2-1. Oil and Gas Security Studies (OGSS)

Draft of OGSS 20: What are the energy security implications of recent declines in both APEC and global spare petroleum refining capacity?"

The 7th APEC Oil and Gas Security Network Forum (OGSN)
20 March 2024, Osaka, Japan

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Agenda of presentation

- Outline of OGSS No. 20 report.
- Key findings:
  - Historical trends.
  - Future challenges to petroleum products security.
  - What measures can APEC economies take to improve supply security?
- Timeline.

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    - Global petroleum products consumption and refinery capacity.
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3. Future challenges on petroleum products supply security:
    - Global outlook of petroleum products consumption and refinery capacity.
    - Outlook in refinery investment.
    - Changing trends of mix in petroleum product consumption.
4. Assessment of petroleum products supply security in APEC sub-regions.
5. Assessment of petroleum refinery utilization in APEC sub-regions.
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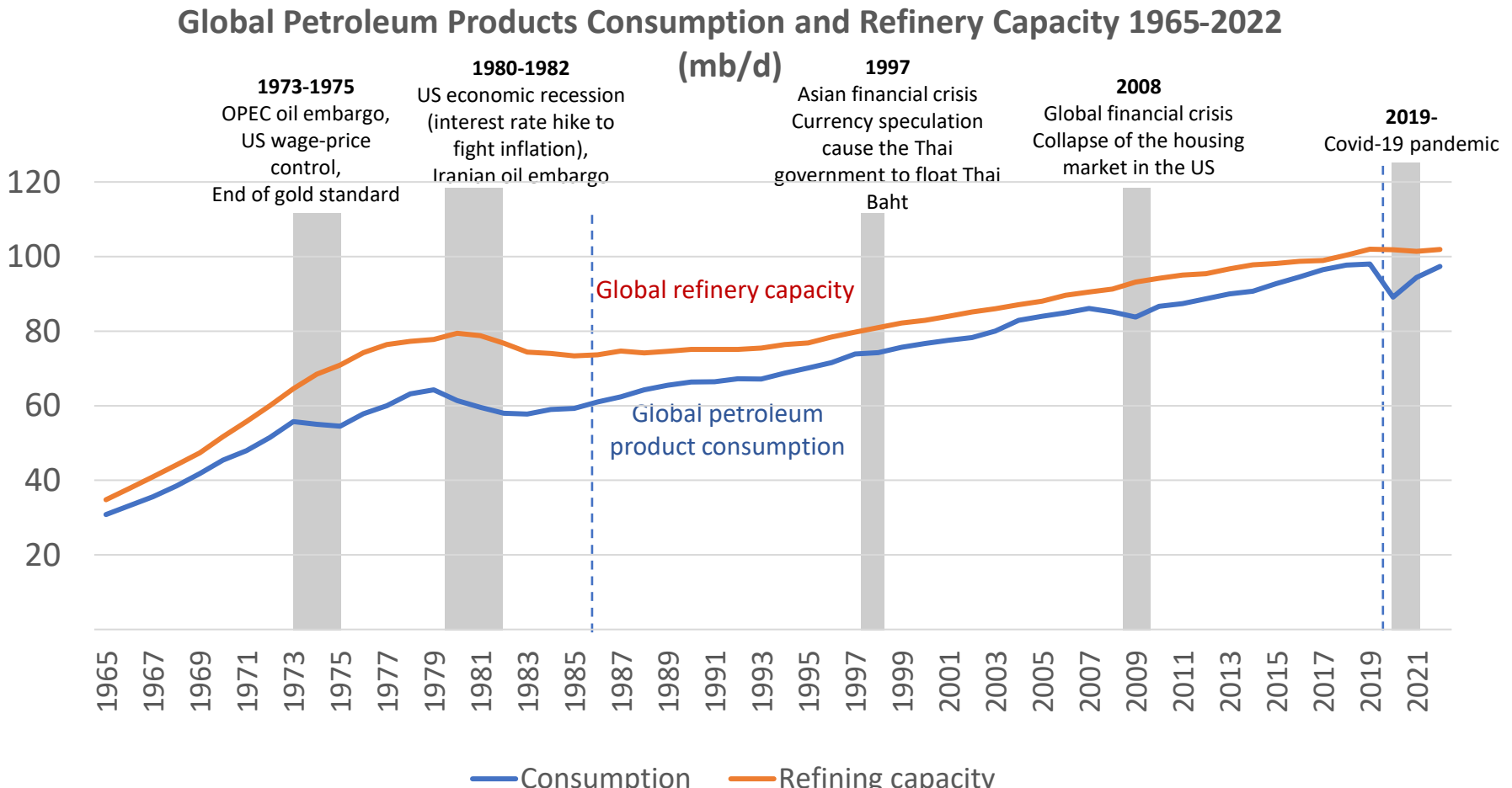
Historical trends

Global refinery capacity has not kept pace with growing petroleum products consumption.

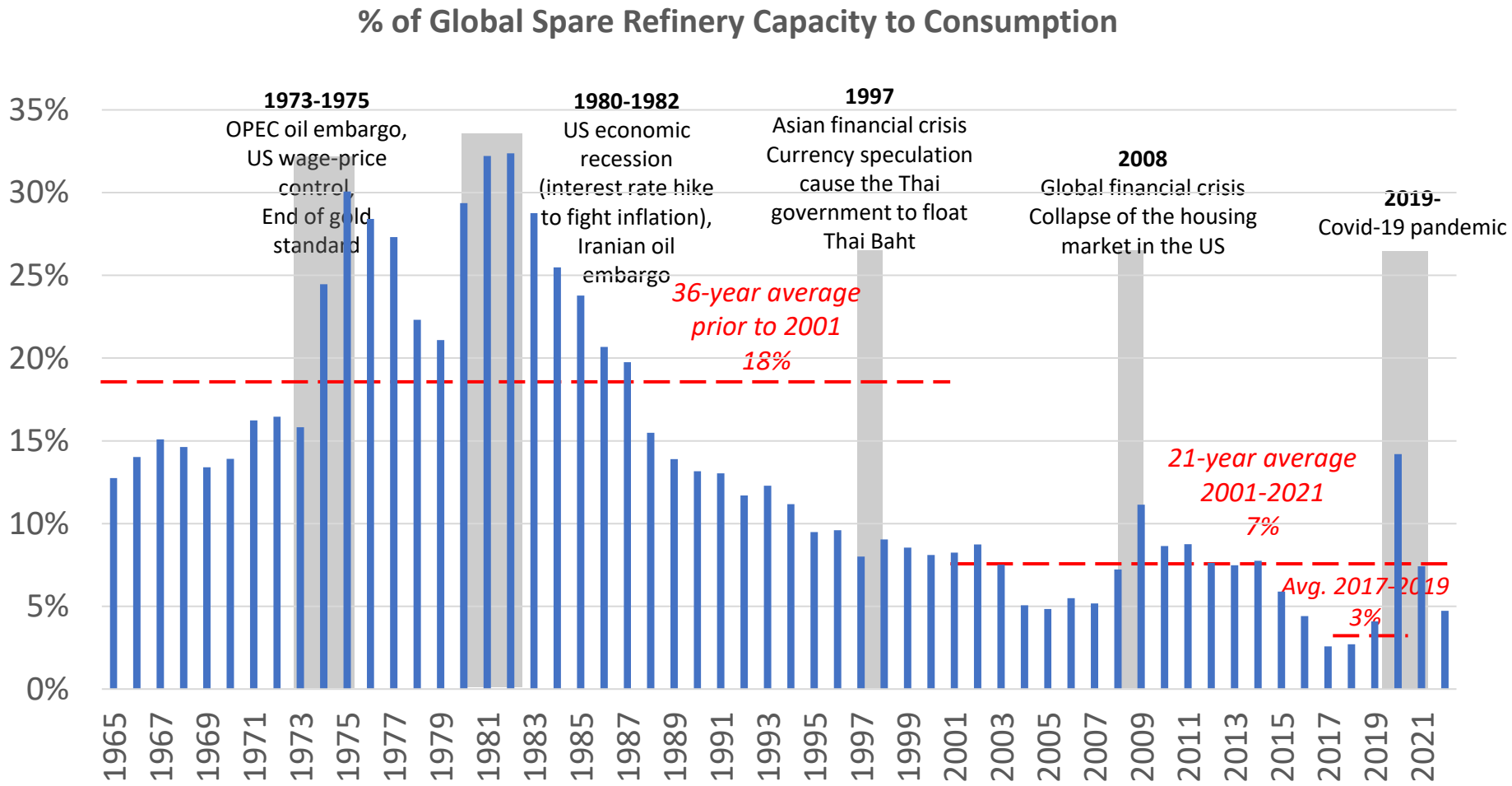
- Expansion in refinery capacity in the 60s and 70s was mainly to supply increasing petroleum product demand in Europe and the US.
- During 1985-2019, global petroleum refinery capacity did not follow petroleum products consumption, at 1.0% vs. 1.5% annual growth, respectively.



Source: BP Energy Statistics 2022 and APERC analysis

Globally, the ratio between spare refinery capacity to product consumption shows a declining trends, posing challenges of supply security of petroleum products.

- Average ratio of spare refinery capacity[1] over consumption reduced from 18% prior to year 2000 to 7% post-2000, and further to average 3% during 2017-2019 prior to the pandemic.

