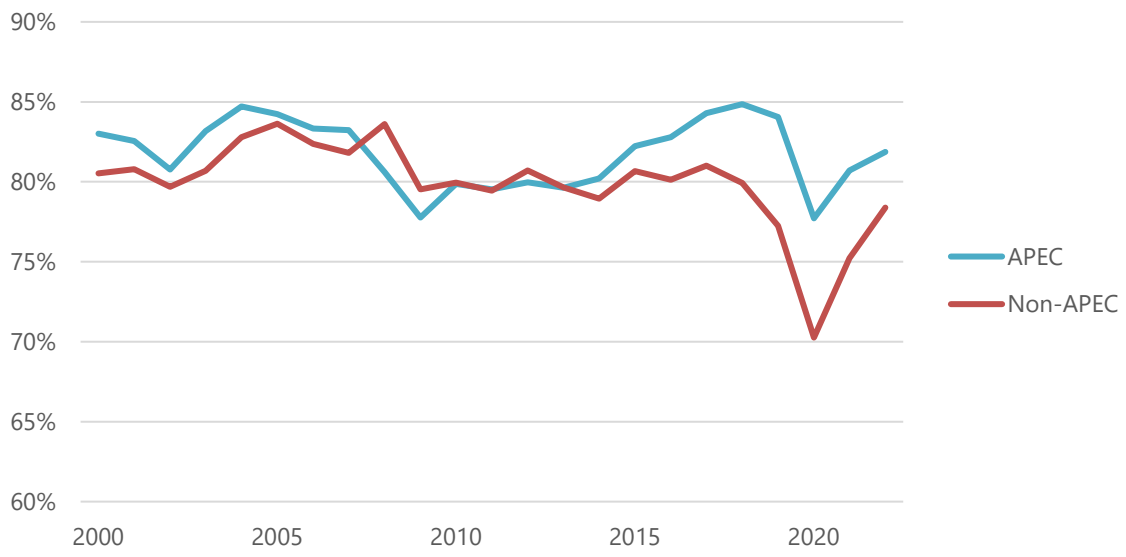
APEC subregion	2000	2019	2022	Growth rate per annum	
				Pre-pandemic (2000-2019)	Pandemic (2019-2022)
China	5.9	16.2	17.3	5.5%	2.1%
Russia	5.5	6.7	6.8	1.0%	0.7%
United States	16.6	19.0	18.1	0.7%	-1.6%
Southeast Asia	4.3	5.1	5.2	0.9%	0.2%
Northeast Asia	8.1	7.8	7.6	-0.2%	-0.9%
Other Americas	3.7	4.1	4.0	0.5%	-0.6%
Oceania	0.9	0.6	0.3	-2.3%	-19.3%

Source: EI (2023)

Global refineries processed 82 mb/d of crude oil in 2022, marking a 1 mb/d decrease from the pre-pandemic level. From 2000 to 2022, the global utilisation rate averaged approximately 80% (Figure 5-3). The disparity in refinery utilisation rates between APEC and non-APEC regions emerged in early 2010 and persists to the present. The APEC utilisation rate exceeded that of non-APEC by 3.5% in 2022.

