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FROM JUST-IN-TIME TO JUST-IN-CASE OR JUST TOO LATE?

THE IMPACT OF EU OIL SANCTIONS ON CRUDE OIL AND OIL PRODUCT MARKETS IN THE NETHERLANDS AND ITS RELEVANT MARKETS

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TITLE
From Just-in-Time to Just-in-Case or Just too Late?

SUBTITLE
The Impact of EU Oil Sanctions on Crude Oil and Oil Product Markets in the Netherlands and its relevant markets

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NUMBER
2022 | 03

EDITOR
Iris Börger

DESIGN
Studio Maartje de Sonnaville

PUBLISHED BY
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FROM JUST-IN-TIME TO JUST-IN-CASE OR JUST TOO LATE?

THE IMPACT OF EU OIL SANCTIONS ON CRUDE OIL AND OIL PRODUCT MARKETS IN THE NETHERLANDS AND ITS RELEVANT MARKETS

PREFACE

International crude oil and oil product markets are currently digesting the consequences of the EU oil sanctions on Russian crude oil and oil products. The sanctions will be implemented on 5 December 2022 for crude oil and 5 February 2023, respectively. This qualitative study tries to assess the potential impact of the sanctions on NW Europe.

The EU is a large importer of crude oil and oil products. The re-routing of crude oil flows is well underway. The ban on oil product imports from Russia may be more problematic to digest for world and NW European markets because of an anticipated shortage in ocean-going transportation capacity to carry the Russian oil products to markets beyond their traditional market in Europe. Many uncertainties remain also on the exact prerequisites of an oil price cap and may influence the volume of crude oil and oil products (particularly fuel oil, naphtha, and gas oil/diesel) available to world markets after the sanction dates.

The disintegration of the EU crude oil and oil product market from Russia is challenging. The EU refinery capacity has been shrinking over the past 20 years and has exacerbated the unbalance between consumption and production of oil products. This unbalance will grow due to the lighter crude oil intake in refineries and the concentration of consumption of so-called middle distillates. These oil products are important for the motor fuel market and feedstocks for industry.

The Netherlands is an important hub for both crude oil and oil products to NW European and world markets. The hub is facilitated by a deep-water harbour, various refineries, pipeline connections, storage facilities, chemical industries, and a distribution network, also in west Germany, and Belgium.

This study is based on desk research and confidential discussions with oil industry analysts and senior management of companies, sector organisations and policymakers to grapple with the complexity of the expected impact of the oil sanctions and understand the interrelated operation of all the different parts of the oil value chain and markets. We are very grateful for the time that people were willing to invest in this project and their efforts to help uncover insights in what to expect from this crucial change in energy relations and dampen the impact. VEMOBIN and VOTOB enlisted CIEP to conduct this study to contribute to the government's efforts to manage this part of the energy crisis.

Coby van der Linde
Director CIEP

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EXECUTIVE SUMMARY

The Dutch oil sector is integrated in the NW European and international crude and oil product markets. Crude oil is imported, processed in refineries to oil products, and made to specification for clients in the Netherlands, Europe and international markets. The Netherlands plays an important role in receiving crude oil imports, breaking bulk crude oil for other markets in NW Europe, refining crude oil in oil products, storing crude oil and oil products, supplying oil products to other industries for further conversion, transporting crude oil to refineries in the Netherlands, Belgium and Germany and transporting oil products to markets in Europe or overseas as well as to distribution points in the Netherlands and neighbouring countries.

The harbour of Rotterdam and its industries functions as an important entry point for crude oil for NW Europe because of its facilities to receive the largest crude vessels and because it has transportation links (pipeline, river, rail, truck) to refineries and petrochemical plants in the Netherlands, Belgium, and west Germany. The facilities in Amsterdam and Zeeland refinery and Rotterdam make the Netherlands into an important hub in NW Europe for crude oil, oil products and feedstock for industries, which transcends the fuel and feedstock needs of the Dutch economy.

IMPACT OF THE SANCTIONS

On 24 February 2022 Russia invaded Ukraine, which led to various rounds of EU sanction packages. On 3 June 2022 the sixth sanction package was accepted, focussing mainly on banning Russian oil and oil products from European markets. The EU embargo on crude oil from Russia comes into force on 5 December 2022 and on oil products on 5 February 2023. Fuel oil imports from Russia were already banned on 10 August 2022, as part of the earlier coal package.

With the introduction of the sanctions, the integration of the Russian crude oil and oil product sector with that of the EU will come to an end (with a few specific exemptions). Instead of sourcing from Russia, the EU will have to source crude oil from other countries. Prior to the war in Ukraine, Russian crude oil accounted for about a quarter of the EU crude oil imports. In addition, the EU also imported substantial volumes of Russian oil products. Russia is one of the three largest crude producers and exporters in the world, and the largest exporter of crude oil and oil products together.

The implementation of the sanctions will also end the function of the Netherlands as hub for Russian crude oil and oil products for non-European markets. Russian crude oil and oil products are exported in relatively small seagoing vessels due to bottlenecks in the Denmark Strait and transshipped to larger vessels for further away markets. In addition, Russian supplies played an important role in supplying fuel oil to the Rotterdam bunker market. With the implementation of the fuel oil sanctions this has stopped.

ON CRUDE SUPPLIES

Russian crude oil and oil product exports will have to travel further and either carry the crude oil or oil products in the smaller ships to further away markets (such as India and the Middle East) implying a much longer journey before reaching the market, or transship outside the EU, most likely in international waters. This increases the danger of environmental incidents such as oil spills.

The re-routing of crude oil and oil products implies that the commodities are longer enroute and later available for the market. This redirection requires time for international markets to adapt, and probably also requires more vessels to transport crude oil and oil products to new destinations. Furthermore, oil for the EU from non-Russian producers is also longer enroute. A shorter distance between Russia's export ports and the NW European import ports, also created a practise of shorter time spans between purchasing and arrival in port (about one to two weeks). Purchasing oil from further away producers implies a longer time between purchasing and delivery (up to three months). This affects storage and logistic needs.

Apart from longer journey times for crude oil and oil products in international markets, the available tankers may fall short of demand. This shortage may grow because the oil sanction package in combination with the impending internationally coordinated oil price cap may have implications for insuring Russian cargoes. Activities in the tanker market indicate that some vessels are transferred in ownership, to carry Russian crude oil with alternative insurance arrangements. These are no longer available for carrying crude to the EU.

The overall effect of the observed relocation of flows is that the international crude oil and oil product market is moving from a relatively efficient logistical international supply system to an inefficient logistical system one.

In the short run, crude oil supplies to the EU have been successfully transferred from Russian supplies to other supplies. This, however, has an impact on the quality of the crude available for EU refining. The replacement supplies come from more var-

ied sources and are lighter in quality than Urals (with about 2 API). This affects the refinery output, producing more gasoline from a barrel of crude oil and less middle distillates, among which diesel and kerosine/jet fuel. Urals was very suitable for the relatively high demand for middle distillates in the EU. In addition to crude oil, the EU also imported substantial volumes of middle distillates from Russian refineries. The anticipated short position for diesel in the EU will increase as a result.

Investments in crude oil production in the world has been subdued in the past decade, apart from in the US. Investments in refineries mainly took place in the Middle East and Asia. Refining capacity in the EU continued to shrink, a process that has been ongoing since the early 2000s. Most of the refinery capacity additions are east of Suez, and not in the Atlantic Basin, also reflecting the expected move away in Europe from oil demand in the future in Europe.

ON EU OIL PRODUCT SUPPLIES

Demand for crude oil and oil products is projected to slow down in the short-term due to declining economic activity in the world. A weak economy in China, the energy crisis in Europe and tightness in certain oil product markets restrained demand. Inventories for oil products are running low and although China widened the export quota for diesel in the fourth quarter of 2022, it is still unclear what the Chinese export policy will be in 2023. India has also imposed export restrictions for diesel, and discussions about implementing similar measures are ongoing in other countries are as well. The consequence of the sanctions is that EU countries must rely more on oil product imports from China, India, the Middle East, and the US. This creates a greater dependency on policy decisions made in these countries.

The EU market for oil products, in particular diesel, is very tight. Europe has been a long-time gasoil/diesel importer. Prior to the war, about 21% of these imports originated from Russia. Although Russian gas oil/diesel imports have declined somewhat and have been replaced by various other sources, a substantial volume still must be found elsewhere in international markets before 5 February 2023. Commercial stocks of gas oil/diesel are low in North America and Europe. Issues with an Austrian refinery, strikes in France and potential strikes in the Netherlands and the UK add pressure on other refineries to make up for these lost supplies in the run up to the sanction date.

In the current market circumstances, partly caused by the EU sanction packages, refineries increasingly depend on the price differentials - or crack spreads - between their crude intake and their diesel/gasoil and jet/kerosine output. The premiums awarded to these products have to compensate for the higher processing costs (caused by

high gas prices) and low cracks spreads for naphtha and fuel oil. The latter products often trade at a discount to the crude intakes. The balance between increased processing costs and uncertainties about the continued returns on oil products, could influence decisions on utilisation rates. This could negatively influence the availability of diesel supply in certain markets.

The IMO 2020 rule for marine fuel oil in combination with the sanctions creates competition between markets for low-sulphur fuel in bunkers and diesel demand. The costs of desulphurisation have increased due to high natural gas prices, putting a premium on low-sulphur crudes. These developments all add to bottlenecks in conversion and supplying markets. The recent decline in natural gas prices has subdued this pressure somewhat but the IEA outlook for natural gas supplies in Europe in 2023 does not provide a positive signal.

Several transportation bottlenecks exist, which will become more apparent after the enactment of the oil and oil product sanctions. The relatively low level of commercial inventories and the high level of turnover in Dutch storage facilities to markets, attests to the very tight market in diesel, already prior to the implementation of the oil product sanctions in February 2023. The fact that the Dutch oil sector is well connected to markets in NW Europe and the international markets, may influence the level of supply available for the domestic market. Dutch consumers must compete on price for supplies with consumers elsewhere, while their demand is relatively inelastic.

The differences in price between natural gas and crude oil and oil product prices incentivised fuel switching. Fuel switching in industry in Germany is more prominent due to the relaxation of permits to ease the pressure on domestic natural gas demand. Germany industries with the ability to switch fuel have increased their coal and oil product demand. Such a relaxation of fuel use permits to use fuel oil and/or LPG could also ease potential natural gas bottlenecks in the Netherlands.

Another factor that influences the potential impact of the oil and oil product sanctions on the Netherlands and NW European oil product markets, is striking the right balance between strict sanction enforcement and the ability to endure economic pain. The discussions about the design and implementation of the sanction packages in Brussels underlined the varieties in the approach of EU member states. This can lead to increasing disparities implementation and enforcement, especially when the economic pain increases.

IN CONCLUSION

The re-routing of Russian crude oil to non-sanctioned markets and the increase of European imports from other producers is well underway. A little over 1-1.5 mb/d still needs to be replaced before 5 December 2022. Oil product imports from Russia are declining but are still about 1 mb/d with the lion's share for diesel imports.

The sanctions create the largest bottlenecks for oil products. This is due to the change in chemical composition of the crude oil intake, and the inelastic demand for certain oil products, the post 2020 product specifications for marine fuels, the natural gas costs in processing crude oil, including hydrogen, and the pending shortage in seaborne crude oil and oil product vessels to transport over much longer distances, and the fact that Europe is a net importer of oil products. The optimised logistics of world crude oil and oil products will be disturbed for quite some time before a new equilibrium is found. This also depends on the duration of the sanctions. Some of the flows will be redirected to other markets permanently, while other flows may be restored at some point.

With commercial stocks already low combined with the high turnover rate of products flowing in and out of storages (just-in-time), the implication is that further tightening of the market translates more quickly in a call to release from the strategic reserves. The strategic crude oil and oil product reserves in the Netherlands are replenished prior to the oil product sanctions are implemented on 5 February 2023 (just-in-case). Ideally releases from strategic reserves are coordinated among the Netherlands and neighbouring countries or the EU member states to reduce pressure on each other's markets. In the absence of such coordination, such a strategic reserve release should be offered as deep as possible in the Dutch market to reduce leakage to elsewhere.

The Netherlands is not competent in external trade policy, this is the competence of the EU. Trade measures aimed at reducing the flow of diesel to third countries could boomerang in restrictions on exports to the EU. This is not in the interest of the Netherlands, home to an important hub for liquid fuels and feedstocks. Restricting trade within the EU would also impede the hub to function properly and would be in breach of the EU free trade of goods, services, and labour. Limited intervention to maintain supply levels in the Dutch market, would only be possible in an advanced stage of oil product shortages when national security is at stake and a supply crisis declared (just-too-late).

The Crisis and Restore plan, developed by the Dutch authorities, could include a measure in the more acute stages of the crisis, to reserve a certain share of the volume of diesel produced or flowing through the Netherlands for the Dutch market without impeding normal market activities for the rest of the volumes. The Ministry of Economic Affairs and Climate Policy (EZK) should urgently organise a National Emergency Sharing Organisation (NESO), with market participants at the oil supply-side and COVA, the Dutch organisation responsible for strategic oil and oil product reserves. In addition, the Ministry should also organise international coordination with neighbouring EU member states to align actions like supply aid, issuance of strategic stocks or demand restraint measures. COVA is best suited to monitor and determine the level of diesel reserved for the domestic market in case of a more acute crisis in supply.