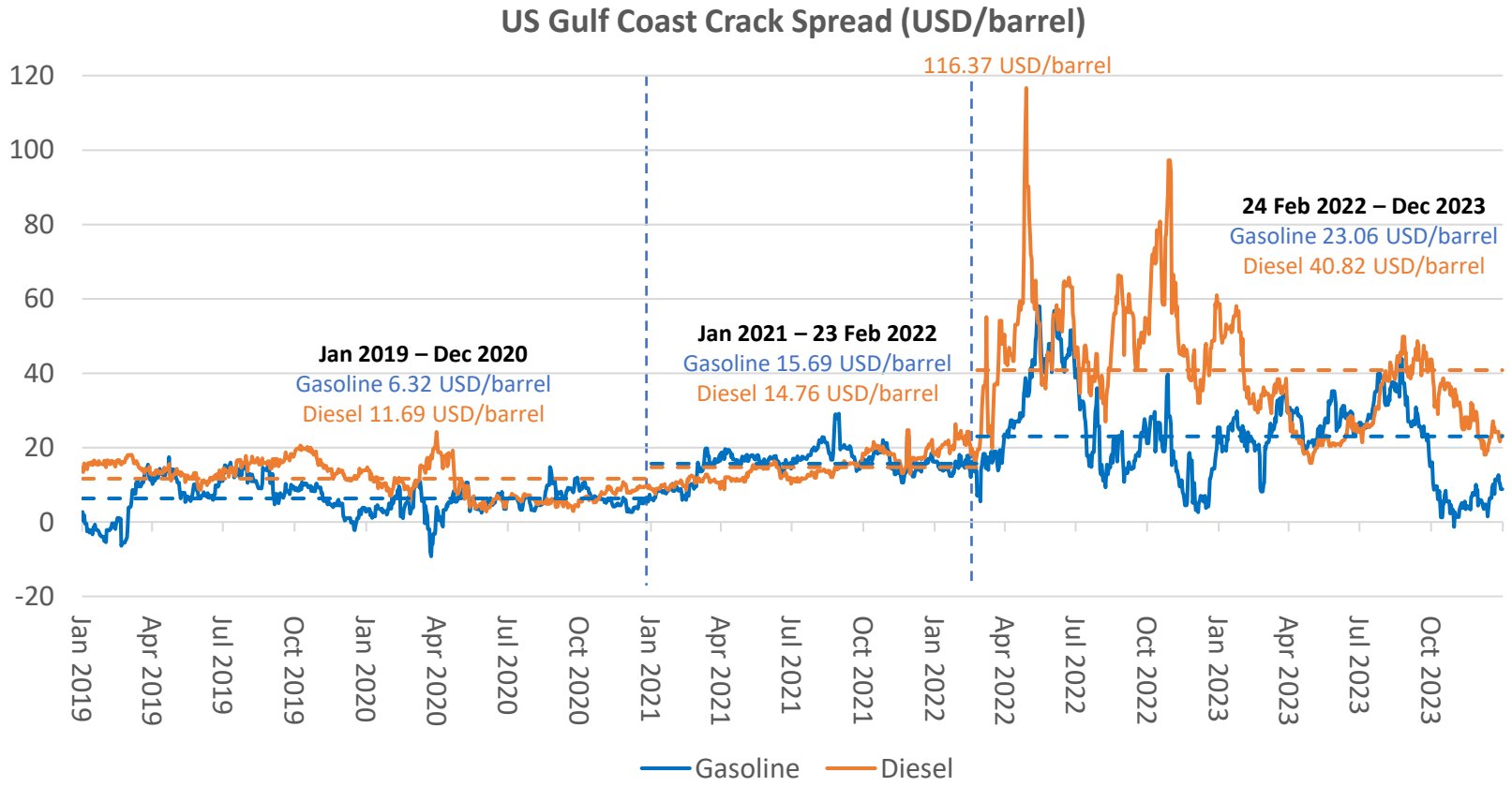


([1] Atmospheric distillation capacity less petroleum products consumption)

Source: BP Energy Statistics 2022 and APERC analysis

Low level of spare refinery capacity in APEC and the world likely contributed to increases in gasoline and diesel crack spreads.

- Average US Gulf Coast gasoline crack spread[2] increased to almost threefold to 15.65 USD/bbl prior to Russia-Ukraine war, and almost fourfold to 23.06 USD/bbl after the war started.
- Average diesel crack spread showed similar trends, with its peak at a historic 116.37 USD/bbl on 28 April 2022.



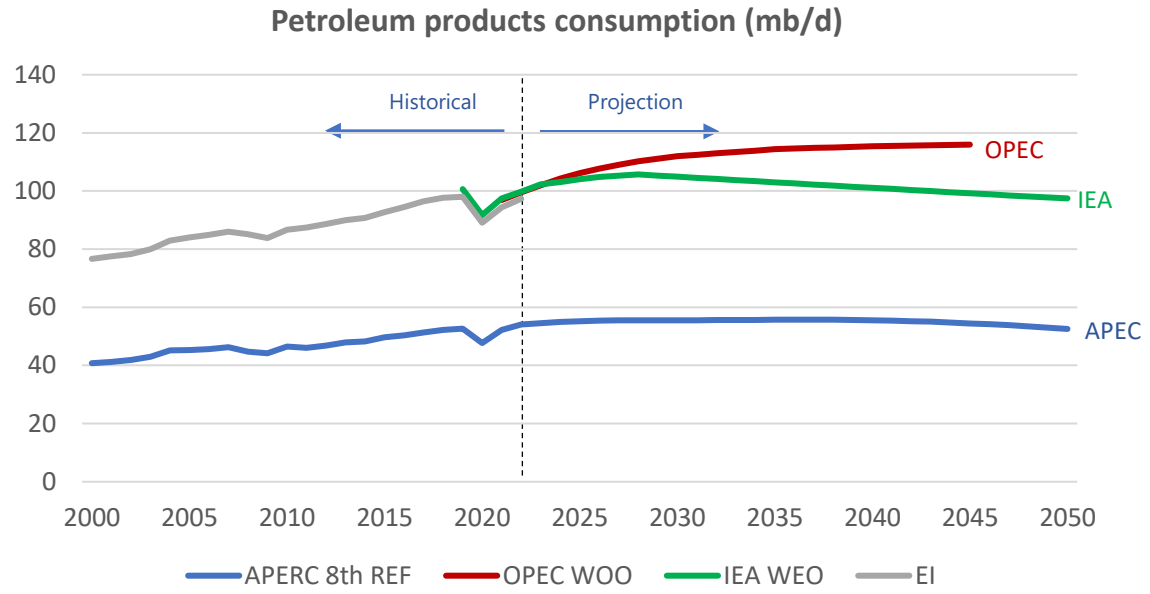
Source: IEA

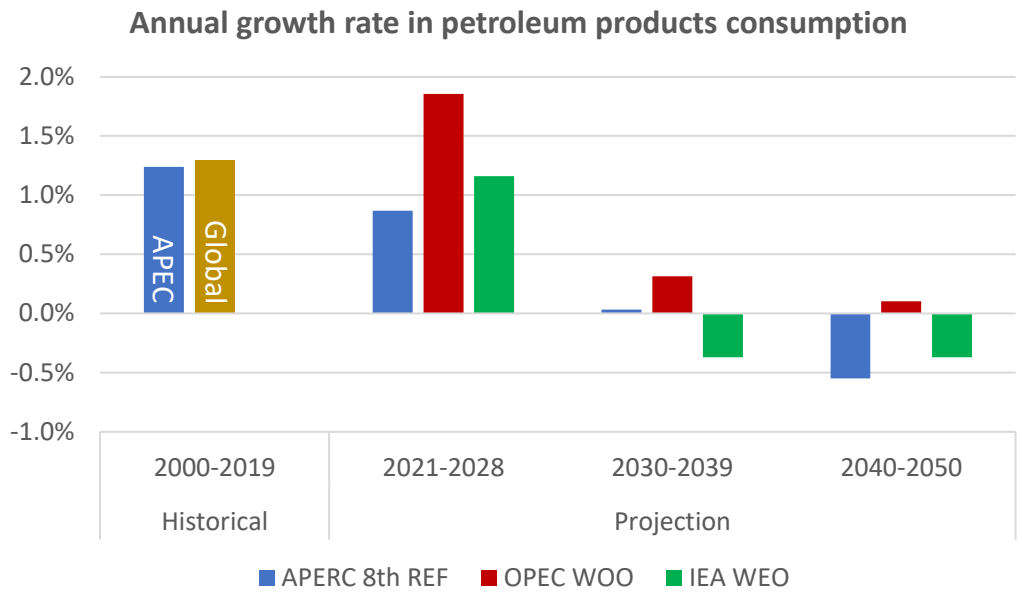
(2 US Gulf coast crack spread is calculated by wholesale products spot price in the US Gulf Coast market less Brent spot crude oil price FOB)