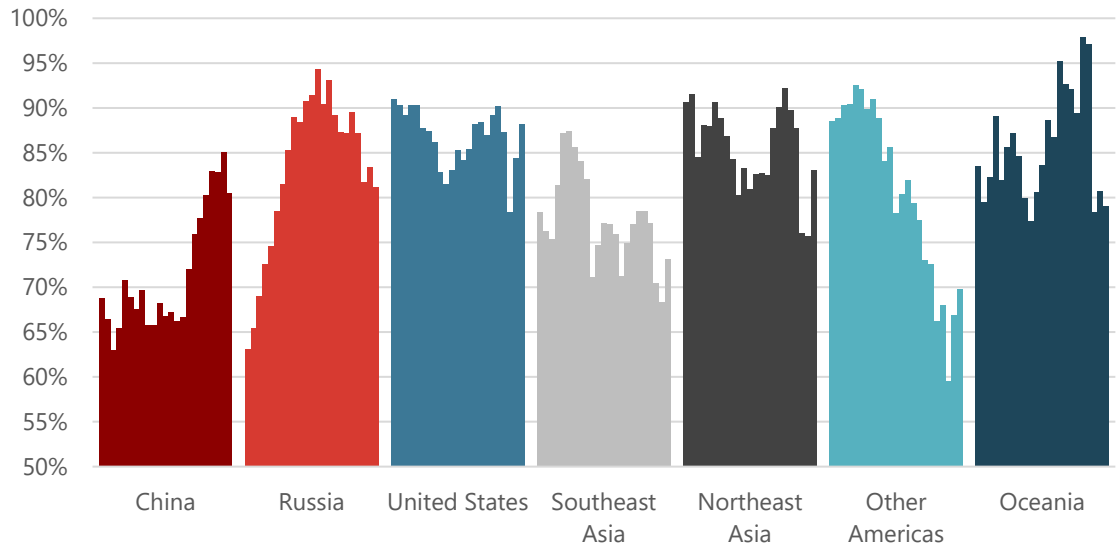
Refinery utilisation rates varied between APEC subregions, with improving refinery utilisation rates in China, Russia, and Oceania, and declining rates in Southeast Asia, Northeast Asia, and Other Americas (Figure 5-4). China's utilisation rates showed a significant rising trend from 65% to 85% since its consumption growth exceeded the refinery capacity added. Additionally, the refinery sector in the United States was able to sustain high utilisation rates of above 80% throughout the 23 years, with the only exception in 2020 during the pandemic.

Figure 5-3: Refinery utilisation rates in APEC and non-APEC regions (%)



Source: EI (2023)

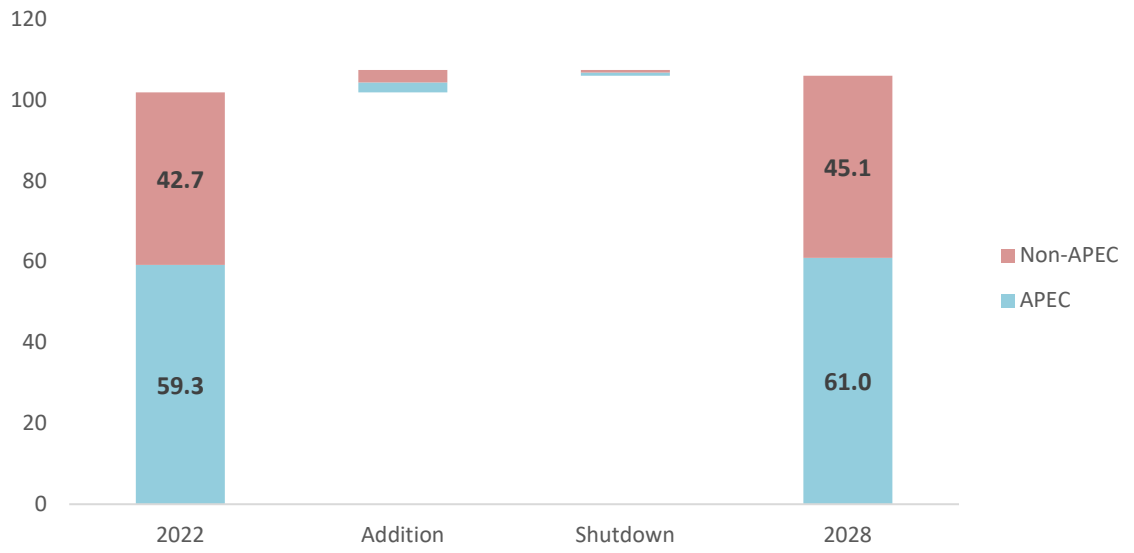
Figure 5-4: APEC's refinery utilisation rate by subregion, 2000 – 2022 (%)