Despite the current energy crisis, the plans to invest in energy transition projects in the oil sector remains strong, although the expected demand for low carbon molecules may have become more uncertain due to accelerated deindustrialisation. The chemical sector is struggling because of high natural gas prices and limited options to mitigate this. Looking ahead, it is important that the industry-flywheel for the development of low carbon hydrogen (carriers) remains intact to realise the targeted volumes for this decade.

1 INTRODUCTION

This study on the impact of the EU sanctions on crude oil and oil products was conducted at the behest of VEMOBIN and VOTOB to assist the Oil Task Force of the Dutch Ministry of Economic Affairs and Climate Policy in taking stock of the consequences. The war in Ukraine and the subsequent EU sanctions on oil and oil product imports[1], to be implemented on 5 December 2022 for crude oil, and for oil products 5 February 2023 respectively[2], has necessitated a snapshot of the oil sector in the Netherlands to understand its importance for the Northwest European economy in providing mobility fuels and feedstocks for the chemical industry.

The Netherlands is an important hub in NW Europe for crude oil and oil products and is firmly connected with both the hinterland and international markets. This study offers a qualitative assessment of the key impacts on the crude oil and oil product supply situation of the EU and the Netherlands once the sanctions come into force. Without assessing the potential impact of the sanctions on supplies, policymaking may be more complicated. This study on the unfolding reorganisation of international crude oil and oil product flows and the impact on NW European crude oil and oil product market, is based on desk research and many discussions with key players in the NW European oil value chain.

The international oil market has experienced severe shocks in the past three years. The dramatic decline in demand in March 2020 because of worldwide lockdowns due to the Covid-19 pandemic, the upsurge in demand in 2020 and 2021 when lockdowns were lifted in parts of the world followed by the supply shock of sanctions on Russian oil imports in the US, Canada, UK, and EU due to the Russian invasion of Ukraine on 24 February 2022. OPEC and OPEC+ have played an important role in managing these demand and supply shocks in the international oil markets. Digesting the sanctions on Russian crude oil and oil products is straining all parts of

1 Council Regulation (EU) 2022/879 of 3 June 2022 amending Regulation (EU) No 833/2014 concerning restrictive measures in view of Russia's actions destabilising the situation in Ukraine (accessed at 18-10-22 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32022R0879)

2 Russian Fuel Oil imports were banned as of 10 August 2022 due to embargoed custom code 2707 as part of the coal sanction package (fifth sanction package, 8 April 2022). "Last month, market sources told Reuters the EU could ban the import and transit of some fuel oil from Russia about six months ahead of plan – from 10 August – due to its aromatic content, which could subject the product to the embargoed custom code 2707." https://www.euractiv.com/section/energy/news/sanctions-hit-russia-sending-fuel-oil-to-asia-loadings-at-greek-terminal-increasing/

the international value chain This ranges from adjusting production in the face of a potential international economic recession to the strain on the logistics of bringing oil and oil products to a specific market, when the international markets for crude oil and oil products is becoming seriously dislocated. Rerouting of crude and oil product supplies is required for the international market to digest the sanctions, while the impact of additional sanctions such as the price cap, are yet unknown.

The impact of the oil sanctions depends not only on the success of rerouting crude oil and oil product flows, but also on the level of international economic growth. Increased energy prices (natural gas and electricity) also play an important role in the rising costs of production. The impact of rising energy costs in Europe due to higher natural gas and electricity prices, in addition to dislocations in international crude oil and oil product markets, works its way through the economy, from the macro to the micro level, and result in unexpected side-effects. The production of certain industrial products in for instance fertilizers, where production in the EU has been reduced because of high natural gas prices, may disrupt supplies crucial for other sectors, such as AdBlue (for trucks) and dry ice (important for transporting pharmaceuticals). Also, the crude oil and oil product value chains rely on natural gas and electricity in processing and transportation. All sorts of adjustments, such as fuel switching, are still unfolding. Many of the potential side-effects of the broader energy crisis in the EU are still unfolding. Some of these issues will be addressed in the next two chapters.

The Dutch oil sector is very large compared to the country's own oil product demand, due to the important function of the Netherlands as an entry point for crude oil, oil processing and storage and blending. Crude oil flows for both Germany and Belgium enter via the Port of Rotterdam. In addition, the Netherlands is also a major producer and exporter of oil products to the rest of the world (gasoline and bunker oil). The function as entry point for crude oil and oil products for processing in Northwest European refineries is due to Rotterdam's deep-water harbour and its early development after WWII as a major entry point into Northwest Europe.

The remarkable size and importance of today's oil-based cluster in the Antwerp-Rotterdam-Rhein/Ruhr Area (ARRRA) is also shown in two CIEP studies[3] on the refining industry published in 2016 and 2017. The cluster is comparable in function to the ones in Houston, Texas in the US and to that in Singapore.

The oil sanctions taking effect on 5 December 2022 and 5 February 2023, challenge the international crude oil and oil product markets to realise a complicated change in their logistics, leading to longer transportation routes and re-balancing of various markets. This dramatic change in crude oil and oil product markets will encounter

3 Long-Term Prospects for Northwest European Refining, CIEP (2016) and The European Refining Sector: a Diversity of Markets?, CIEP (2017) The European Refining Sector: A Diversity of Markets?

several bottlenecks, which take time to overcome. Tightness in certain oil product markets will persist for a while due to national policies, dislocated conversion and transportation capacities compared to demand and the short term orientation of the crude oil and oil product market in Europe.

The study starts with analysis of the adjustment in international crude oil markets in 2022 followed by a chapter on international and EU oil product markets, and an assessment of the impact on the Netherlands oil sector. In the conclusion we will explore the potential measures industry and government may consider mitigating the unfolding crisis in oil product supply in the short and the longer term.

In the Annexes, a timeline of the EU sanction packages is included, some figures underlining Europe's import dependency for certain oil products and an overview of the Dutch oil value chain based on 2019 data, the last 'normal' year.

2 WORLD CRUDE OIL MARKETS IN TURMOIL

The gyration of oil prices was very large between March 2020 and 2022 (from 20 dollars per barrel in spring 2020 to 120 dollars per barrel in spring 2022) and followed a period of relatively low oil prices since 2014. Investments in new oil production capacity, apart from the US, had been subdued prior to 2020, while the consolidation of the refinery sector in Europe continued, creating additional stress on supply in the post-24 February 2022 international oil markets.

In March 2020, when in addition to China, also other countries were forced to impose lockdowns due to the Covid-19 pandemic, the production policy of the OPEC+[4] group of countries broke down temporarily over the proper response to the demand shock in international oil markets. Prices collapsed as demand for all sorts of oil products collapsed, when (passenger) planes virtually stopped flying, and motor gasoline demand dropped. Oil production had to be substantially reduced to calibrate to pandemic demand levels. Income from oil production and exports dropped dramatically.[5] Although prices recovered when China came out of lockdown in the second half of 2020 (see Figure 1), production cuts were held stable. This, in 2020 and 2021, income from oil, although recovering, created economic hardship in producing countries.

FIGURE 1 CRUDE OIL PRICE BRENT (1970-2022) SOURCE: HTTPS://TRADINGECONOMICS.COM/COMMODITY/BRENT-CRUDE-OIL ACCESSED AT 3-11-22

4 OPEC Plus refers to a group of 23 oil-producing countries that includes 13 members of OPEC (Saudi Arabia, the UAE, Iran, Iraq, Kuwait, Algeria, Angola, Equatorial Guinea, Gabon, Libya, Nigeria, the Republic of the Congo, and Venezuela) and 10 other oil-producing countries (Russia, Azerbaijan, Bahrain, Brunei, Kazakhstan, Malaysia, Mexico, Oman, South Sudan, and Sudan).

5 https://www.eia.gov/international/analysis/special-topics/OPEC_Revenues_Fact_Sheet

The experience of tremendous market instability in 2020 and recovery in 2021, may influence the response to the market instability which is caused by the Russian invasion of Ukraine and the subsequent sanctions on crude oil and oil product imports by the US, UK, and EU. Before the invasion, Russia was vying with the US and Saudi Arabia for the position of largest oil producer in the world.[6] Prior to the pandemic and the war in Ukraine, all three countries produced prior to the pandemic and war in Ukraine approximately 11-12 million barrels a day. Both Saudi Arabia and Russia are large exporters of crude oil and oil products to world markets. These exports have become increasingly regionalised in the past 20 years with Middle Eastern exports mainly flowing to the growing Asian markets, while Russian exports flowed predominantly to the European markets. After 24 February 2022, the flows shifted due to sanctions and self-sanctioning of some market players. Discounted Russian crudes began to flow to Asia. Supplies through the ESPO pipeline increased (China) and seaborne crude flows were increasingly redirected from Europe to India and Asian countries.

February 2022 was the beginning of the massive disintegration of the European oil, gas, coal, and electricity sectors from those in Russia and Belarus and the subsequent re-organisation of LNG, crude oil, oil product and to a lesser extent coal markets. The pre-war level of integration was much deeper than publicly known. The size of energy trade flows and (partial) ownership of energy assets in each other's energy economies was obfuscated by the organisation of international energy trade and how that translated into physical flows. Although energy can be seen as strategic, the changes in ownership of (fossil) energy companies to owners from Russia and China did, by hindsight, not draw enough political attention in the last decade nor did the EU liberalisation drive make sufficient provisions for a security of supply policy. The consequences of this integration simply did not filter into the narratives of liberal markets and energy transition. The focus on short-term benefits for consumers was prevailing over the longer-term costs of security of supply.

In March 2022 the decoupling of the EU energy market from Russia's energy system began with the implementation of the first sanction packages (see Appendix). The first package was targeted on seizing the financial relations and persons, energy sectors were left untouched. Already early March energy companies were under growing pressure to apply self-sanctioning and terminate energy trading with Russia, while the call from certain political parties to sanction energy relations increased. The EU very quickly offered an expediated and ambitious version of *Fit for 55* as the way

6 For the top ten oil consumers and producing countries see: https://www.forbes.com/sites/rrapier/2022/07/22/the-us-is-still-the-worlds-top-oil-producer/

forward to remedy the (medium to longer-term) supply situation in the EU, while the IEA presented 10-point plans for oil and gas to address the shorter-term issues. All in the first three weeks of the war in Ukraine. The sanction packages followed in quick succession. Coal was the first energy trade flow to be sanctioned, to be implemented per 10 August 2022. Fuel oil was included in the coal sanction package, because of the UN coding, which was based on its aromatic content. Late April/early May discussions started on expanding the sanctions to include all crude oil and oil product trade. This (sixth) sanctions package was accepted on 3 June and will be implemented on 5 December 2022 for crude oil and 5 February 2023 for oil products. This package was accepted without any due diligence on the impact on the EU economies. The argumentation for this sixth sanction package was to reduce the income from oil trade for the Russian state, to reduce its ability to finance the war in Ukraine. The justification did not take the context of the international crude oil and oil product markets into account nor the, known, slow impact of sanctions, in this case on oil income of the Russian state to finance the war.[7]

The costs of disintegration of European and Russian energy systems will be potentially high in and outside the EU, because large internationally organised oil and gas systems are forced to divert unprecedented flows of gas, crude oil, and oil products. The rebalancing of these international markets will impact internationally organised value chains and the logistics belonging to this system. The EU is a substantial net importer of crude oil, oil products and natural gas and in the past 30 years the share of Russian supplies in EU energy supplies has increased substantially (see Figure 2). Diverting these flows to other markets is one thing, replacing Russian flows from elsewhere to the EU (and the Netherlands) is another. This is of particular concern for the Netherlands/ARRRA, which is deeply integrated in international markets, important for bunkering, but also an entry point for crude oil, oil products and natural gas and an exit point to the EU hinterland and international markets.

Securing supplies in the Netherlands does not necessarily imply securing supplies for the Netherlands. The Netherlands is an energy 'bathtub', it can be filled as quickly as it can be emptied, due to its connections with international market and the hinterland. It is therefore important to understand the ramifications of the EU decision-making on international crude oil markets, the impact on international oil product markets, and the potential policy responses (including internationally) in the coming 18-24 months when markets are re-adjusting to the new realities. For a longer-term assessment, much depends on the progress of the energy transition plans such as

7 https://www.clingendaelenergy.com/inc/upload/files/Sanctiebeleid-verdient-strategische-discussie.pdf accessed on 3-11-2022

building out offshore wind, hydrogen production, solar, nuclear, biorefining, biomass and importing hydrogen carriers. Nevertheless, the volumes involved in replacing Russian energy flows to the EU are very large, the replacement of all fossil fuel use concerns much larger volumes and it will take time for new alternative sustainable flows to be organised.

2.1 THE ROLE OF OPEC AND OPEC+ IN INTERNATIONAL CRUDE OIL MARKETS

In the period to the summer, OPEC+ countries were still expanding supplies to world markets as part of their agreements prior to the war, but the gap between what they could produce based on the agreements and what they could deliver to international markets, was growing. Many countries, which are part of the OPEC+ agreement, were unable to fill their allotted quota.