Future challenges on petroleum product supply security: global context

Global outlook of petroleum products consumption and refinery capacity

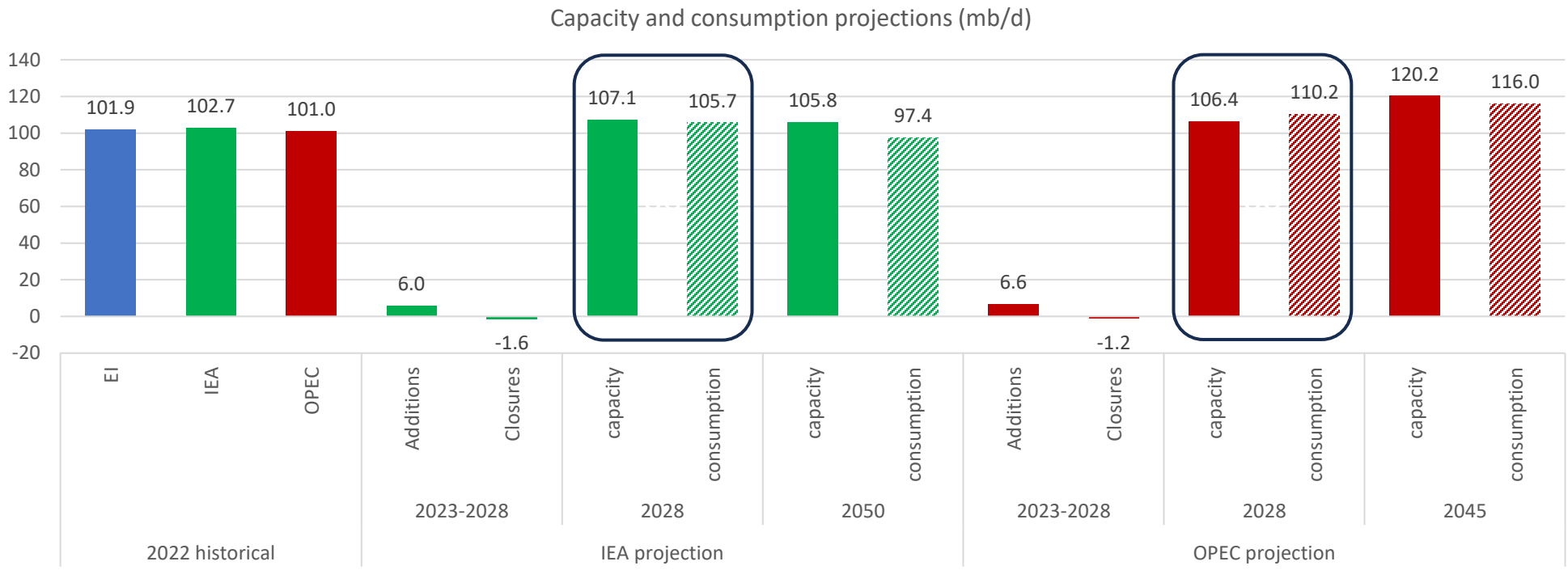
OPEC and APEC Outlook 8th Edition anticipate increasing petroleum product consumption at least until 2040.





- APERC, OPEC, and IEA forecast petroleum product consumption to grow at 0.9%-1.9% per annum near-term.
- OPEC projected a growth trajectory to 116 mb/d in 2045, though a diminishing trend over time. IEA projected peak at 105.7 mb/d in 2028.
- APEC region sees a slight decline in consumption in long-term with its growth significantly drops after 2040.

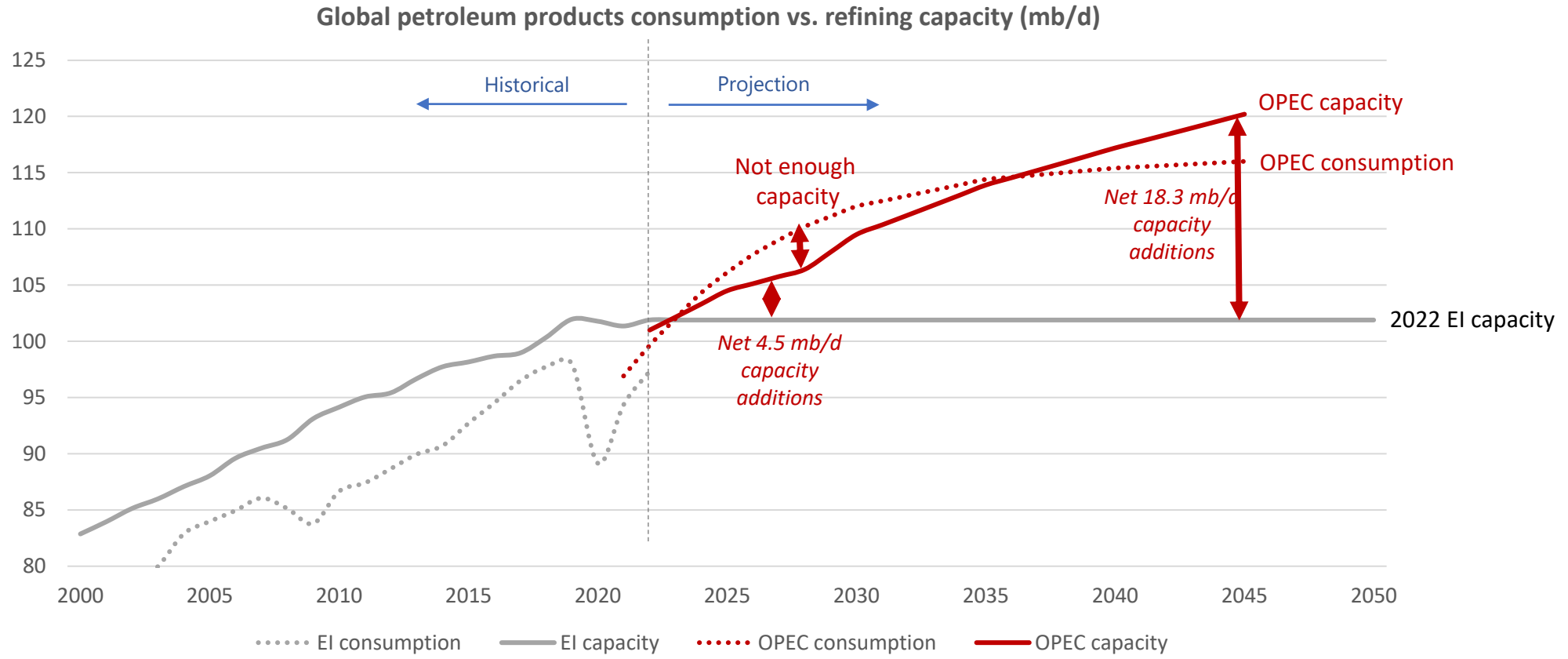
Different views on refinery capacity pose challenges to future product supply security.



- IEA anticipates global net refinery capacity to peak at 107 mb/d in 2028 followed by a decline to 105.8 mb/d in 2050, against its peak consumption 105.7 mb/d.
- On the contrary, OPEC projects the global net capacity to reach 106.4 mb/d in 2028, which is lower than its projected consumption (110.2 mb/d). Both capacity and consumption continue to grow in the long term.
- The marginal discrepancy between refining capacity and petroleum products consumption underscores the necessity for spare capacity.

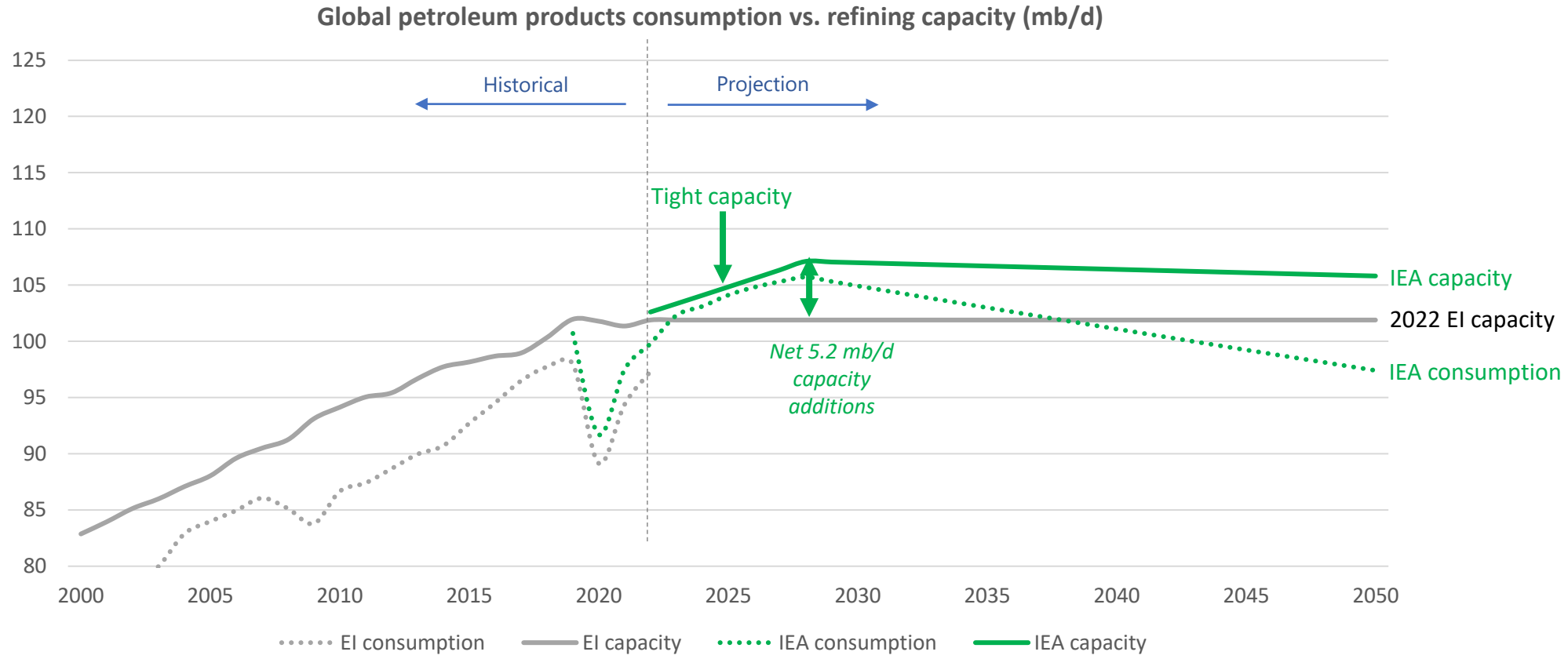
Outlook in refinery investment

OPEC projects global petroleum products consumption likely to exceed refinery capacity despite near-term capacity expansion.