Source: EI (2023)

IEA anticipates a net increase of 4.2 mb/d in refining capacity between 2022 and 2028 (Figure 5-5). Both APEC and non-APEC economies are positioned to follow a parallel trajectory, with an anticipated capacity additions of about 3 mb/d each and shutdowns of approximately 1 mb/d each. The upward trajectory of additional capacity remains pronounced in China, marked by the establishment of five large-scale refineries, each with a capacity exceeding 300 kb/d, and notable developments in India. Notable projects for additions include the significant 340 kb/d Pemex – Dos Bocas refinery in Mexico and the medium-scale Thai Oil – Sriracha expansion project in Thailand, both anticipated to be operational by 2025. On the other hands, the United States and Japan are expected to contribute predominantly to the shutdowns, primarily from small and medium-scale refineries with capacities ranging from 100 kb/d to 300 kb/d. This shift in refining capacity reflects a dynamic global energy landscape driven by evolving demands and investments in key regions.

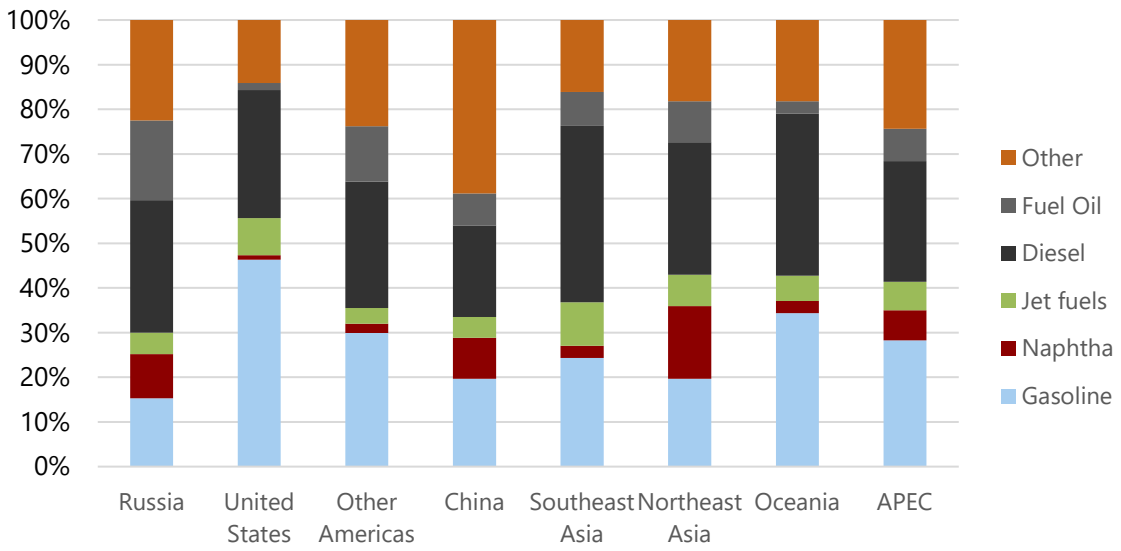
Figure 5-5: Change in global refining capacity between 2022 and 2028 (mb/d)



Source: EI (2023), IEA (2023)

APEC demonstrated a robust petroleum product production of 56 mb/d in 2021, surpassing its own consumption of 47 mb/d, positioning APEC as a net exporter. Notably, APEC exhibited a consistent ratio in the production yields of gasoline and diesel, accounting for 28% and 27%, respectively, for every unit of crude oil processed (Figure 5-6). However, an investigation of each sub-region shows different refinery petroleum product yield ratios. In 2021, the United States' refining sector exhibited highest combined yields of gasoline and diesel at 75%, followed by Oceania and Southeast Asia at 70% and 63%, respectively. Russia and China exhibited refinery combined yields of gasoline and diesel at 45% and 40%, respectively. These different yield ratios could be attributed to the differences in refinery configurations and market conditions in each sub-region. However, the structural change in petroleum consumption mixes (for instance, the increasing mix of light distillates in China, Southeast Asia, and Northeast Asia) may prompt refinery sector in these subregions to consider adjusting their petroleum product yields to meet the changing demand.