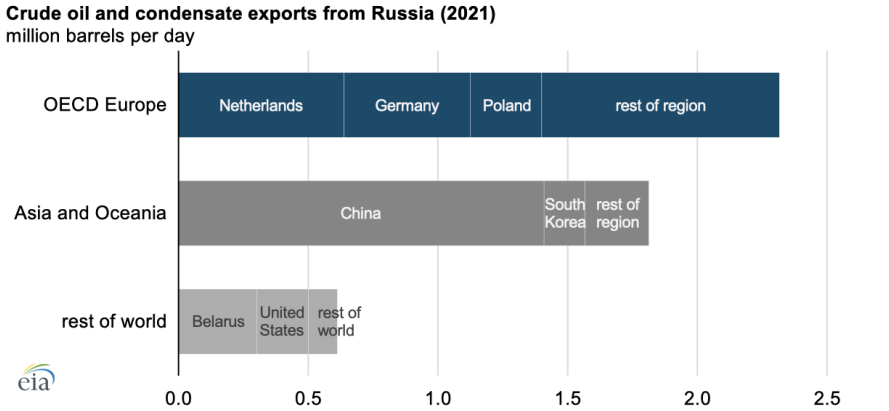
After the dramatic decline in oil demand in the period March-August 2020 due to Covid-19 lockdowns, oil consumption began to rebound in the third quarter of 2020, mainly because of rebounding Chinese demand growth. In response to the dramatic decline in oil demand in 2020, OPEC had agreed on a production reduction policy together with 10 non-OPEC countries, allied in the OPEC+ group, to manage the Covid-19 induced demand shock with production reductions to restore the price level. Oil prices recovered slowly. They stayed below $50 per barrel in 2020 and only in 2021 began to resume an upward trend to reach $70 per barrel in September 2021 and increased further in the fall of 2021 when first China's energy market was constrained and then Europe's. OPEC was careful in easing production cuts, with the impact on oil income in 2020 still fresh in their mind.

In 2021, Russia a prominent member of this OPEC+ group, is the second largest producer in the world (10.5 million barrels per day – mb/d) in the world in 2021 after the US (11.2 mb/d) and Saudi Arabia (producing about 9.4 mb/d).[8] Despite its large production, the US is still a small net importer of oil/liquids, while both Saudi Arabia and Russia are large net exporters (about 7-7.5 mb/d). Prior to the war, the Netherlands was an important gateway for Russian crude and oil condensate imports (see Figure 2), while also China was a substantial importer.[9]

In May 2022, China was the fifth largest producer in the world, but with a consumption of 14.01 mb/d, also a very large and growing net importer of oil.[10] In 2019, oil demand in the EU was approximately 14.8 mb/d and had declined to 13.3 mb/d in

8 Forbes, 22 July 2022.
9 EIA, 14 March 2022.
10 EIA FAQs 10 May 2022 (What are the top producers and consumers of oil?).

2022, of which a large share was imported. The share of Russia in EU crude oil imports was about 25%.



Source: Graph by the U.S. Energy Information Administration, based on Russia's export statistics and partner country import statistics published by Global Trade Tracker

FIGURE 2 RUSSIAN OIL EXPORTS. SOURCE: EIA, 14 MARCH 2022

Since the 1990s, Russia has developed into a substantial energy exporter to world markets and its largest oil and gas companies were also investing in the oil and gas value chains around the world. The Russian participation in the OPEC+ group in December 2016 was significant, because before that, OPEC countries saw Russia as a country freeriding on OPEC production policies. Since then, with some ups and downs, the alliance has endured and pressure of the US to push Russia out of this group have failed.

From March 2022 to September 2022, OPEC+ eased the production ceiling in several steps, only to reverse this easing in their meeting in September. The problem with the easing of the production ceiling was that it exposed the inability of OPEC+ to produce the additional barrels. The gap between the OPEC-plus ceiling and what could be delivered to the international market widened to 3,5 mb/d by September 2022.[11] The reduction of 2 mb/d announced in October 2022, implies a reduction of OPEC+ production of about 1 mb/d, mainly due to reduced production this winter by Saudi Arabia and Russia. Possibly, Russia is experiencing some issues with its production, due to the sanctions and the supply bottlenecks in its own country and in evacuating crude oil to international markets, in addition to traditional reduced winter production levels. At the same time, Saudi Arabia will see the precariously low spare capacity return to somewhat higher levels.[12] Russia and Saudi Arabia are the two largest producers in the OPEC+ group (see Figure 3).

11 IEA OMR September 2022.
12 SP Global, 4 October 2022.

The OPEC+ group is pressing non-OPEC+ producers to step up production, particularly the US, which has been lagging a bit in the expected production increase foreseen for 2022. The OPEC+ decision to cut production just ahead of the US mid-term elections and during the discussion of imposing a price cap on Russian oil exports, was taken as a political afront by the White House, but the EU governments took a more muted position, as they will rely on the Middle East's willingness to service their market after the sanctions kick in.[13]

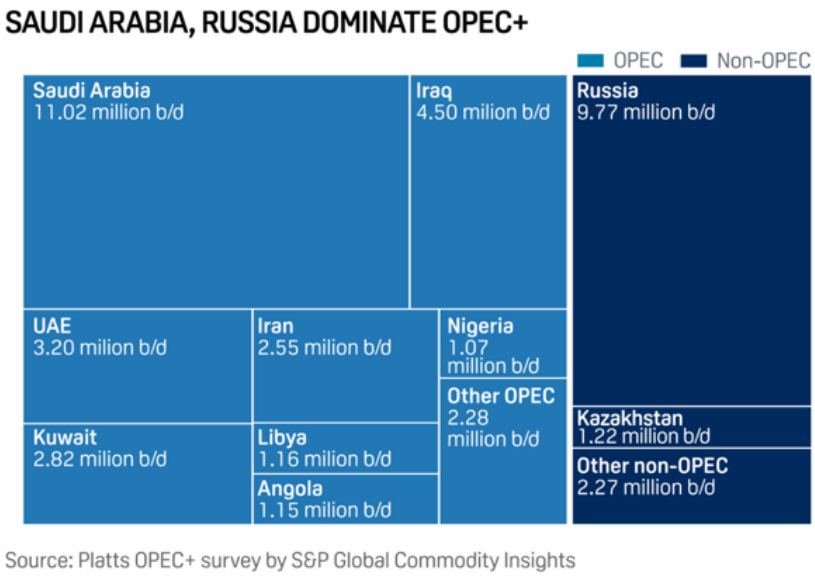


FIGURE 3 LARGEST PRODUCERS IN THE OPEC+ GROUP. SOURCE: S&PGLOBAL, 13 OCTOBER 2022

2.2 FIRST IMPACTS OF THE EU SANCTION POLICY ON CRUDE OIL FLOWS

The immediate response of international crude oil markets was a sharp increase in oil prices (see Figure 1). The first successes in rerouting Russian crude oil flows to India and the increasing fear of a sharp international economic downturn, translated in somewhat lower prices. Early November 2022, the spread between the American WTI and Brent was about 5-7 dollars (88,6 dollars for WTI and 95,4 dollars for Brent on 3 November 2022).[14] Russian crude oil traded at a discount to the Brent crude oil price in the period March to July 2022, between 25 to 35 US dollars, of which mainly India and China benefitted.[15]

13 FT 13-10-22.

14 https://tradingeconomics.com/commodity/brent-crude-oil accessed on 3-11-2022.

15 FSU Weekly Monitor 4-10 July 2022, Icar Energy services, p, 23.

In June 2022, although the EU is still a substantial importer of Russian oil products, its share of Russian crude oil exports was already equalled by China, while also India saw Russian crude imports increase substantially (see figure 4). Russian refineries experienced difficulties to send oil products to international markets, due to bottlenecks in storage and transportation capacities resulting from the reorientation of the markets.

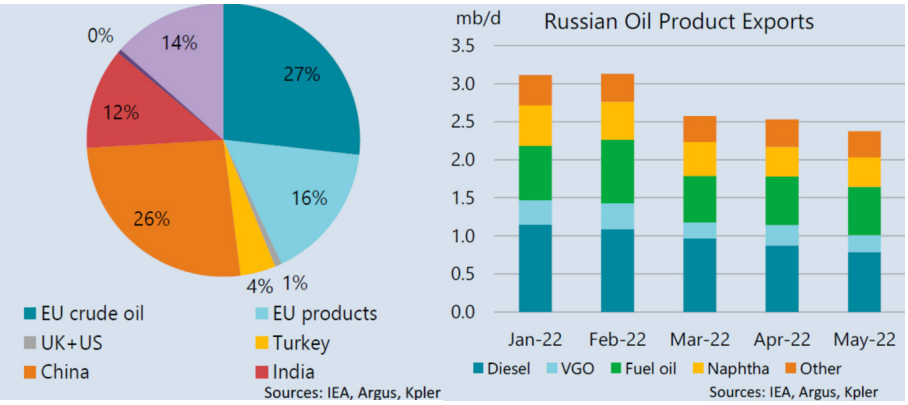


FIGURE 4 DESTINATION OF RUSSIAN CRUDE AND VOLUME OF OIL PRODUCT EXPORTS. SOURCE: OMR, IEA, 15 JUNE 2022

The share of oil imports from Russia in India and China has increased substantially, while supplies to the EU have declined. The decline in oil product imports into the EU is discernible for all oil products, although it was not evenly spread over the EU member states. The hub function of the Netherlands (the size of the storage and transshipment activities) for crude oil and oil products and the re-exports to Germany and Belgium may obscure the Russian imports ending on the Dutch oil market. Mounting public pressure to end imports from Russia in March and April of 2022, forced some companies, active in the Dutch oil sector, to end their term contracts early.

2.3 CHANGING RUSSIAN CRUDE OIL FLOWS IN 2022

Before February 2022, Russian crude oil exports were mainly destined for the Chinese and EU markets. China was mainly supplied by pipeline (ESPO), while the EU was supplied by pipeline (Druzhba) and seaborne oil deliveries. The Netherlands and Italy are prominent importers of Russian crude oil, but also other EU member states import oil from Russia, underlining the potential impact of the oil sanctions. These supplies need to be replaced with crude oil imports from other exporting countries which will imply longer journeys, a less optimal infrastructure in some EU countries to receive seaborne supplies and a changing refinery slate.

Thus, in February 2022 (see Figure 5), the Netherlands is the second largest recipient of Russian crude oil flows, while Germany and Italy are also large importers of Russian crude oil. In the months since March 2022, Russian crude oil flows to the EU declined, while India and Turkey saw imports of Russian crude increase. In September 2022 (See Figure 6), India and China are by far the largest importers of Russian crude oil, with Turkey the third largest importer. Imports of the Netherlands and Italy have declined substantially and will decline further with December 5 approaching. Central and East European countries receive most of their crude oil supplies through the Druzhba pipeline system. Although countries connected to the southern leg of the pipeline negotiated an exemption of the crude oil sanction package, it still leaves these countries very exposed to disruptions. Without many alternative routes to supply some of these refineries, the local markets may become starved of crude oil, and may require oil product supplies from elsewhere by whatever transportation means available and/or rely on strategic oil product releases to fill the gap.

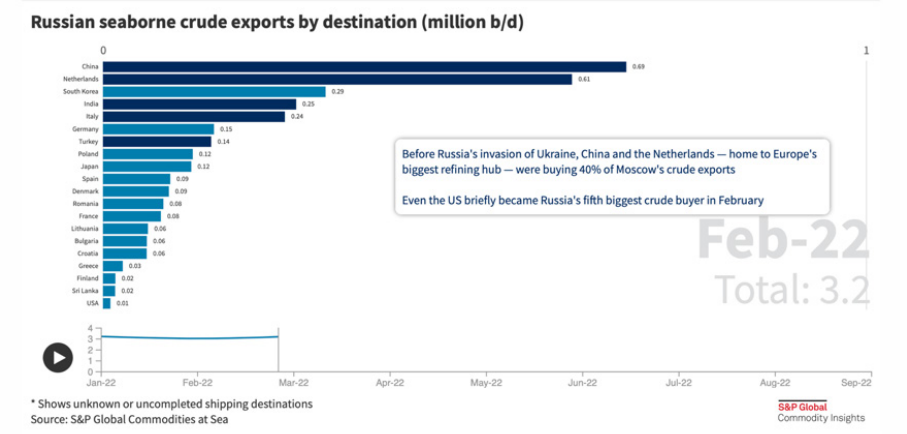


FIGURE 5 RUSSIAN EXPORTS OF CRUDE OIL FEBRUARY 2022. SOURCE:HTTPS://WWW.SPGLOBAL.COM/COMMODITYINSIGHTS/EN/MARKET-INSIGHTS/LATEST-NEWS/OIL/072122-INTERACTIVE-GLOBAL-FLOW-TRACKER-RECORDING-CHANGES-RUSSIAN-OIL-EXPORTS

Much depends on the ability of Russia to find alternative markets for its oil. In September 2022, the discount on Russian crude oil was narrowing and combined with increased tanker rates, the attraction of Russian crude to non-EU off takers began to wane. Also, Middle Eastern suppliers saw their supplies to Asian markets improve again, in part because of their term contracts[16] and in part because Asian buyers do not want to upset their long-term relations with these suppliers for short-term gains.

16 https://www.reuters.com/business/energy/when-eu-embargo-comes-where-will-russia-sell-its-crude-oil-2022-09-23/ accessed at 4-11-22

Moreover, Indian and Chinese refiners may approach their limit to take in Russian crude.[17] Nevertheless, the upsurge of Indian and Chinese demand for Russian crude oil in 2022 has been impressive, and it compensated to a large extent for the drop in EU demand for Russian crude oil (see Figure 6). Turkey also increased its imports of Russian crude oil and is vying to become a hub for Russian natural gas and oil.