- Global refinery capacity likely to fall short by 5 mb/d between 2022 and 2028.
- Additional investment is required to meet future consumption projections.
  - Net additional capacity of 4.5 mb/d and 18.3 mb/d to meet OPEC consumption in 2028 and 2045, respectively.

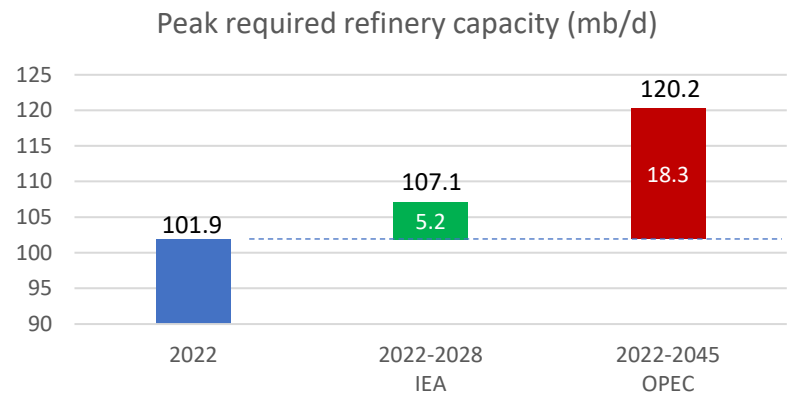
IEA projects global petroleum products consumption likely to exceed refinery capacity despite near-term capacity expansion.

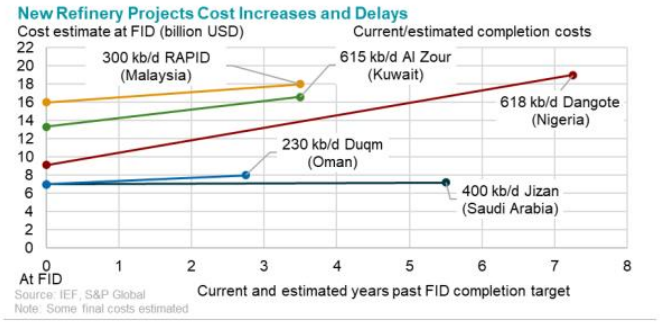


- Net additional capacity of 5.2 mb/d is required to meet IEA consumption in 2028.

Significant investment in global refinery capacity additions is required to meet near-term and medium-term demand.

- Assuming a constant capacity at the 2022 level (refer to EI) and no refinery closure after 2022, a capacity of 18.3 and 5.2 mb/d is required to meet the anticipated demand from OPEC and IEA, respectively (taking into consideration the highest projections from each source).
- These capacity additions translate to an investment ranging from 90 to 490 billion USD.
- Most investment is expected to be front-loaded, driven by high annual consumption growth in the near term before 2028 but with high uncertainty in longer term.





Estimated investment (cumulative)	Net refinery capacity additions (mb/d)	Low-cost estimate (billion USD)	High-cost estimate (billion USD)
2022-2045 OPEC	18.3	320	490
2022-2028 IEA	5.2	90	140

Assumptions:

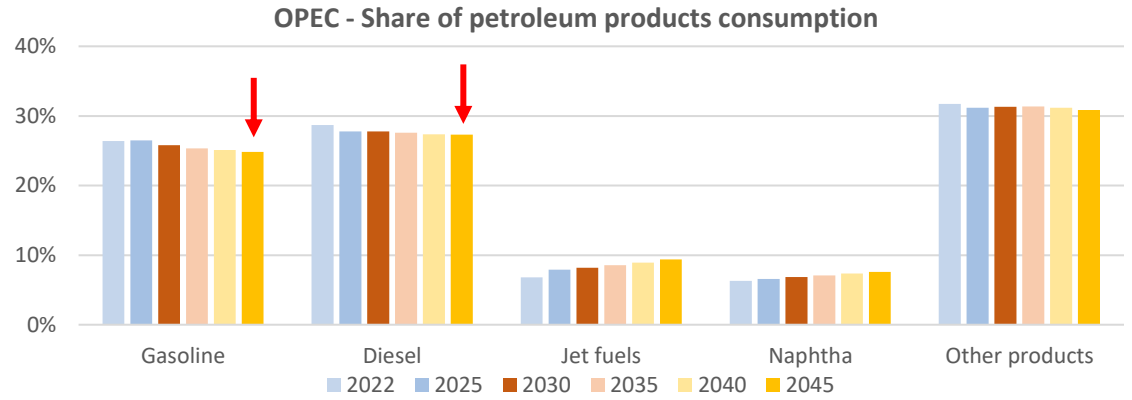
1) Low-cost estimate >> 7 billion USD per 400 kb/d capacity (Jizan, Saudi Arabia)
2) High-cost estimate >> 16.5 billion USD per 615 kb/d capacity (Al Zour, Kuwait)

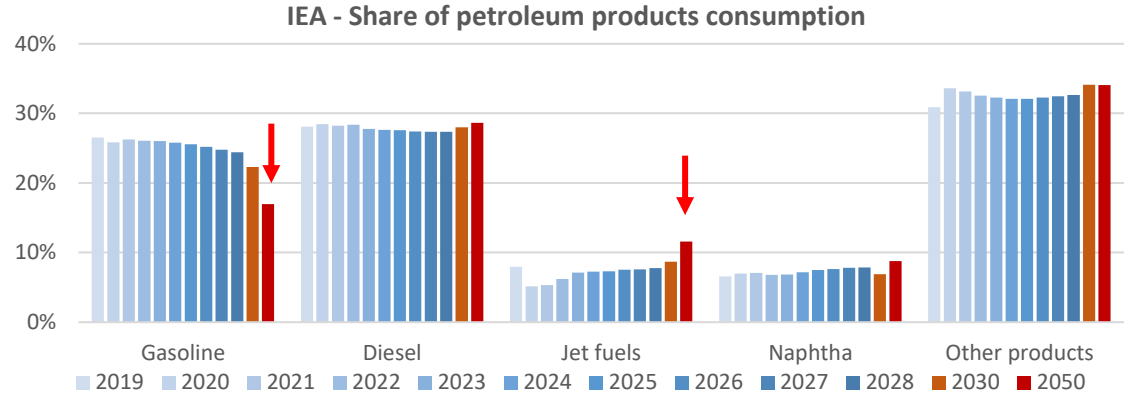
Refinery - ief-sp-global-downstream-investment-outlook---vf.pdf - All Documents (sharepoint.com)

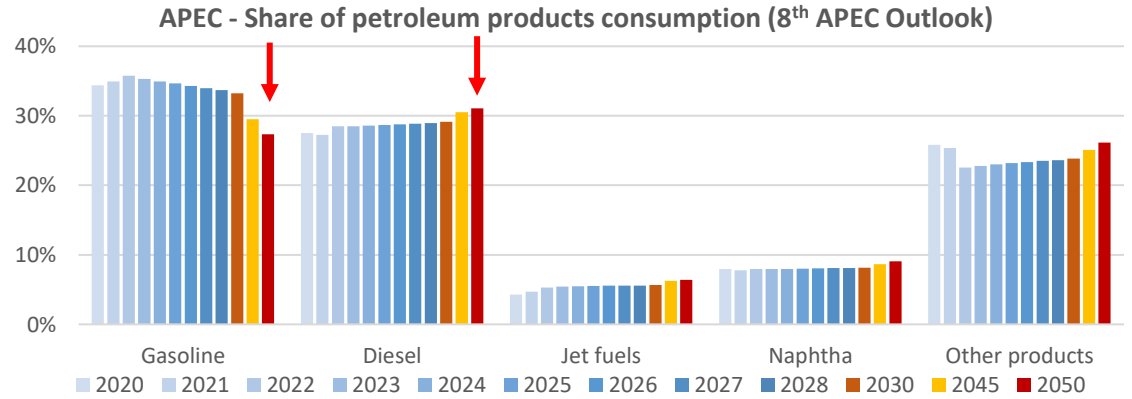
Changing trends of mix in petroleum product consumption

Changing shares of petroleum products consumption can pose another challenges to flexibility of refineries.