Figure 5-6: APEC's petroleum products yield, 2021 (%)



Source: EGEDA (2023)

References

Albatayneh, A. Assaf, M. N., Alterman, D. & Jarradat, M. (2020). Comparison of the Overall Energy Efficiency for Environmental and Climate Technologies, 669 – 680. https://sciendo.com/article/10.2478/rtuect-2020-0041

Argus (2022), 'Rosneft To Extend Oil Supply to China via Kazakhstan', 04 February 2022. https://www.argusmedia.com/en/news/2298745-rosneft-to-extend-oil-supply-to-china-via-kazakhstan

BloombergNEF (2020), 'Chinese Refiners Ramp Up Chemical Feedstocks Amid Covid-19', 03 September 2020. https://about.bnef.com/blog/chinese-refiners-ramp-up-chemical-feedstocks-amid-covid-19/

Bloomberg (2023), 'The Most Overlooked Oil Production Boom is in China', 10 July 2023. https://www.bloomberg.com/opinion/articles/2023-07-10/china-s-oil-production-boom-shouldn-t-be-overlooked?leadSource=uverify%20wall

ChemAnalyst (2023), 'South Korea Removes Tariffs on Naphtha Imports to Boost Petrochemical Industry', 11 August 2023. https://www.chemanalyst.com/NewsAndDeals/NewsDetails/south-korea-removes-tariffs-on-naphtha-imports-to-boost-petrochemical-industry-19115

China Oil Trader (2012), 'China's Five Largest Oil Producing Provinces and Cities', 04 October 2012. https://www.chinaoiltrader.com/?p=202

EI (2023), 'Statistical Review of World Energy 2023 – 72nd Edition', Energy Institute, June 2023. https://acrobat.adobe.com/link/review?uri=urn:aaid:scds:US:596293e3-0eaa-33b9-879a-9b88fe7c55d9

Hook et. al (2010), 'Development journey and outlook of Chinese giant oilfields', Petroleum Exploration and Development, Vol. 37, Issue 2, April 2010, pg. 237 – 249. https://uu.diva-portal.org/smash/get/diva2:326095/FULLTEXT01.pdf

IATA (2022), 'Passenger Demand Recovery Continued in 2021 but Omicron Having Impact', Press Release No: 5, 25 January 2022. https://www.iata.org/en/pressroom/2022-releases/2022-01-25-02/

IEA (2021), 'Fuel economy in China', 13 December 2021. https://www.iea.org/articles/fuel-economy-in-china

IEA (2023), 'Oil 2023 – Analysis and forecast to 2028', June 2023. https://iea.blob.core.windows.net/assets/6ff5beb7-a9f9-489f-9d71-fd221b88c66e/Oil2023.pdf

International Centre for Sustainable Carbon (2017), 'Visiting the World's Biggest Single Coal-to-Liquid Project in Yinchuan, China', 27 June 2017.
https://www.sustainable-carbon.org/blogs/visiting-the-worlds-biggest-single-coal-to-liquid-project-in-yinchuan-china/

NewsBase (2022), 'AsianOil: Bohai Overtakes Daqing as China's Largest Oilfield', 11 January 2022.
https://newsbase.com/story/asianoil-bohai-overtakes-daqing-as-china-s-largest-oilfield-231405

OilPrice (2022), 'China and India are Buying Russian Crude at a 40% Discount' 29 November 2022.
https://oilprice.com/Energy/Energy-General/China-And-India-Are-Buying-Russian-Crude-At-A-40-Discount.html