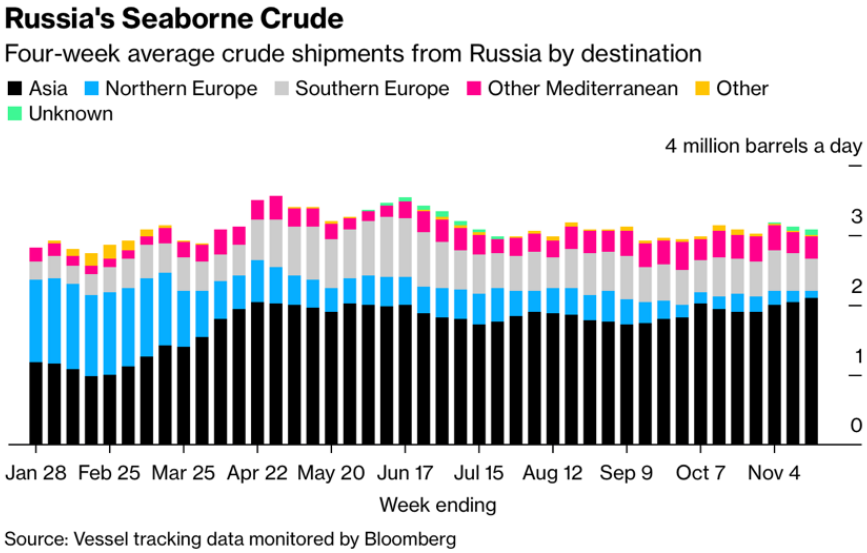


FIGURE 6 RUSSIAN SEABORNE EXPORTS OF CRUDE OIL IN 2022. SOURCE: HTTPS://WWW.BLOOMBERG.COM/NEWS/ARTICLES/2022-11-21/RUSSIA-LOSES-90-OF-ITS-KEY-EUROPEAN-MARKET-BEFORE-SANCTIONS?CMPID=BBD112122_BIZ&UTM_MEDIUM=EMAIL&UTM_SOURCE=NEWSLETTER&UTM_TERM=221121&UTM_CAMPAIGN=BLOOMBERGDAILY (ACCESSED AT 22-11-22)

Thus, mounting public pressure reduced NW European demand for Russian crude early in the war (see Figure 7). The impact on Russian income from crude oil and oil product imports was small, in part because of the uptake of Russian supplies by Asian and Middle East markets, the increase in oil prices, which still delivered a higher price compared to 2021 for the discounted Russian oil, and the increase in Russian export tax on crude oil.[18]

17 https://www.csis.org/analysis/european-union-imposes-partial-ban-russian-oil accessed at 4-11-22.

18 https://www.iea.org/commentaries/coordinated-actions-across-europe-are-essential-to-prevent-a-major-gas-crunch-here-are-5-immediate-measures, Commentary Fatih Birol, 18 July 2022.

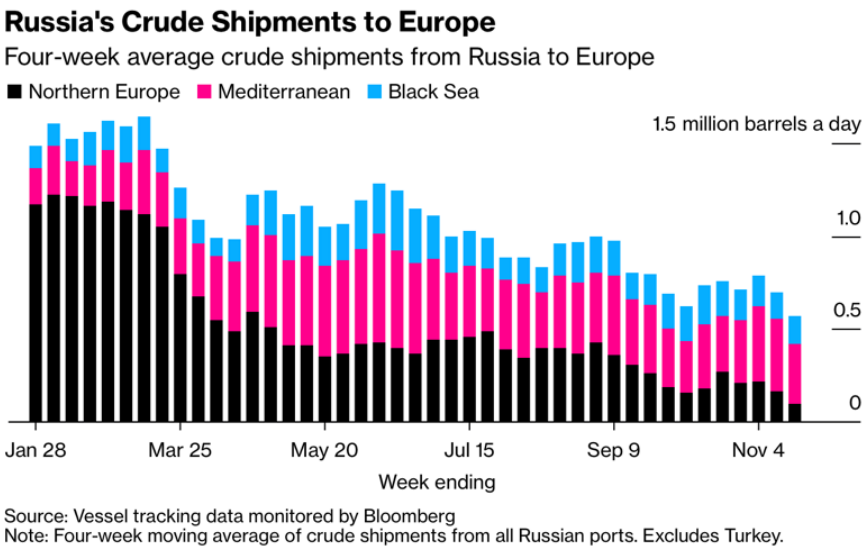
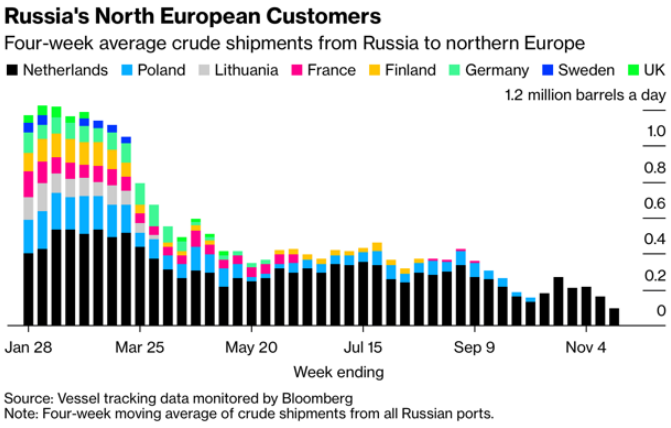
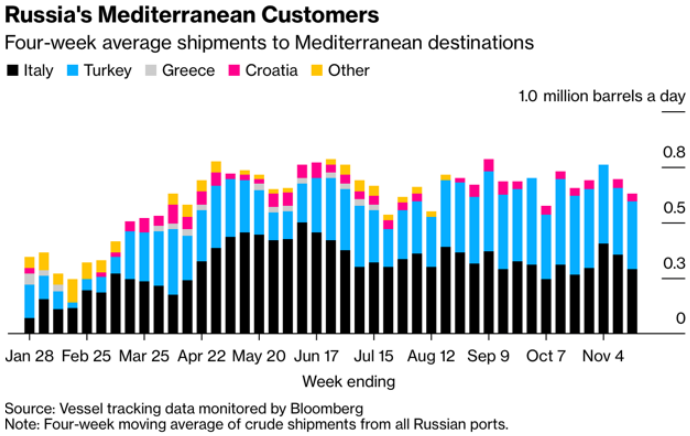


FIGURE 7 RUSSIAN SEABORNE EXPORTS TO EUROPE. SOURCE: HTTPS://WWW.BLOOMBERG.COM/NEWS/ARTICLES/2022-11-21/RUSSIA-LOSES-90-OF-ITS-KEY-EUROPEAN-MARKET-BEFORE-SANCTIONS?CMPID=BBD112122_BIZ&UTM_MEDIUM=EMAIL&UTM_SOURCE=NEWSLETTER&UTM_TERM=221121&UTM_CAMPAIGN=BLOOMBERGDAILY (ACCESSED AT 22-11-22)

The share of the Netherlands is rapidly declining from the summer of 2022 onwards (see Figure 8). The continued imports are largely due to refineries with a Russian shareholder in Italy, the Netherlands and Bulgaria, which are geared towards processing of Russian crudes (see Figure 9) and term contracts. Replacing crude oil flows in the Mediterranean may be a challenge. Based on these Bloomberg figures, the diversion of crude oil flows is in full swing ahead of the December sanction date, but finding a replacement source for these last volumes may be hard. Regarding oil products, exports of fuel oil, already sanctioned in August, show a shift towards Asian markets too.[19]





FIGURES 8 AND 9 RUSSIAN SEABORNE CRUDE DESTINATIONS IN EU. SOURCE: HTTPS://WWW.BLOOMBERG.COM/NEWS/ARTICLES/2022-11-21/RUSSIA-LOSES-90-OF-ITS-KEY-EUROPEAN-MARKET-BEFORE-SANCTIONS?CMPID=BBD112122_BIZ&UTM_MEDIUM=EMAIL&UTM_SOURCE=NEWSLETTER&UTM_TERM=221121&UTM_CAMPAIGN=BLOOMBERGDAILY (ACCESSED AT 22-11-22)

19 https://www.vortexa.com/insights/products/russian-residual-oil-flows-to-the-east/ accessed at 2-11-22.

The changing export destination of Russian exports is reflected in the changing origin of EU crude oil imports. Russia is, as said, in February 2022 the largest source of crude oil of the EU with 1.5 mb/d (see Figure 10), while in September 2022 Russia is still the largest (1 mb/d), but a declining source of crude oil in the run up to the 5 December 2022 sanctions (see Figure 11). Nevertheless, still nearly a million barrels per day need to be replaced. It is not easy to replace these supplies with imports from just one source, consequently imports must increasingly consist of smaller volumes with a variety of origins.

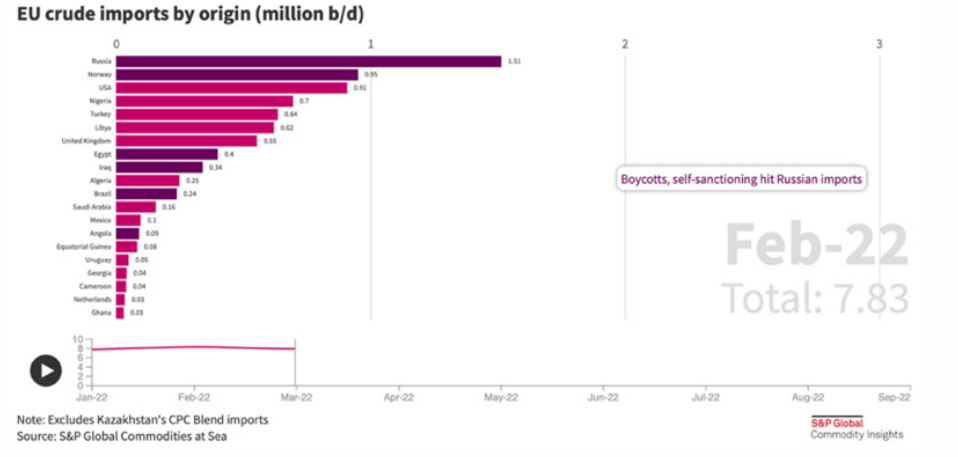


FIGURE 10 EU CRUDE OIL IMPORTS FEBRUARY 2022. HTTPS://WWW.SPGLOBAL.COM/COMMODITYINSIGHTS/EN/MARKET-INSIGHTS/LATEST-NEWS/OIL/072122-INTERACTIVE-GLOBAL-FLOW-TRACKER-RECORDING-CHANGES-RUSSIAN-OIL-EXPORTS

Previous smaller suppliers have increased their flows, notably Brazil and Saudi Arabia, while larger non-Russian suppliers, US, and Norway, held supplies steady. Nevertheless, in September 2022 about 1 mb/d of Russian crude oil imports still needed to be replaced by 5 December 2022. The relative scarcity of Ural-like oils, so called medium sour crudes, have benefited Sverdrup oil from Norway[20], while Russia made Ural lighter and sweeter to make the crude more attractive to Asian buyers.[21] The crude slate in the EU has already become 2[0] API[22] lighter than when Urals was the baseload crude, negatively affecting the middle distillate output.[23]

20 PIW 3-11-22

21 Reuters, June 27, 2022, https://www.reuters.com/article/russia-oil-quality-idUSKBN2O80U5, accessed at 4-11-22

22 A specific gravity scale developed by the American Petroleum Institute (API) for measuring the relative density of various petroleum liquids, expressed in degrees. API gravity is gradated in degrees on a hydrometer instrument and was designed so that most values would fall between 10° and 70° API gravity. The arbitrary formula used to obtain this effect is: API gravity = (141.5/SG at 60 degF) – 131.5, where SG is the specific gravity of the fluid. https://glossary.slb.com/en/terms/a/api_gravity accessed at 8=11=22

23 PIW, 3-11-2022.

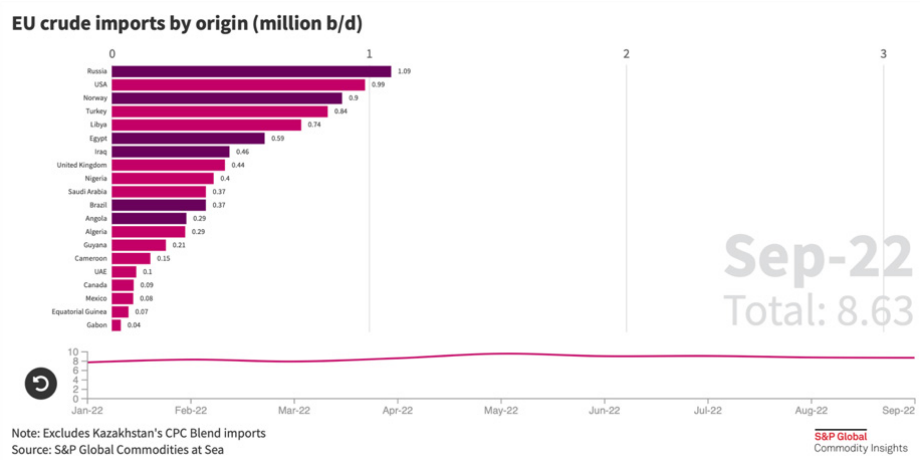


FIGURE 11 EU CRUDE OIL IMPORTS SEPTEMBER 2022.HTTPS://WWW.SPGLOBAL.COM/COMMODITYINSIGHTS/EN/MARKET-INSIGHTS/LATEST-NEWS/OIL/072122-INTERACTIVE-GLOBAL-FLOW-TRACKER-RECORDING-CHANGES-RUSSIAN-OIL-EXPORTS