- OPEC forecasts gasoline share in consumption to drop from 26% to 25% in 2050 while diesel drop from 29% to 27%.
- IEA anticipated share of gasoline to drop significantly from 26% to 17%, and share of jet fuel to double from 6% to 12% in 2050.
- APEC sees a large drop of gasoline share from 36% to 27% and diesel share to increase from 28% to 31%.
- Additional investment is required in advance to upgrade existing refineries to meet changes in consumption patterns.





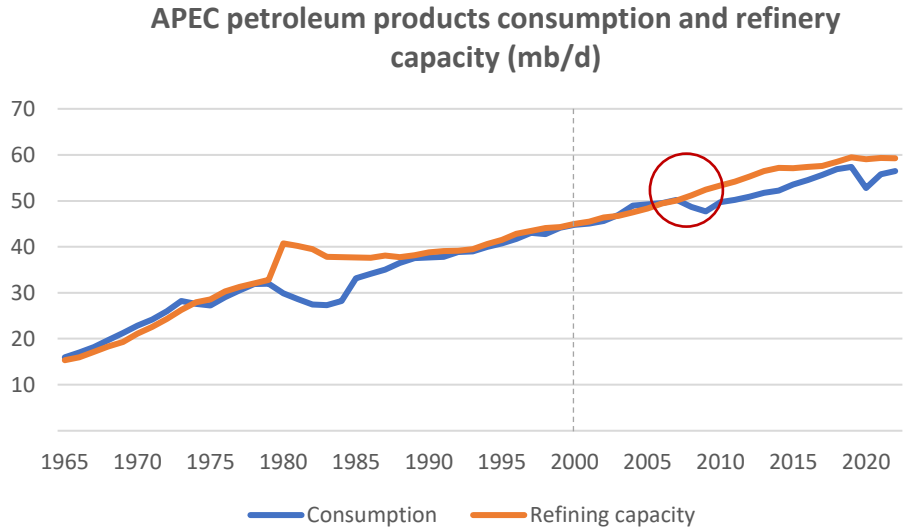


Other challenges that can impact petroleum products supply security and refinery capacity investment.

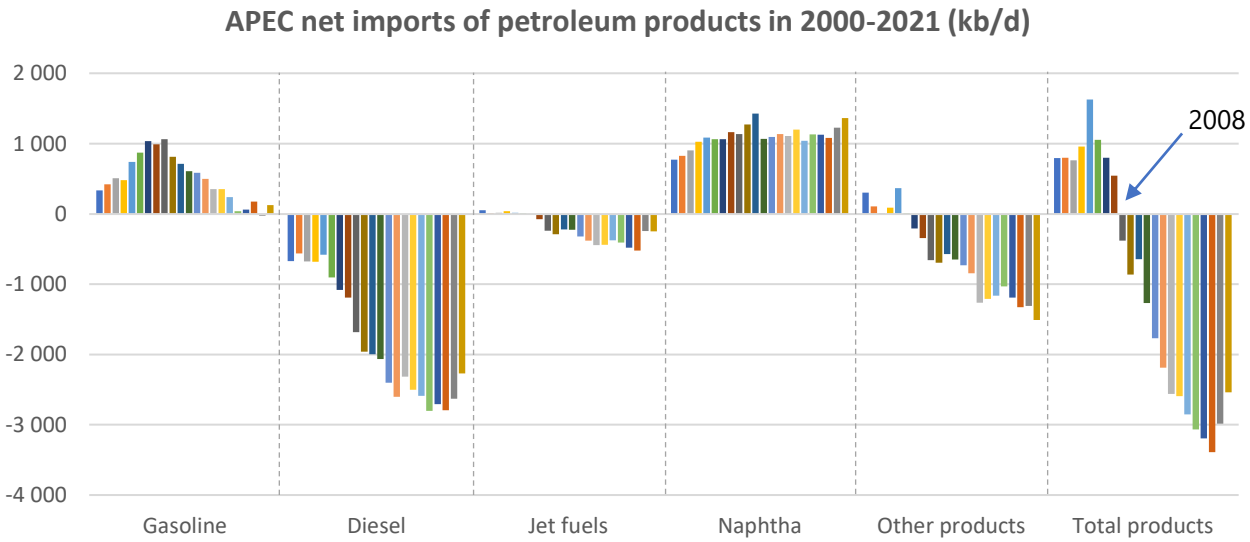
- Petroleum products output from a refinery is typically less than the refinery capacity. Therefore, having spare refinery capacity compared to consumption is necessary to ensure petroleum products supply security.
- Investment and construction of a greenfield refinery or a capacity expansion project typically involves a long lead time (> 5 years) and require at least 15-20 years with stable margins to break even. For instance, investment decision in oil refinery projects to prevent global capacity shortage in 2030 must be made now.
- These multi-billion-dollar refinery projects are very difficult to justify in current unfavorable investment hurdles and uncertain future situation.

Assessment of petroleum products supply security in APEC sub-regions

APEC oil market tightened before 2008, preceding a downward shift in consumption that enabled it to become a net exporter.



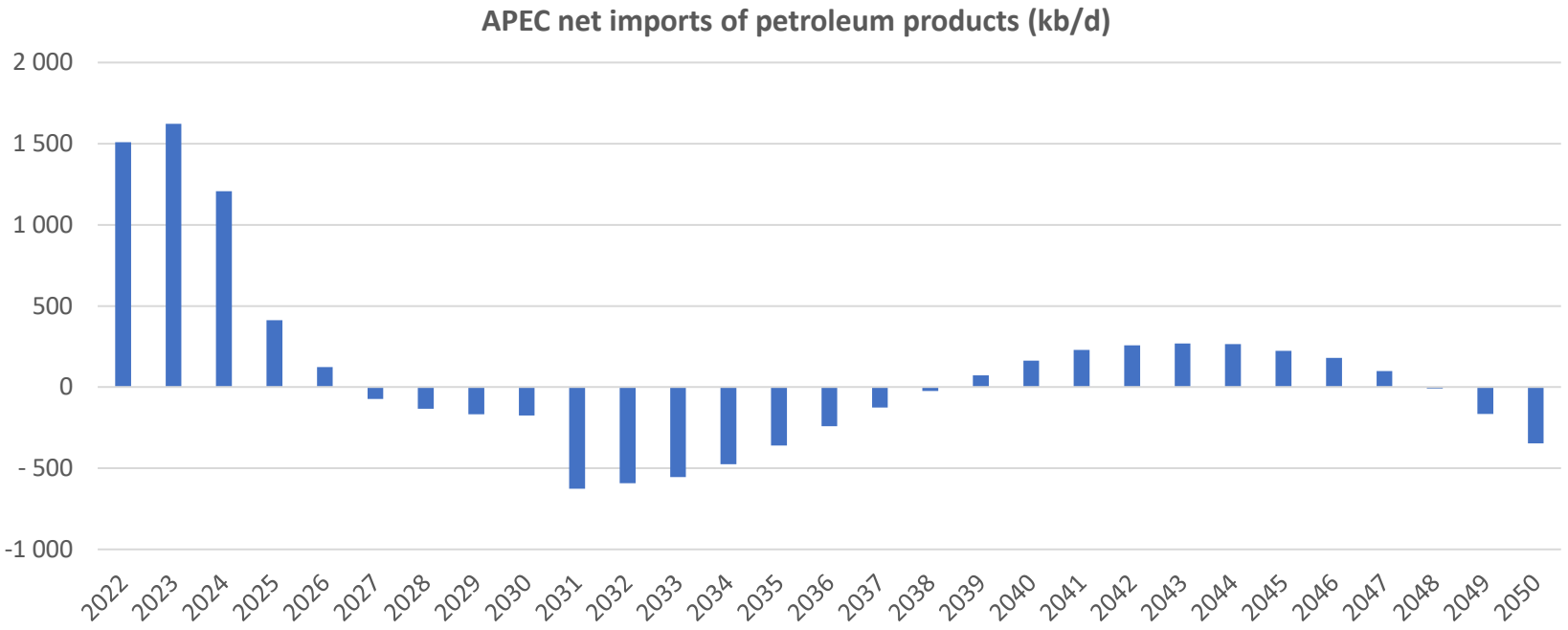
Source: EI



Source: EGEDA
Note: Other products includes fuel oil, petroleum coke, bitumen etc. (excluding LPG)

- APEC became the net exporter of petroleum products in 2008, with diesel as main export product, largely driven by diesel exports from the US, Russia, and China.
- However, a closer look into APEC sub-regions sees diverse situations of petroleum product supply security.