OPEC (2023), '2023 World Oil Outlook 2045, Organization of Petroleum Exporting Countries, October 2023.
https://acrobat.adobe.com/link/review?uri=urn:aaid:scds:US:1c237e57-3b96-3346-8b6e-4038594aec8e

Reuters (2020), 'China's 2019 and December crude oil runs hit record highs', Commodities News, 17 January 2020.
https://www.reuters.com/article/us-china-economy-output-oil-idUSKBN1ZG0AS

Reuters (2021), 'China's teapot refining hub seeks to stop crude quota trading', Energy, 04 August 2021.
https://www.reuters.com/article/china-oil-quotas-teapots/chinas-teapot-refining-hub-seeks-to-stop-crude-quota-trading-idUSL4N2PB15K/

Reuters (2022), 'Storm cuts U.S. oil, gas, power output, sending prices higher', 24 December 2022.
https://www.reuters.com/business/energy/storm-cuts-us-oil-gas-power-output-sending-prices-higher-2022-12-23/

S&P Global (2021), 'Singapore's 2020 maritime performance resilient despite global COVID-19 hurdles: Minister', Commodity Insights, 14 January 2021.
https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/shipping/011421-singapores-2020-maritime-performance-resilient-despite-global-covid-19-hurdles-minister
https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/shipping/011421-singapores-2020-maritime-performance-resilient-despite-global-covid-19-hurdles-minister

S&P Global (2021), 'S Korea may seek more naphtha as polypropylene, medical device needs surge', Commodity Insights, 07 May 2021.
https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/oil/050721-s-korea-may-seek-more-naphtha-as-polypropylene-medical-device-needs-surge

S&P Global (2023), 'CHINA DATA: 2022 crude throughput falls 3.4% on year to 13.6 mil b/d, Commody Insights, 17 January 2023.
https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/oil/011723-china-data-2022-crude-throughput-falls-34-on-year-to-136-mil-bd

Tax Foundation (2023), 'Diesel and Gas Taxes in Europe'. 11 July 2023.
https://taxfoundation.org/data/all/eu/gas-taxes-in-europe-2023/

The Guardian (2015), 'China stuns financial markets by devaluing yuan for second day running', 12 August 2015.
https://www.theguardian.com/business/2015/aug/12/china-yuan-slips-again-after-devaluation

US EIA (2016), 'U.S. crude oil production in 2015 was the highest since 1972, but has since declined', 07 November 2016.
https://www.eia.gov/todayinenergy/detail.php?id=28672

US EIA (2019). 'In late January, Gulf Coast gasoline crack spreads reached their lowest levels since 2014', 05 March 2019.
https://www.eia.gov/todayinenergy/detail.php?id=38552

US EIA (2020), 'China's crude oil imports surpassed 10 million barrels per day in 2019', 23 March 2020.
https://www.eia.gov/todayinenergy/detail.php?id=43216#:~:text=Although%20China's%20domestic%20crude%20oil,and%205.2%20million%20b%2Fd.

US EIA (2021), 'International Energy Outlook 2021'.
https://www.eia.gov/outlooks/ieo/pdf/IEO2021_Narrative.pdf

US EIA (2022), 'Country Analysis Executive Summary: China', 08 August 2022.
https://www.eia.gov/international/content/analysis/countries_long/China/china.pdf

US EIA (2023), 'Short-Term Energy Outlook', October 2023.
https://www.eia.gov/outlooks/steo/pdf/steo_full.pdf

World Bank Blogs (2018), 'What triggered the oil price plunge of 2014-2016 and why it failed to deliver an economic impetus in eight charts', 18 January 2018.
https://blogs.worldbank.org/developmenttalk/what-triggered-oil-price-plunge-2014-2016-and-why-it-failed-deliver-economic-impetus-eight-charts

Xinhua (2021), 'China has another 10-mln-tonne oil, gas production base', 31 December 2021.
https://english.news.cn/20211231/64fe232238914037a5ace4cb5f96114b/c.html