2.4 CRUDE OIL TRANSPORTATION

The oil sanctions also include insurance and financing services for Russian seaborne crude and oil product trade. The sixth and the eighth EU sanction packages will limit these services. Because of the dominance of UK and EU companies in maritime insurance, the trade may be limited if no alternatives for these services can be found. Moreover, though some EU member states/refineries are exempt from the sanctions on importing crude through the Druzhba pipeline, which will alleviate their supply situation, it may also make them more vulnerable for political pressure because of the absence of alternative sourcing. In recent months, supplies through the Druzhba pipeline amounted to 490 thousand b/d through the northern leg, supplying Poland and Germany's eastern refineries and 245 thousand b/d supplying refineries in Slovakia, Hungary, and the Czech Republic through the southern leg (see Figure 12).[24] Other refineries in Germany and Austria are connected to the pipeline system which originates in Trieste, on the Adriatic coast (the Transalpine pipeline system, or TAL), or to the Adria pipeline system in Croatia, Hungary and Serbia. Nevertheless, there appears to be room to supply the refineries in Slovakia, Hungary and the Czech Republic after debottlenecking.[25] It would, however, put more strain on the EU to replace Rus-

24 Reuters, 12 October 2022.

25 HIS/S&PGlobal 16 March 2022: "The Adriatic pipeline systems should have the spare capacity to ramp up imports of waterborne crude in case of a full Druzhba system shutdown. The Adria crude oil pipeline system, starting at the Omisalj terminal in Croatia, is rated at 480,000 b/d and would support refineries in Croatia, Serbia, Hungary, and Slovakia. There may be limitations to the transit capacity from Croatia to Hungary and Slovakia, but sustaining at least 75% utilization in Slovakia and Hungary should be feasible from a pipeline perspective. The maximum observed flows on the Transalpine (TAL) pipeline system, which originates at Trieste, have been around 930,000 b/d. If all connected refineries were operating at a 90% utilization rate, that would call on 960,000 b/d via TAL, which should be feasible, again assuming alternative crudes can be secured in the Mediterranean, for instance diverting Middle Eastern spot barrels from Asia or maximizing West African inflows as well as volume flexibility on term contracts."

sian crude flows with alternative seaborne supplies, and would challenge the refinery slate of these refineries, as Urals must be replaced by other types of crude. This may unbalance supply of oil products in the region.

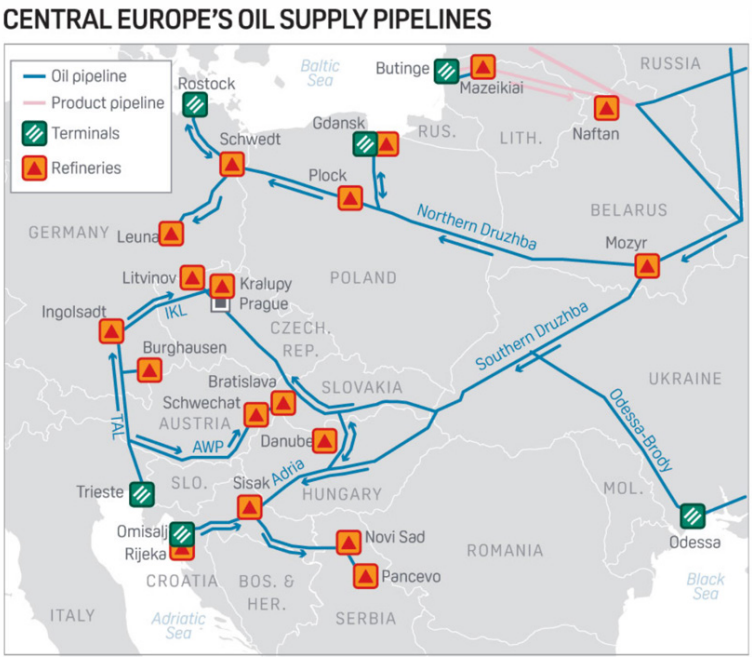


FIGURE 12 PIPELINE CRUDE OIL SUPPLIES. SOURCE: S&PGLOBAL, 20 JUNE 2019 (HTTPS://WWW.SPGLOBAL.COM/COMMODITYINSIGHTS/EN/MARKET-INSIGHTS/LATEST-NEWS/OIL/062019-TRANSNEFT-REPORTS-NEW-DRUZHBA-OIL-PIPELINE-CONTAMINATION-DISCOVERY)

The changing call on crude oil imports from the EU, also impacts the tanker market in the world. The lead time to accommodate the redirection of crude and oil product flows around the world creates logistical problems. With more crude oil required to travel longer distances to markets, the call on the available tankers will increase (see Figures 13 and 14).[26] The lead time to build new tankers to accommodate the changing logistics is long, also because shipbuilders are booked 18 months ahead of time. Furthermore, the demand for LNG tankers is also increasing, because of similar dislocations in the international gas market. The dislocation in crude oil markets will tighten the market for tankers and raise tanker rates. This may impact the attractiveness of Russian crude oil for alternative markets when the discount on Russian oil

26 "The switch of Russian oil shipped to China and India instead of Europe is estimated to require around 30 Aframaxes (including those employed for lightering), 50 Suezmaxes and most importantly more than 40 VLCCs." Source: https://ihsmarkit.com/research-analysis/tanker-demand-to-grow-35-56-as-europe-avoids-russian-oil-asia-.html

no longer compensates for increased tanker rates. Besides, shipping companies also must decide if they are willing to be banned from the EU market, or comply with the sanction regime of the sixth and foreseen eight package (price cap). It is possible that two types of fleets will come into existence, those that can and cannot berth in the EU with oil and oil products. This will impact the efficiency of carrying crude oil and oil products around the world, and may further impede transport efficiency, increasing the volume of crude oil and oil products at sea. Importers in the EU are required to check IMO codes of ships to avoid reflagging and reregistering to avoid sanctions.[27]

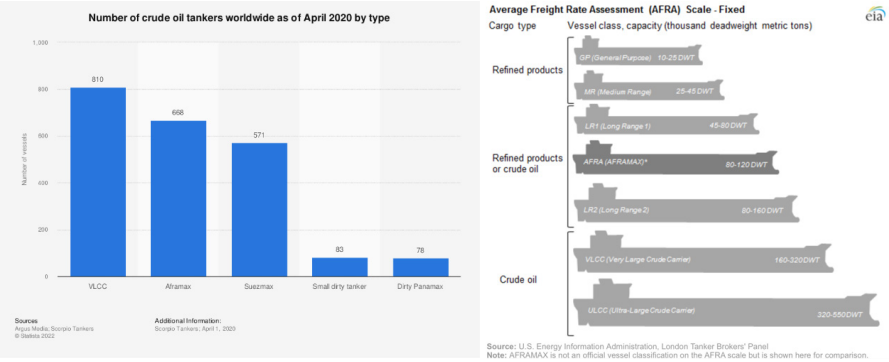


FIGURE 13 AND 14 NUMBER OF OIL TANKERS BY TYPE IN 2020 AND TYPES OF OIL TANKERS. SOURCE: HTTPS://WWW.STATISTA.COM/STATISTICS/468405/GLOBAL-OIL-TANKER-FLEET-BY-TYPE/ (LEFT) AND HTTPS://WWW.EIA.GOV/TODAYINENERGY/DETAIL.PHP?ID=17991 (RIGHT)

Exports from Russia take about 8 days to reach the EU market, while exports to alternative markets in the Atlantic, Latin America and West Africa, will take about 30 days to reach.[28] The longer voyage would be more efficient if larger ships could be used to carry the oil to further away markets. Russian crude oil is transported mainly in Aframax ships, which are relatively small for longer distances to for instance India, and China (see Figure 15). However, the larger vessels cannot load in Russia to increase voyage efficiency. Ship-to-ship loading from Aframaxes to VLCC's to take Russian oil to markets beyond the EU usually took place on the Danish and Dutch coasts.[29] Currently, these ships may also benefit from the fact that they bring alternative crude from the Middle East to NW Europe, while they take Russian crude for the return

27 https://www.consilium.europa.eu/en/policies/sanctions/restrictive-measures-against-russia-over-ukraine/sanctions-against-russia-explained/#sanctions accessed at 4-11-22

28 IEF-S&P Global, Oil Refining Industry Insights, Stretched Sector Market Fuels Market Volatility, September 2022, p. 10.

29 "There have never been any VLCCs loading directly from any of Russia's biggest crude oil exporting ports in the Baltic and the Black Sea (Novorossiysk, Primorsk and Ust-Luga), with local port restrictions allowing ships up to Suezmaxes to call at their berths, according to Market Intelligence Network." https://ihsmarkit.com/research-analysis/tanker-demand-to-grow-35-56-as-europe-avoids-russian-oil-asia-.html

journey to Middle Eastern and Asian markets, offering some crude flow switching efficiencies. How long these operations can be sustained after the sanction package is implemented is still unclear, depending on the strictness with which the sanctions are enforced. Here, the administrative burden may lead to further self-sanctioning, or to sanction slippage when administratively the origin of crude oil shipments is hard to determine.

Russia bought vessels from the 'dark fleet' to expand its crude and fuel oil fleet. These ships were previously used to carry Venezuelan and Iranian oil to circumvent sanctions.[30] Buying ships from the dark fleet to carry clean products (CPP[31]) will be harder and may not add sufficient capacity to Russia's fleet to carry their products to distant markets. Furthermore, also vessels destined to be scrapped were brought back into operation.

Another preparation for the coming sanction date is in transshipment. Already, transshipment activities are occurring in international waters near the Azores. The danger of transshipments in open international waters instead of in specialised harbours like Rotterdam, is more oil spillage and spillage far away from specialised services to reduce the environmental impact.

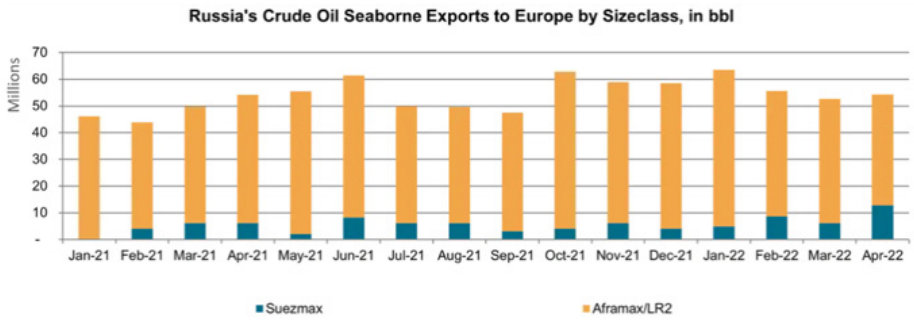


FIGURE 15 TYPE OF TANKERS CARRYING RUSSIAN CRUDE OIL MILLION BARRELS. SOURCE: HTTPS://IHSMARKIT.COM/RESEARCH-ANALYSIS/TANKER-DEMAND-TO-GROW-35-56-AS-EUROPE-AVOIDS-RUSSIAN-OIL-ASIA-.HTML

30 https://www.tradewindsnews.com/tankers/russia-grabs-growing-share-of-dark-fleet-at-iran-s-expense-says-braemar/2-1-1320896 accessed at 4-11-22

31 CPP stands for Clean Petroleum Products which includes gasoline, heating oil, gas oil, naphtha, and jet fuel. Vortexa noted: "The continued attractiveness of clean maiden voyages is also indicated by the number of crude vessels that took part in a CPP trade relative to the total deliveries. During H1 2021, 55% of the VLCCs delivered were involved in a CPP voyage, while the number fell only slightly to 46% during H2 2021. A similar comparison for Suezmaxes showed that 2 out of the 3 vessels delivered in the H2 2021 carried CPP for their first voyage. https://www.vortexa.com/insights/freight/maiden-crude-tanker-cpp-voyages-what-happened-and-what-to-expect/ accessed at 8-11-22

Apart from the sanctioning of crude oil deliveries to the EU, the impact on the crude oil services sector may be substantial. The international marine insurance business was largely a European affair, and these sectors already see newcomers on the market without any track record in the business, but with an appetite to benefit from the EU withdrawing from this market. Much will depend on the price cap under construction by the G-7 and the adoption by the EU, and how this may dampen the impact on crude oil supplies, while capping income from oil for Russia.[32]

2.5 REFLECTION[33]

The diversion of crude supplies to the EU, including to the Netherlands, is in full swing from spring onwards. Early November 2022, the EU still needed to replace about 1,2 mb/d by alternative crude oil supplies. In the short term, it appears that new crude supplies were found in a combination of new and existing EU suppliers to the EU to replace Russian supplies. The new deliveries create a more diverse crude supply in terms of crude oil types and geographic origin; the crudes are lighter than Urals and come mainly from Norway, West Africa, US, and the Middle East. The change in types of crude delivered in the EU has consequences for the yield of EU refineries because refining lighter types of crude implies more output of gasoline and less middle distillates like gas oil/diesel. Another consequence is that EU refineries may operate less efficiently because they were optimized for Urals.