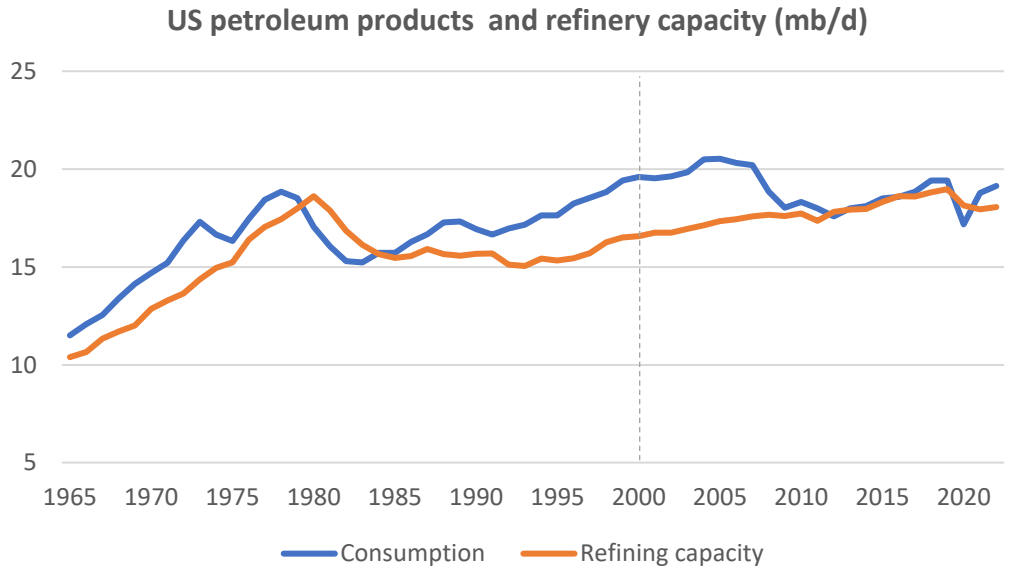
Looking forward, APEC is unlikely to continue its position as a net exporter



Source: APERC (Outlook 8th)

- According to Outlook 8th REF, the net refined product exports decrease as demand in China and SEA outpaces refinery output, prompting an increase in gross imports

The US became a major net product exporter in 2009 as a result of low energy prices and efficient refineries.



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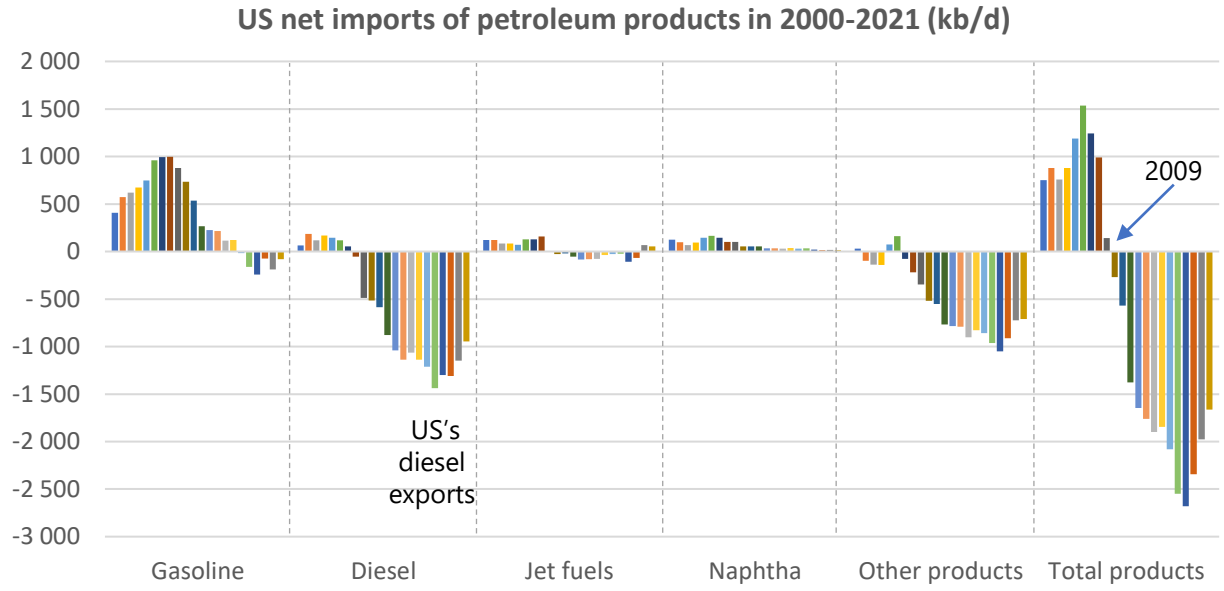
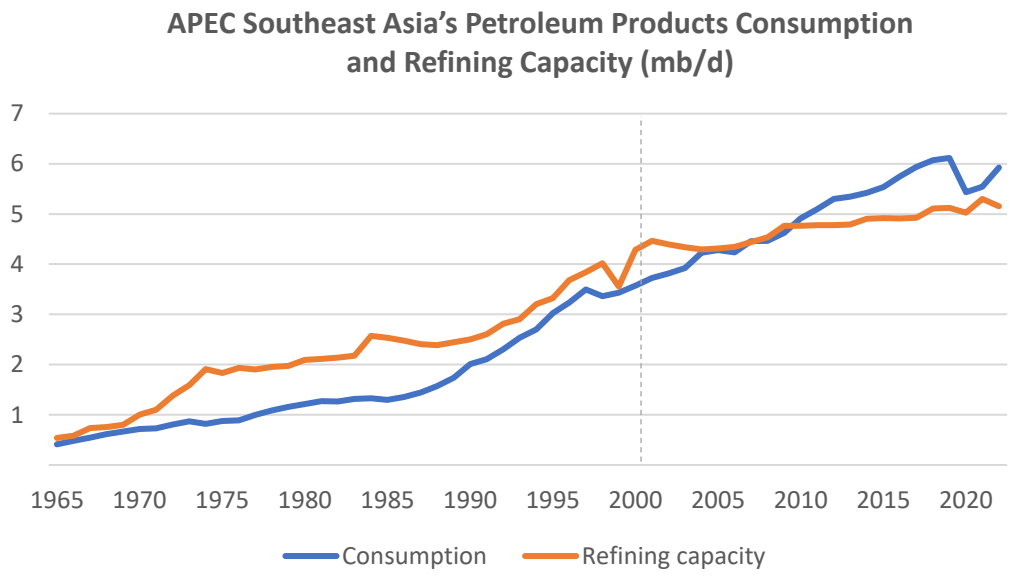


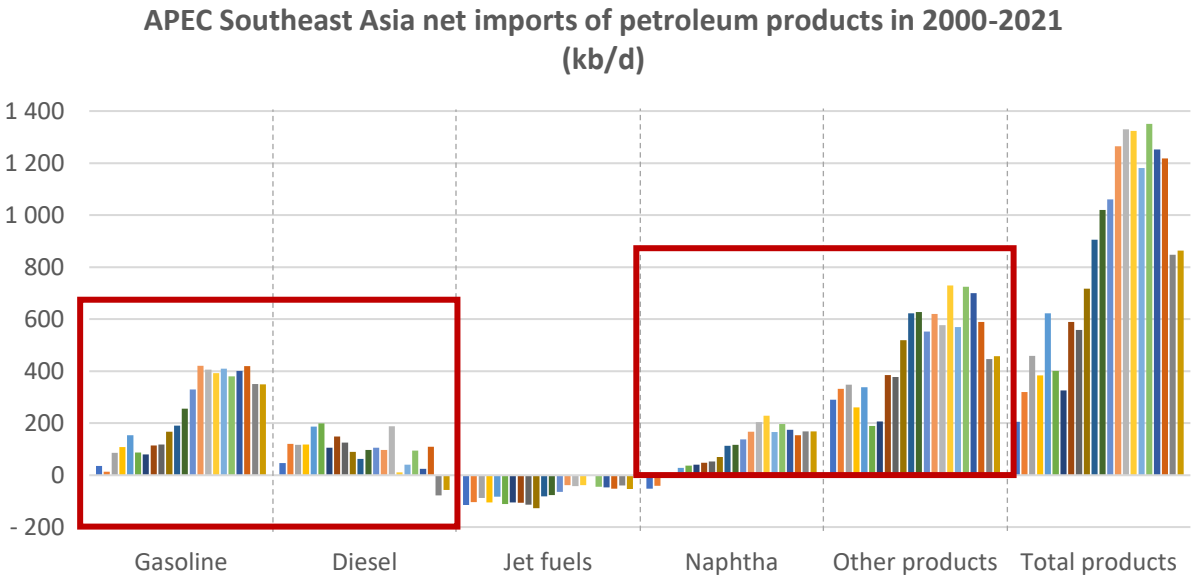
Source: EGEDA
Note: Other products includes fuel oil, petroleum coke, bitumen etc. (excluding LPG)

- US refinery capacity increased from 17 mb/d to 19 mb/d during 2005-2019, coupled with the high throughput of the US refinery sector, contributed to the increase in diesel exports
- During the same period, US refineries increased the diesel product yield ratio from 20% to 35% to capture export potential in both Europe and other developing economies.
- Looking forward, the low production cost of crude oil/natural gas and the efficiency of the refinery sector should enable the US to maintain its competitiveness as a major petroleum products exporter.
- The refinery capacity of the US in 2022 was 18.1 mb/d, the largest among APEC economies (EI). Between 2022-2028, refinery capacity in the US will be reduced slightly to 17.6 mb/d (IEA).

APEC Southeast Asia (SEA) pose a different perspective in petroleum products supply security.