The time in which purchased supplies reach the EU market will increase substantially and will require more (types of) tankers to deliver the crude oil to the markets. The longer distance to market implies that crude oil is trapped in tankers for a longer period of time, and thus not available for conversion into oil products. Supplies from Russia could be purchased with relative quick delivery times and short journeys, while, due to the longer journey, the new supplies need to be purchased much longer ahead, to arrive in time for conversion. Moreover, the longer journey can be optimised by using VLCCs (Very Large Crude Carriers), but will require break bulking the crude in smaller ships for the oil to be able to reach the markets in the East Sea/Baltic Sea. The East Sea/Baltic Sea harbours changed from being close to the export ports in Russia, to being at the end of the journey for longer range crude oil supplies. This makes these entry points in Germany and Poland and the inland markets they serve more vulnerable. At the same time, the tankers taking Russian crude oil to markets beyond the EU and UK are too small to make the longer journey to new markets. The tanker size is limited for passage through the Danish Strait. The relatively small Russian crude oil tankers must travel further to transship the crude oil into the VLCCs

32 FT, 5-11-2022.

33 These reflections are a based on the analysis of this chapter and insights from discussions with market participants.

for Asian and Middle Eastern markets. Until the sanctions take effect, these transshipments take place off the coast of Denmark and the Netherlands, but may have to move south, off the North African coast, to avoid infringement of the sanctions. Another complication is that the impending price cap may effectively divide the tanker fleet in those that do and those that don't comply with sanctions, all leading to more demand for tankers, more oil trapped in tankers and potentially less supply.

To deal with the supply and transportation pressures, much will depend on the efficiency with which the flows can be reorganised, the impact of the expected economic recession on oil demand and the return of demand in China. Spare crude oil production capacity is low compared to the size of the market of around the 100 mb/d and resides only in three countries, Saudi Arabia, the United Arab Emirates and increasingly in Russia, available only to the non-sanctioned part of the international oil market. The tightness of the international market depends on the ability to bring Russian crude oil to non-sanctioned markets, and the absence of further disruptions in crude oil flows. Decision-making by the OPEC+ group of countries on their supply quota also matters for world crude oil supply, although many producing countries in de group have been unable to deliver their share. The relatively low levels of investments in new crude oil production in the past decade, apart from the US, in combination with sanctioning one of the three largest oil producers and a very large net-exporter from the OECD markets, and the lower willingness of international capital markets to invest in new crude oil projects, all contribute to the tight international market in the next few years. Demand is still projected to increase, albeit at a slower level, depending on economic growth.

The price cap seeks to facilitate a reduction of the impact on world supplies and maintain the dominance of European companies in the marine insurance sector. Compliance of India and China with the price cap is crucial for it to have the desired effect on Russian income from oil exports, just like the (grudging) acceptance of Russia of the cap. The balancing act of Saudi Arabia in combining longer-term OPEC+ interests with short-term world economic interests is also crucial to avert further international crude oil market tightness. The outcome of the complicated balancing act of crude oil supply diversion is still unclear.

The availability of crude oil flows for the Netherlands is important to feed the Dutch, German and Belgian refineries, and service the crude oil and oil product flows in the storage and blending sector. The Dutch refineries have replaced most of the Russian crude oil intake and replaced them with crude oil from other countries. The advantage of Dutch refineries prior to the war was the ability to desulphurise sour crudes

and fuel oil, but high gas prices and less supply of these type of flows, have changed the economics of this type of refinery activity. Servicing Russian crude and fuel oil flows for markets beyond NW Europe, may not return after the war, which would imply a loss of international functionality for the hub.

Replacing the last crude oil barrels coming from Russia might become harder, and the type of oil available less suitable for EU refineries. This will affect the supply of middle distillates. In an already tight market for middle distillates, it leaves little space for the oil market participants to solve some of the bottlenecks. The emergence of new untested players makes crude oil supplies also vulnerable to illegal or non-compliant practices. This could result in more caution to contract supplies. Strategic reserves may be important to supplement supplies in case of a physical shortage or disruption in the much longer supply lines.

The call on Atlantic crude oils (West Africa, Brazil, Norway, and US) has increased substantially and may need to be supplemented with Middle Eastern crudes, although these are often under term contracts. The absence of 'baseload' Urals grade crude in the EU and their replacement with sweeter and lighter crudes will impact the refinery yield. In turn, this will impact the production of oil products in the EU and may emphasize the importance to tap into new oil product imports to remedy the sanctions on oil products implemented on 5 February 2023.

3 IMPACT OF DISPLACING RUSSIAN OIL PRODUCT EXPORTS FROM WESTERN MARKETS

Apart from the large exports of crude oil to world markets, including the EU, Russia is also a substantial exporter of oil products to the EU. The EU has been a net importer of a variety of oil products. The European refinery industry has been in a consolidation process since the early 2000[34], resulting in a declining refinery capacity and a disbalance in demand and supply for certain refinery products.

Refiners operate between two markets, the crude oil market, and the markets for oil products. Refineries also produce a variety of other oil products, in so-called co-production. The volume of production of certain oil products depends also on the type of crude oil or crude blends that are processed and the complexity of the refinery. The economics of the refinery relies on the refinery's ability to produce sufficient oil products with a positive crack spread compared to crude oil. Gasoline and diesel are typical premium products due to the relative price inelasticity of demand, while kerosine, naphtha and fuel oil are oil products more sensitive to economic activity. EU refineries are geared towards middle distillates (see Figure 16). The chemical industry is an important customer for oil products, ranging from gasoil, naphtha, LPG, to ethane.[35] The energy crisis is impacting the chemical industry hard, and the increasingly unlevel playing field due to high energy prices (natural gas and power), has led to net chemical imports.[36] Declining demand for some oil products such as naphtha and tightness in other oil product markets, may squeeze refineries beyond their flexibility. This flexibility is now crucial for the EU refineries, to adapt to the shock of moving away from the 'baseload' Russian crude oil supply. Another limiting factor for refinery production, may be the lack of sufficient storage facilities for naphtha. Although naphtha can be blended away to some extent in motor fuels, demand for naphtha in

34 https://www.clingendaelenergy.com/publications/publication/european-union-industrial-energy-use-with-a-focus-on-natural-gas (2017) and https://www.clingendaelenergy.com/publications/publication/long-term-prospects-for-northwest-european-refining (2016).

35 Fuels Europe, Statistical Report 2022, figure 39, https://www.fuelseurope.eu/statistics, accessed at 9-11-2022.

36 Energy Crisis: the EU Chemical industry is reaching breaking point, CEFIC Position Paper, October 2022.

the chemical industry is important to prevent production merely for storage.[37] Once the available storage space is filled, apart from the cost of storing, it can create a bottleneck in the production of other oil products.

Demand for oil products has been stable in the past years, apart from in 2020 and 2021, when Covid-19 lockdowns caused a demand shock in kerosine markets. Future EU demand for motor fuels is expected to decline because of the rise of electric vehicle sales and policymaking.[38] In the past 20 years, many refineries were either sold, converted to terminals or biorefineries (more recent), or closed.[39] This process of consolidation was matched in the same period by an upgrade of Russian refineries, resulting in more exports to the EU of fuel oil, naphtha[40], VGO and diesel. This integration of EU and Russian oil product markets will come to an end on 5 February 2023 at the latest, leaving the oil product market in the EU unbalanced.[41] Much will depend on the ability of refineries elsewhere and on the international oil product trade, to mitigate these unbalances between oil product demand and supply in Europe. In China, for instance, refining is seen predominantly as a domestic industry

37 https://www.vortexa.com/insights/products/nowhere-but-storage-for-naphtha-amid-global-supply-glut/

38 In some countries with a large share of natural gas-powered electricity generation (and short-term natural gas-oriented markets), the advantage of per kilometre energy cost of an EV has as good as disappeared due to high electricity prices compared to gasoline and diesel. A prolonged energy crisis may impact the expected growth of EV and hybrids in these markets. See also https://www.euronews.com/next/2022/11/01/electric-cars-are-still-cheaper-to-run-than-petrol-and-diesel-recharging-vs-refuelling.

39 https://www.clingendaelenergy.com/publications/publication/refinery-2050-refining-the-clean-molecule and https://www.clingendaelenergy.com/publications/publication/the-european-refining-sector-a-diversity-of-markets accessed at 6-11-22.

40 James G. Speight, Handbook of Industrial Hydrocarbon Processes, 2019 (section 2.1.6), Elseviers. "In general, crude oil, once refined, yields three basic groupings of products that are produced when it is broken down into cuts or fractions (Speight, 2014a, 2017a). The complexity of crude oil is emphasized insofar as the actual proportions of low-boiling, medium-boiling, and high-boiling fractions vary significantly from one crude oil to another. (…) Naphtha, a precursor to gasoline and solvents, is extracted from both the low-boiling and middle range of distillate cuts and is also used as a feedstock for the petrochemical industry. The middle distillates refer to hydrocarbon products from the middle boiling range of crude oil and include kerosene, diesel fuel, distillate fuel oil, and low-boiling gas oil. Waxy distillate and lower boiling lubricating oils are sometimes included in the middle distillates. The remainder of the crude oil includes the higher boiling lubricating oil fractions, gas oil, and residuum (the nonvolatile fraction of the crude oil). The residuum can also produce high-boiling lubricating oils and waxes but is more often used for asphalt production."

41 On 5 December 2022 the sixth sanctions package must be fully implemented regarding crude oil imports as formulated in article 3m of the amended EU Regulation no. 833/2014 and on 5 February 2023 the same applies to imported oil products. See https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52022XC0803(01)&qid=1666023128148&from=EN. This sanctions package was agreed on 3 June 2022 and includes the suspension of financial and insurance services on oil and oil products trade. Pipeline supplies (Druzhba) and Bulgaria (on VGO) have received a derogation from this Regulation. From 3 June 2022, only term contract concluded before 3 June 2022 and one-off purchases (spot) are allowed until the cut-off dates. The EU Commission must be notified of these one-off deals. Fuel oil imports from Russia were already banned in August 2022, in the so-called Coal sanction package. For the latter see: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32022R0576&from=EN; https://www.reuters.com/business/energy/eu-could-ban-some-russian-fuel-oil-imports-six-months-ahead-deadline-2022-07-15/ and https://www.reuters.com/markets/europe/sanctions-hit-russia-sending-fuel-oil-asia-ship-to-ship-terminals-2022-08-24/. Why Fuel Oil was made part of the coal sanction package is unknown.

and exports capped, while India and the Middle East are home to some large export refineries. Oil product trade depends on the open market approach of national governments. The exports of American oil products to export markets in summer 2022, left American storages low and pushed domestic gasoline and diesel prices up.

3.1 EUROPEAN REFINING

The EU refining slate is geared towards middle distillates (see Figure 16).[42] Germany and Italy, followed by Spain and the Netherlands have the largest refining capacities. (see Figure 17). Refining lighter grades of crude when Urals are backed out of the EU market, implies a larger yield of gasoline and about 6% less of gas oil/diesel.[43]

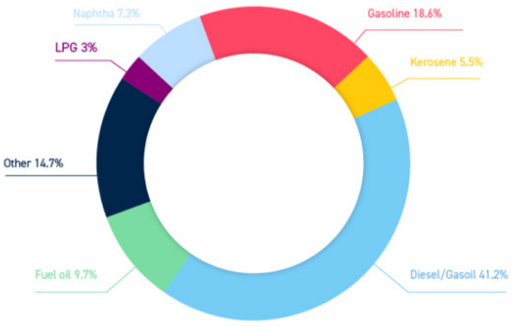


FIGURE 16 DISTRIBUTION OF OIL PRODUCT PRODUCTION IN EU REFINERIES; GEARED TOWARDS GAS OIL/DIESEL. SOURCE: HTTPS://WWW.FUELSEUROPE.EU/STATISTICS

In the past years, Russian oil companies have enlarged their asset base in Europe. They hold shares in various refineries in Europe. Germany has brought these refineries under custodianship, while in other countries it is still unclear what the position of these refineries will be. Recently, the sale of the ISAB refinery in Sicily, Italy, by Lukoil to an American buyout group has run into difficulties, making a solution prior to 5 December 2022 uncertain, and may pressure the Italian government in a similar move as Germany to prevent the refinery from closing.[44] Also elsewhere in the EU, Russian co-owners may have to either be bought out, or will see their assets seized or

42 "A major factor is what is known as refinery configuration, i.e. the combination of processes operated by a given refinery which, to a large extent, determines which crude oils can be processed and the type, yield and quality of the different refined products that can be manufactured." Cited from Concawe report no.3/12, p. 4.

43 See assessment of COVA on potential supply gap, figure 27.

44 FT 4-11-22 (https://www.ft.com/content/f63cc4c0-7766-4a9c-bfe5-242a129aa990#myft:my-news:page accessed at 5-11-22). "However, according to several people close to the talks, Lukoil remains reluctant to sell to the US buyout fund. Vitol was willing to extend credit to Crossbridge at a rate better than the US group could get from a traditional lender as it stood to benefit from supplying crude to the Italian refinery. The deal would have helped avoid Italy nationalising the Sicilian plant, which is facing a cliff-edge in its crude supplies when EU sanctions targeting Russian seaborne oil exports come into full effect next month. Before the outbreak of the war in Ukraine the refinery sourced its crude from a variety of countries but lenders stopped providing financing after the EU imposed sanctions on Moscow, forcing the refinery to rely exclusively on its Russian parent company for crude."

put into guardianship to guarantee continuation of business after 5 December 2022. This may depend on which company operates the refinery and how the operations can be continued under the sanction regime.

In 2019, the last 'normal year', Russia produced 11.2 mb/d and exported 5 mb/d of crude and 2.8 mb/d of oil products. The EU imported 2.4 mb/d of crude oil from Russia and 2.8 mb/d in oil products.[45] The Netherlands was by far the largest importer of refined oil products from Russia with on average 335 thousand barrels per day.[46]

Country	Mainstream > 30 kb/cd Mt/a
Germany	101.5
Italy	84.8
Spain	71.5
Netherlands	61.3
France	57.6
Belgium	32.3
Poland	29.2
Greece	24.7
Sweden	19.8
Romania	11.9
Portugal	11.3
Finland	10.3
Austria	9.7
Lithuania	9.5
Czechia	8.7
Denmark	8.7
Hungary	8.1
Bulgaria	5.8
Slovakia	5.8
Croatia	4.5
Ireland	3.6
EU total	**580.2**
United Kingdom	57.1
Norway	10.2
Switzerland	3.4
UK, NO & CH total	**70.6**
Total	**650.8**

Data retrieved from Fuels Europe, statistical report 2022

During the Covid-19 pandemic, demand for oil products declined and the consolidation of the world refining industry continued. Refinery conversions and closures, mainly in the OECD countries, reduced world refining capacity.[47] According to the BP Statistical Review 2022[48], world oil refining capacity stood at 101 mb/d in 2021 with a throughput of 79,3 mb/d. Refinery capacity in the EU was 12,3 mb/d in 2021 with a throughput of 9,4 mb/d. EU throughput in 2022 will be higher due to increasing utilisation rates. Within the EU, Germany and Italy have the largest refining capacities. In 2021, a Covid-19 year, throughput in Germany was 1.6 mb/d, while in Italy this was 1.2 mb/d. In the Netherlands the refining capacity in 2021 was 1.24 mb/d and throughput 1.19 mb/d.

FIGURE 17 REFINERY CAPACITY IN THE EU. SOURCE: HTTPS://WWW.FUELSEUROPE.EU/STATISTICS

45 Icar Energy Services, FSU Weekly Monitor, 11-17 July 2022, p. 20.

46 Reuters, June 1, 2022, at https://www.reuters.com/markets/commodities/how-much-oil-does-european-union-import-russia-2022-06-01/#:~:text=The%20EU%20imported%202.2%20million,0.7%20million%20bpd%20via%20pipeline.&text=The%20bloc%20also%20imported%201.2,0.5%20million%20bpd%20of%20diesel accessed at 13 October 2022.

47 IEF-S&P Global, Oil Refining Industry Insights, Stretched Sector Market Fuels Market Volatility, September 2022, p. 9.

48 https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2022-full-report.pdf accessed at 13-11-2022

3.2 WORLD REFINING

World refining capacity between 2019 and 2022 declined with 3.8 mb/d, while oil product demand increased with 5.6 mb/d once most of the pandemic restrictions were lifted (apart from China) in 2021 and 2022 (apart from China).[49] Refining capacity in 2023 will increase with about 3 mb/d, mainly in the Middle East, Nigeria and China, provided no further delays are encountered.[50] Demand for jet fuel/kerosene is still below 2019 levels, but demand for gasoline and diesel has recovered to 2019 levels, adding pressure on the refinery sector in the world to match demand. Utilisation rates in refining are high, apart from those in China, due to their zero Covid-19 policy (see Figure 18) and in Russia, where refineries struggled in with dislocations (internal transport and storage capacity) due to the war, in the first and second quarter of 2022.

Due to increasing crude and oil product prices and very positive refining margins in spring 2022, the oil industry drew the attention of governments as a potential source for additional taxation, but since the summer, the margins have decreased due to high natural gas prices and subdued demand for certain oil products (among which gasoline).[51] However, low commercial inventories and market dislocations in middle distillate markets made certain oil product prices increase more than crude oil prices in the course of 2022. The tightness in middle distillate markets was the most prominent, reflected in the so-called crack spreads for gas oil/diesel. Russia plays an important role in supplying world markets with heavy feedstocks. The EU is still a substantial importer of Russian middle distillates and gasoil/diesel. Gasoil/diesel output in Russia was in January 2022 around 2 mb/d.[52] Gasoil/diesel imports in the EU from Russia were substantial, with 112.0 MT in 2020, of which 21% originated in Russia.[53] The implementation of EU sanctions on oil products on 5 February 2023 will create a gap between demand and supply in the EU because domestic production will likely decline and the volumes available for imports are insufficient.

49 IEF-S&P Global, Oil Refining Industry Insights, Stretched Sector Market Fuels Market Volatility, September 2022, p. 5.

50 Several refining projects are scheduled in Asia and the Middle East, see https://www.eia.gov/todayinenergy/detail.php?id=53279, accessed at 23-11-2022.

51 https://www.reuters.com/business/energy/global-gasoline-cracks-collapse-blow-refiners-profits-2022-07-25/

52 Bassam Fattouh and Andreas Economou, Implications of the proposed EU ban of Russian oil for global oil markets, 5 May 2022.

53 https://www.clingendaelenergy.com/files.cfm?event=files.download&ui=CVDL-Rondetafel-25-3-2022-Importen-Russische-olie-en-olieproducten-onrust-int-markt.pdf

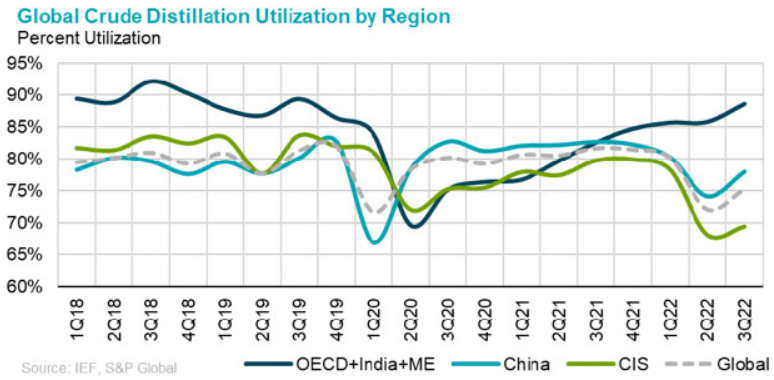


FIGURE 18 UTILISATION RATES IN WORLD REFINING. SOURCE: IEF/S&P GLOBAL, OIL REFINING INDUSTRY INSIGHTS, STRETCHED SECTOR MARKET FUELS MARKET VOLATILITY, SEPTEMBER 2022

In 2021, Russia had a total refinery capacity of 6,861 mb/d and a throughput of 5,273 mb/d.[54] This total capacity is a combination of many very small and simple refineries and a few larger more complex refineries. Only a few refineries have been upgraded to produce export grade oil products, while most other refineries have a low complexity and produce for domestic markets. The export refineries are mainly part of large integrated oil companies, such as Rosneft, Surgutneftegaz, Gazpromneft and Lukoil.[55]

At the same time, until 2021, China was also an important exporter of transportation fuels, but substantially reduced these exports in January 2022 to ensure oil products for domestic markets and to manage its CO2-emissions.[56] India also curbed exports for domestic reasons.[57] The utilisation rate of the Chinese refinery industry is relatively low due to the export restrictions and lower economic activity in 2022.[58] The interest of Chinese refiners, also the National Oil Companies, to export diesel, is growing and they have asked the government for additional quotas for transportation fuels. The weak domestic market may play a role too. The question is whether China is willing to allow these exports for a longer period, to alleviate the tightness in international markets and accept the resultant CO2 emissions. In 2021, China exported 460 thou-

54 BP Statistical Review of World Energy, 2022.

55 Vitaly Yermakov, James Henderson, Bassam Fattouh, Russia's Heavy Fuel Oil Exports: challenges and changing rules abroad and at home, Oxford Institute for Energy Studies, 2019.

56 IEF-S&P Global, Oil Refining Industry Insights, Stretched Sector Market Fuels Market Volatility, September 2022, p. 11.

57 "India's curbs follow similar measures taken by China that have reduced oil product exports from the world's No. 2 refiner." https://www.reuters.com/world/india/indias-export-curbs-tax-hike-exacerbate-global-diesel-gasoline-shortage-2022-07-06/

58 "India's curbs follow similar measures taken by China that have reduced oil product exports from the world's No. 2 refiner." https://www.reuters.com/world/india/indias-export-curbs-tax-hike-exacerbate-global-diesel-gasoline-shortage-2022-07-06/

sand b/d of diesel compared to 100 thousand b/d this year (September 2022). [59] With the relaxation of quotas, export levels could close in on 2021 levels, but will remain far removed from 2019 levels. Much will depend on the economic recovery in China and the governments' willingness to supply world markets.

Commercial distillate inventories are near a 5-year average low (see Figure 19). This world average disguises the unbalance in inventories in the OECD countries and in other countries. Allowing the Chinese refineries to export more to international markets could help improve the availability of middle distillates in world markets. Currently, exports from Russia are still an important part of supplies to the EU and will be hard to replace, other than from the Middle East, India and China, provided they can deliver the proper products specifications.

Refineries in China and the EU, as the large net-gas importing regions, also suffered from significantly higher natural gas prices, which increased their processing costs.[60] According to the 2022 IEF report on refining: "Refineries use natural gas to make hydrogen that is in turn used to remove sulphur from petroleum products so that they can meet quality and environmental standards. Higher natural gas prices mean this desulfurization process becomes more costly, and therefore further driving up prices for very low-sulphur petroleum products. The production of diesel from hydrocracking units, which consumes large quantities of hydrogen per barrel of product, are particularly costly and resulting in high diesel and jet fuel crack spreads."[61] This comes on top of other energy costs, such as a plant's electricity use (depending on the location of a refinery), use of a natural gas power generating unit and the organisation of the local electricity market. For the industrial sector, including refining and (petro)chemicals, the increase of natural gas/LNG prices above international oil prices since July 2021 created a price feedback loop where higher natural gas prices led to higher oil product prices. This feedback loop could force refineries to reassess how best to optimise refinery production when the processing costs can no longer be recouped in a market where diesel would become the only product carrying the economics of the refinery.[62] The expected shortness in diesel production compared to demand has led to stronger crack spreads.[63,64]

59 PIW, 22-09-2022, p.5.

60 IEF-S&P Global, Oil Refining Industry Insights, Stretched Sector Market Fuels Market Volatility, September 2022, p. 13.

61 IEF-S&P Global, Oil Refining Industry Insights, Stretched Sector Market Fuels Market Volatility, September 2022, p. 13.

62 "At the same time the market has demanded an ever increasing proportion of light products (such as road and air transport fuels) and a decreasing proportion of heavier materials such as heavy fuel oil. As a result refineries have gradually become more complex, incorporating an array of processes to "reshape" the supply of refined products to meet the market demand including treating the components of the final products. Peculiar to Europe is the development of a large diesel light duty vehicle fleet which has resulted in a very large diesel fuel market compared to gasoline." Cited from Concawe report 3/12, p. 2.

63 https://www.bloomberg.com/news/articles/2022-08-22/us-diesel-margins-soar-to-30-year-record-for-this-time-of-year

64 https://www.cmegroup.com/education/articles-and-reports/introduction-to-crack-spreads.html

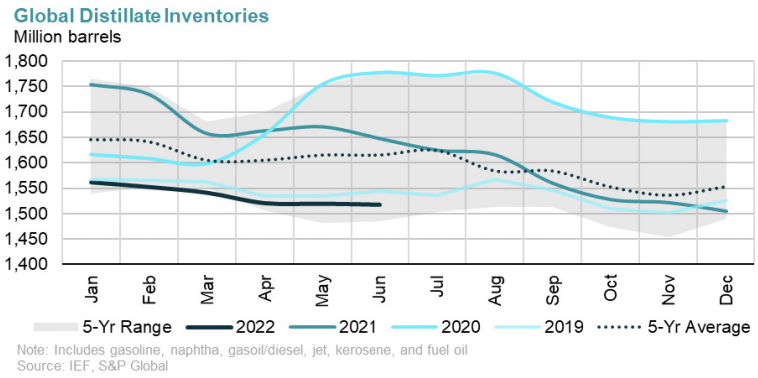


FIGURE 19 GLOBAL OIL PRODUCT INVENTORIES. SOURCE: IEF-S&P GLOBAL, OIL REFINING INDUSTRY INSIGHTS, STRETCHED SECTOR MARKET FUELS MARKET VOLATILITY, SEPTEMBER 2022

For the next few years, refining capacity additions are still expected, mainly in Asia, Africa, and the Middle East, but capacities also continue to be retired or converted in North America and Europe. At the same time, global oil product inventories are low (see Figure 19). Backwardation in crude oil and oil product prices discourages the oil sector players to boost storages, in some countries a reason for governments to increase strategic reserves to counter this trend.[65]

3.3 GASOIL/DIESEL TRADE IN A TIGHT WORLD MARKET

In international gas market, a large volume of LNG cargoes was rerouted to the natural gas short EU market. Low demand for natural gas in China due to a fuel switch to coal and zero-covid policies led to a substantial re-routing of LNG of LT contracted LNG. The export restrictions on diesel and other fuel exports in China running from January 2022 to late September have added to the tightness of international gasoil/diesel markets and prevented a similar move in international oil product markets as in LNG. Low Chinese utilisation rates in 2022 attest to the impact of the export restrictions on international trade in oil products, while markets were looking for alternative supplies for Russian oil product supplies.