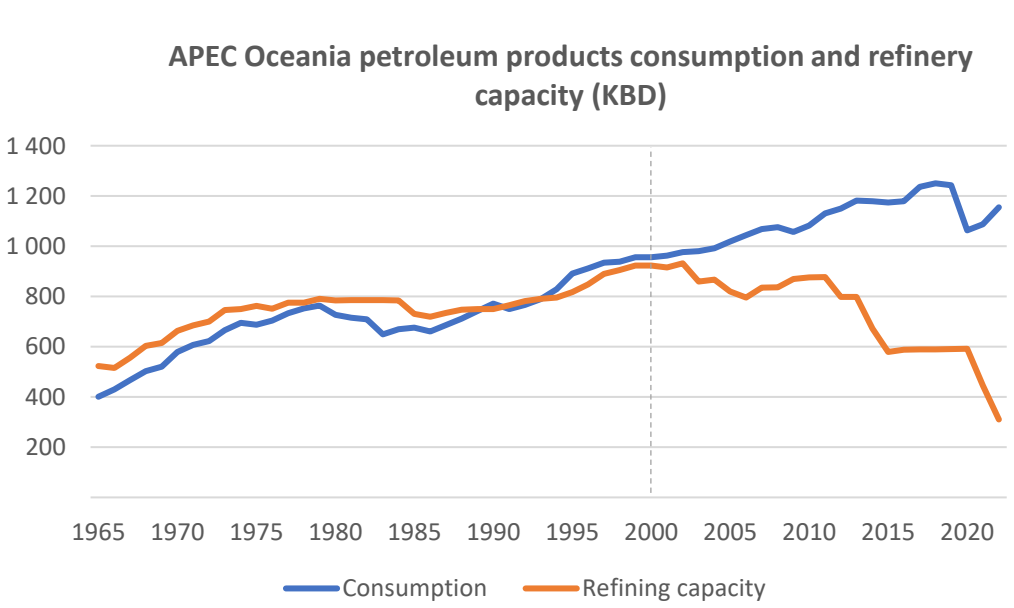
Source: EI



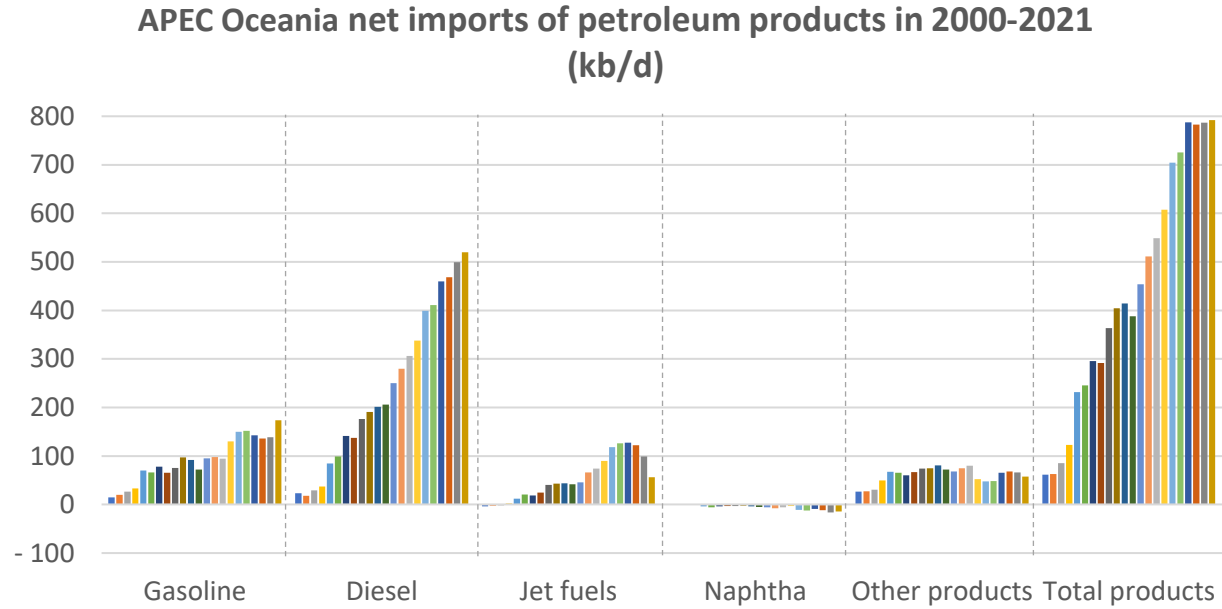
Source: EGEDA
Note: Other products includes fuel oil, petroleum coke, bitumen etc. (excluding LPG)

- APEC SEA oil consumption grew faster than the refining capacity (2.5% vs. 0.8% p.a. from 2010-2019).
- APEC SEA relies on net imports of all petroleum products except for jet fuel.
- Looking forward to 2025, Thailand is the only economy in APEC SEA that announced net capacity additions of 125 kb/d, posing challenges to rapid increases in regional demands.

APEC Oceania is becoming more reliant on imports of petroleum products.



Source: EI



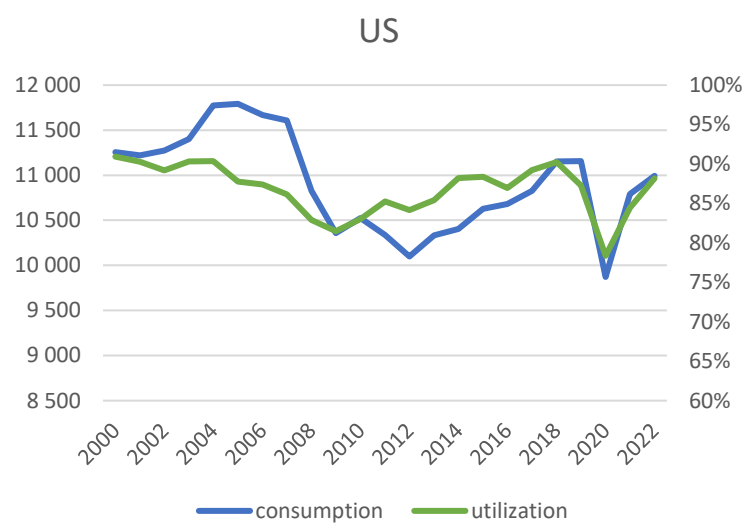
Source: EGEDA
Note: Other products includes fuel oil, petroleum coke, bitumen etc. (excluding LPG)

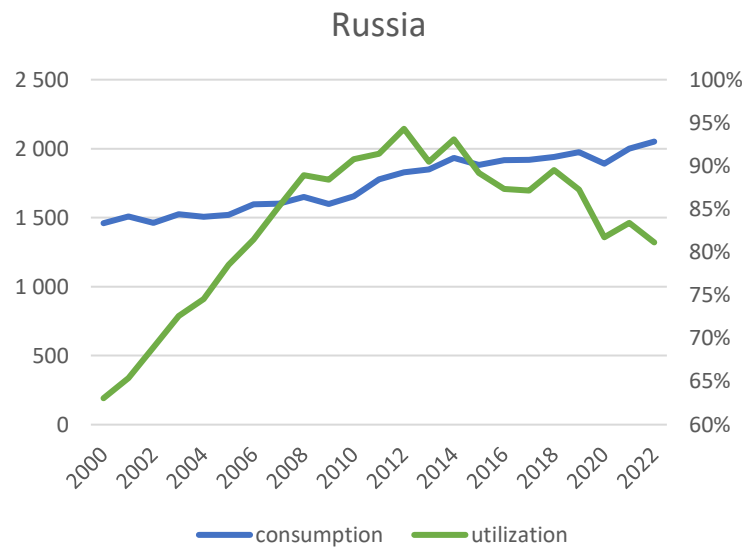
- Refinery capacity in Oceania dropped by over half since 2000, standing at above 300 kb/d in 2022. Meanwhile, consumption was on the rise.
- Oceania is growing more reliant on imports of all products, particularly diesel. The closures of refineries in Australia and New Zealand in recent years exacerbate the challenge. Prior to COVID-19, the utilization rate was above 95%.

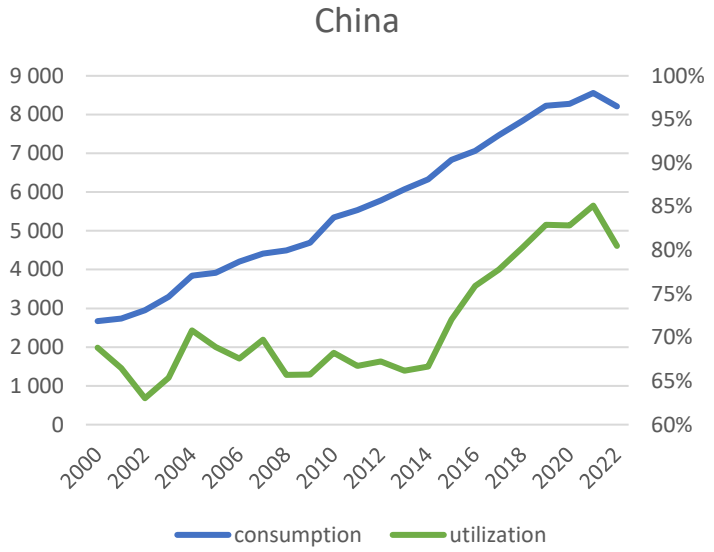
Assessment of petroleum refinery utilization in APEC sub-regions

Refineries in larger APEC sub-regions are running at high utilization rates.

Source: EI



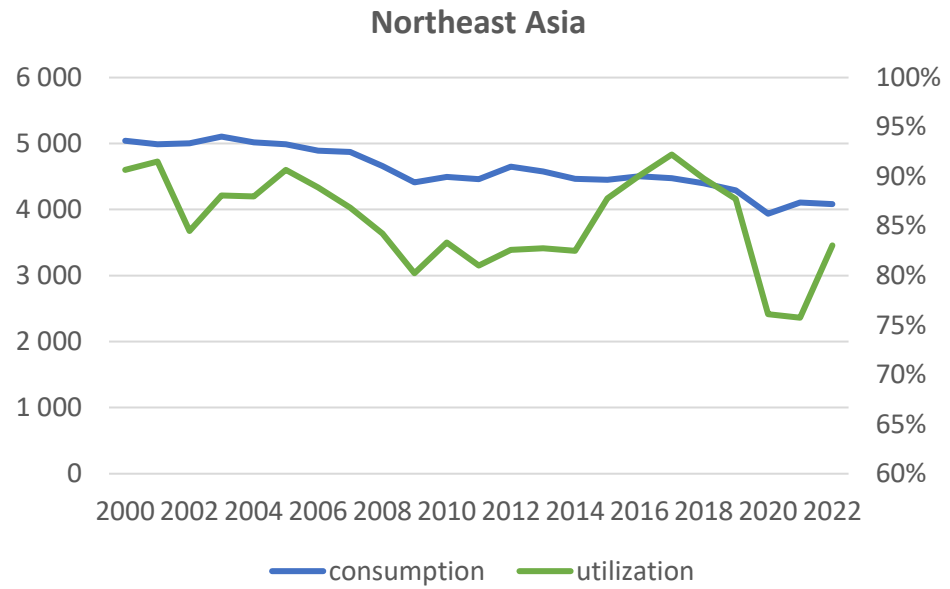


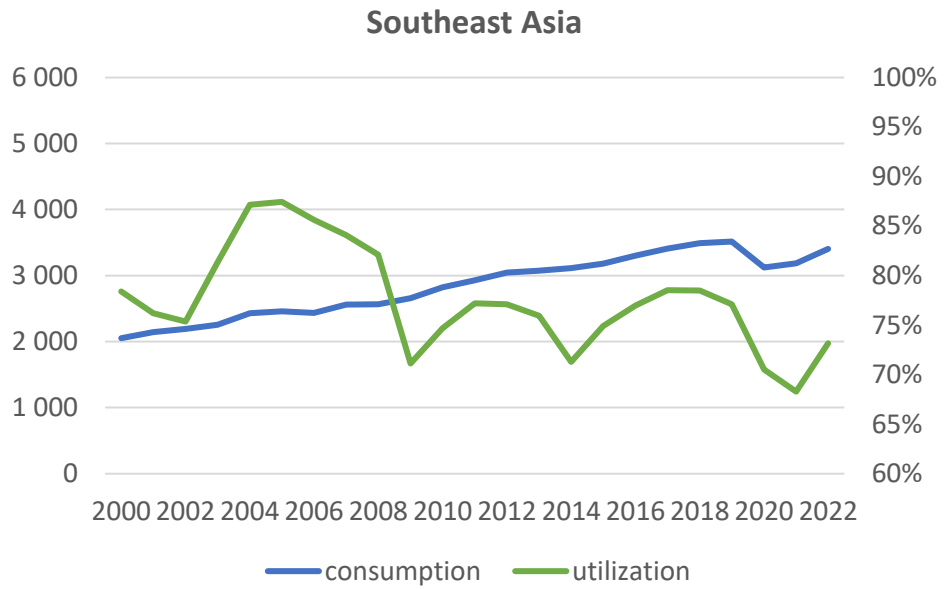


- The US and Russia have consistently maintained refinery utilization rates above 80% over the past 10 years.
- In contrast, China ramped up its utilization rate from 67% to 80% between 2014 and 2022 to meet rising demand.
- While these high utilization rate indicate refining activities' efficiency, they could impose challenges in meeting future demand and could lead to disruption in the event of an unplanned outage at a large refinery.

Divergence of refinery utilization between APEC NEA and SEA.

Source: EI

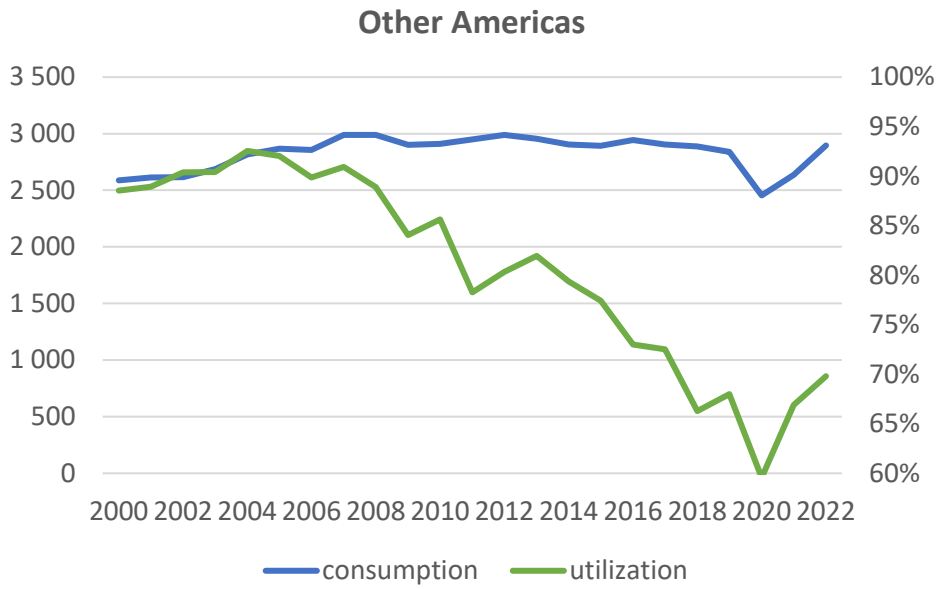


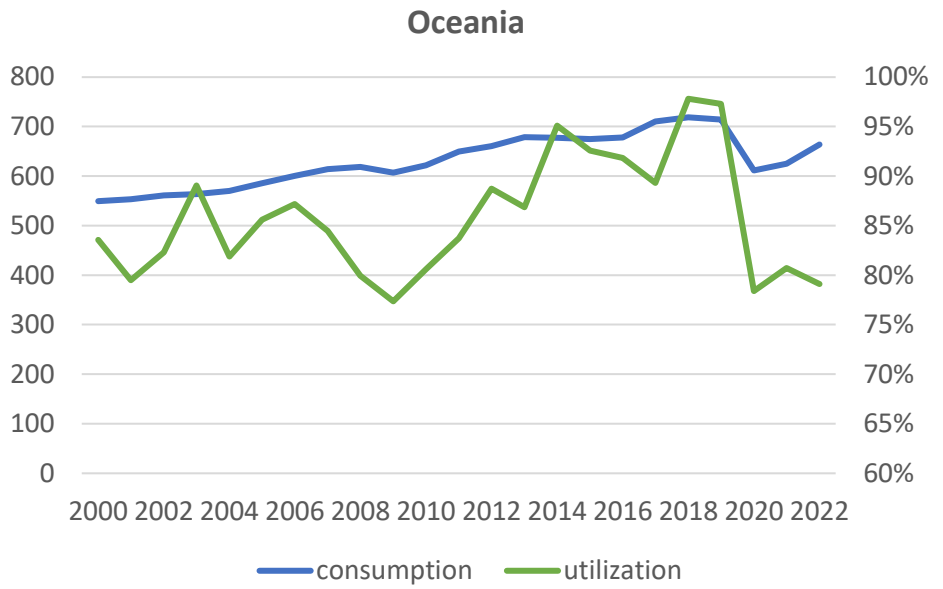


- NEA refineries are running at a high utilization rate (83% in 2022) despite declining consumption and capacity closures.
- On the contrary, SEA refineries are running at lower rate (73% in 2022) despite increasing demand and limited capacity additions.
- Situations in the two sub-regions pose challenges to future uncertainties in both the supply and demand sides.

Different views of refinery sectors in Other America and Oceania.

Source: EI





- Utilization rate of the refinery sector in Other Americas has declined for the past 9 years before picking up to 70% post-pandemic.
- Oceania has seen lower utilization rate since 2020 and relies more on product imports.

Key summary:

- Spare refining capacity has been declining in APEC and the rest of the world for 40 years.
- If petroleum product demand increases in the near term, creating spare refining capacity will require substantial capital investments.
- Uncertainty about long term petroleum product demand increases the riskiness of additional refinery investments.
- Low spare refining capacity increases petroleum product price volatility and degrades energy security.
- Changes in the relative consumption shares of different petroleum products exacerbates those security risks.

What measures can APEC economies take to improve security of petroleum products supply?

- APEC economies should evaluate how low spare refining capacity affects their energy security.
- This evaluation is especially important for import dependent economies.
- Strategic petroleum product reserves can help with localized and/or short-term supply emergencies but are expensive to maintain.
- Spare refining capacity is better for longer term disruptions and/or market changes.
- APEC governments should explore ways to reduce the financial risks of new refinery investments.
- National oil companies may be better positioned than private companies to create spare refining capacity.

Timeline of OGSS No. 20

March 2024: Presentation of key findings to the 7th OGSN Forum

May 2024: Presentation of draft report to EGCFE 2024

August 2024: Presentation of final report to EWG 68

Asia-Pacific
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Thank you.

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