The increase in diesel margins since the start of the war in Ukraine and the run up to EU sanctions on Russian diesel imports is substantial (see Figure 20). In the US, diesel exports to higher priced markets in for instance Europe have resulted in very low levels of diesel inventories already in summer 2022, below the five- and ten-year

65 https://www.bloomberg.com/news/articles/2022-10-21/what-backwardation-has-to-do-with-us-diesel-squeeze-quicktake

averages for the fall season, leaving inventories at 27 days of demand in October.[66,67] The call for export bans has surfaced repeatedly, while also building strategic gasoline and diesel reserves has been discussed. Building strategic reserves in a tightly supplied market may serve the national interest, but also adds to further tightening of supplies for other markets. Strategic reserves were developed to manage acute physical shortages because of a substantial drop in supply. On and off since the 1970s, discussions on also using strategic reserves to manage prices have surfaced. The EU in the 2000s discussed increasing the strategic oil reserves to create an EU space for localised EU oil market management apart from the IEA decision-making process. The discussion on strategic reserves (or assets) is not new to the EU, witnessed by discussions on capacity mechanism in the power sector and on building strategic gas reserves.[68] The liberalisation agenda and enlargement of the EU led to complicated discussions and frameworks.[69] In 2008, the EU passed a new directive on oil security, also making sure that the new member states complied with the practise of the EU and the IEA member states, and to address concerns on energy security by new member states.[70] The liberalisation drive in the EU led to disagreements on making price management part of the strategic oil reserve policy and never materialised. The recent US oil price management through SPR releases[71] then became part of the OPEC+ deliberations to reduce supply.[72] The releases in the current crisis so far have been voluntary and not applied by all IEA member states.[73]

With the EU sanctions on Russian crude oil and oil product approaching (5 December 2022 on crude and 5 February 2023 for oil products), the outlook for shortages of certain oil products is alarming markets. With the diesel cracks already very high (see Figure 20), Goldman Sachs is warning for further market tightness and high prices once the sanctions kick in.[74] This warning is repeated by Thomas L. Friedman of the New York Times. In an article 'Putin is Onto Us' on 25 October 2022, he warns of the frailty of the oil and gas situation (and the relative strength of Russia in hurting EU and western countries on the energy front) in the coming period and the lack of

66 https://www.reuters.com/business/energy/us-diesel-shortage-increasingly-likely-until-economy-slows-kemp-2022-10-27/
67 https://fingfx.thomsonreuters.com/gfx/ce/zgpobwnoovd/US%20DISTILLATE%20FUEL%20OIL%20INVENTORIES%20(OCT%202022).pdf
68 https://www.clingendaelenergy.com/inc/upload/files/Capacity_mechanisms.pdf
69 https://www.belfercenter.org/publication/europe-needs-strategic-gas-reserve
70 https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009L0119&from=EN
71 https://www.reuters.com/markets/us/us-evaluating-need-further-spr-oil-releases-after-october-2022-09-08/
72 https://oilprice.com/Energy/Energy-General/The-Implications-Of-US-SPR-Withdrawals.html
73 Colin Ward, a Closer Look at The IEA Releases, 2022 at https://www.kapsarc.org/research/publications/a-closer-look-at-the-iea-storage-releases/
74 https://www.bloomberg.com/news/articles/2022-10-25/goldman-warns-diesel-scarcity-will-keep-pushing-prices-higher#xj4y7vzkg

preparation for the 'energy war' we are engaged in. [75] The pivot of Russia to central Asia and building a joint stronghold in its hybrid struggle with the west and orientation on the east, signals a long-lasting impact on energy relations and energy flows.[76] The implication is that the short-term re-routing becomes a structural reorganisation of the crude oil and oil product markets, replacing a more economically optimised international system with a more geopolitically oriented system.

In the month since February 2022, both crude and oil product flows have been changing. The tightness of diesel markets incentivised refineries to optimise their diesel output. European refiners must achieve this based on alternative crudes to Urals, while refiners elsewhere took in in more Russian crude. With the recent relaxation of Chinese diesel export quota, the pressure on diesel markets reduced a bit, but US diesel inventories are low, and US refiners may be reluctant to further optimise for diesel given the current political discussion.[77]

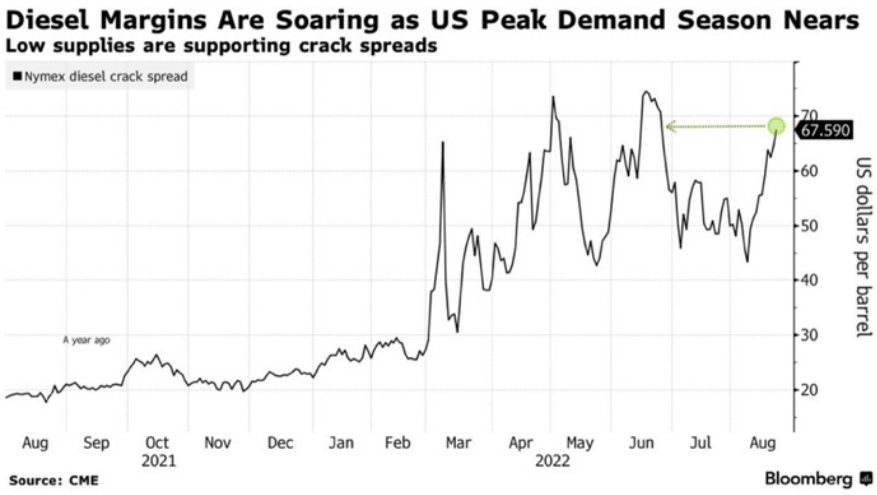


FIGURE 20 INTERNATIONAL DIESEL PRICES HIGH DUE TO TIGHT MARKET. SOURCE: HTTPS://WWW.BLOOMBERG.COM/NEWS/ARTICLES/2022-08-22/US-DIESEL-MARGINS-SOAR-TO-30-YEAR-RECORD-FOR-THIS-TIME-OF-YEAR (ACCESSED 18 SEPTEMBER 2022)

Supplying the European market in the coming months may be more difficult when Russian diesel supplies need to be replaced and refineries running at high utilisation rates require maintenance. Also, the impact of high gas and electricity prices on

75 Thomas L. Friedman, Putin is onto Us, NYT, 27-10-2022
76 FSUWeekly Monitor: 17-23 October 2022, p. 10-26.
77 https://www.vortexa.com/insights/products/where-are-diesel-cracks-heading-to/ accessed at 2-11-2022

demand switching to diesel is yet unclear. Nevertheless, Vortexa concludes: "Clearly, global refineries have responded to the persistently high global diesel crack spreads to adapt their yield structure and crude input to produce more diesel, at the expense of lower performing refined products. The record volumes of diesel expected to land in Europe from Asia in October has nearly doubled m-o-m and underpins the increased reliance on imports seen across the wider Atlantic Basin."[78] The tight market in diesel may continue when the sanctions on Russian oil product imports are implemented on 5 February 2023. According to Vortexa this may be a lot harder than replacing Russian crude supplies, fuel oil and light distillates which are traded now to China, India, and the United Arab Emirates. Redirecting diesel flows to other non-sanctioned markets may be more difficult or arduous to organise in a period of adjustment of markets. The uncertainties over winter demand, refinery outages, export reduction policies in 2023 and fuel switching may reduce the diesel crack spread, but at the same time, Europe must still replace a substantial volume of alternative diesel supplies.[79]

The low inventories and nearing crude oil and oil product sanctions necessitate to look at which countries can potentially export gasoil/diesel to international markets to replace Russia as a very large supplier to the EU. Figure 21 shows Russia as the largest surplus country and can contribute most to international markets, followed by substantially gasoil/diesel long countries such as Saudi Arabia, US, Korea, and China. It is clear however that removing the largest gasoil/diesel surplus country from the list of potential suppliers of Western oil product markets has consequences.

Diesel exports from the US to Latin America and Europe has drained American inventories to a low 25 days of consumption at the start of the heating season, and discussions on increasing oil product strategic storage are mounting.[80] If these plans to

78 https://www.vortexa.com/insights/article/exceptionally-high-global-diesel-exports-continue-through-september/ accessed at 2-11-22

79 https://www.vortexa.com/insights/products/where-are-diesel-cracks-heading-to/ accessed at 2-11-22

80 https://www.bloomberg.com/news/articles/2022-10-19/biden-sets-stage-to-ramp-up-emergency-gasoline-diesel-supplies?leadSource=uverify%20wall reports "The US currently holds 1 million barrels of diesel and 1 million barrels of gasoline in its depots in the Northeast, mostly around New York Harbor and Boston. It's unclear how many barrels the government may buy or if it would allow purchases of foreign fuels. But building emergency reserves could curtail the flow of exports, a chief concern of the administration. Currently Latin America is the biggest destination of fuels produced by US refineries." And https://www.energy.gov/ceser/northeast-home-heating-oil-reserve: "The Northeast Home Heating Oil Reserve (NEHHOR) is a one million barrel supply of ultra low sulfur distillate (diesel) that provides protection for homes and businesses in the northeastern United States should a disruption in supplies occur. Of all the households in the United States that use heating oil to heat their homes, the majority reside in the Northeast region of the country - making this area especially vulnerable to fuel oil disruptions. The Northeast Home Heating Oil Reserve, a one million barrel supply of ultra low sulfur distillate (diesel), provides protection for homes and businesses in the northeastern United States should a disruption in supplies occur."

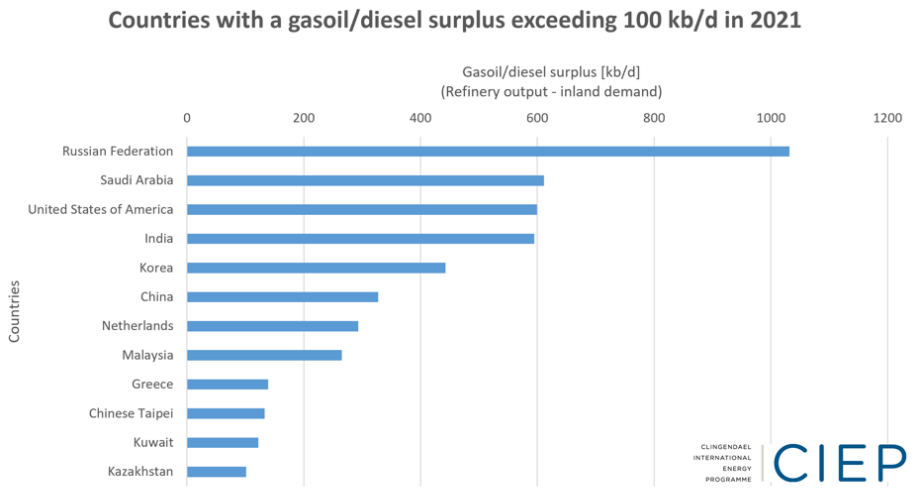
expand these strategic reserves would be executed in already tight markets, serious price effects can be expected due to crude oil type availability and refining industry constraints.

The changing direction of crude and oil product flows imply that large, concentrated flows from for instance Russia and the Middle East, must be replaced by more dispersed supplies from different destinations over longer distances. In addition, traditional exporters of diesel will be called on to supply to markets where Russian gas oil/diesel imports fall under sanctions, while Russian gas oil/diesel must find its way to more dispersed markets further away. The efficiency of the large crude oil and oil product hubs and its satellites will be upended and must be replaced by a new trading system carrying fuels over longer distances and without the benefit of the storage and blending services of a large hub like the one in NW Europe (Rotterdam-Amsterdam-Antwerp). The Netherlands also has a surplus in gasoil/diesel production.

3.4 POTENTIAL DIESEL TRADE FLOWS

The Dutch refining sector is large compared to domestic demand and more a reflection of both demand and the function of the Netherlands in the petrochemical cluster in NW Europe. Traders and the sizable storage and blending sector in the Netherlands direct and facilitate flows of oil products to clients in NW Europe and extra-EU (see Figure 21). The open market for oil products, however, does not guarantee Dutch security of supply when oil products can freely flow to the highest bidder. A look at the largest countries with a gasoil/diesel deficit (Figure 22) shows that the UK, France, and Germany are countries with a substantial gasoil/diesel deficit and can draw on Dutch (and Belgian) gasoil/diesel markets to supply their markets. In normal times, the trade flows in gasoil/diesel reflects the restructuring and optimalisation in the oil products markets of the past 20 years, but in the current tight markets and increased government interventions to support consumption could imply that the Dutch market could be drained by more powerful neighbouring countries or third countries. The strikes in the refining and storage sector in France was noticeable at the pump in France, but also in the pump prices in the Netherlands.[81] Diesel importing countries applying sanctions on Russian diesel have a difficult task in attracting supplies from elsewhere.

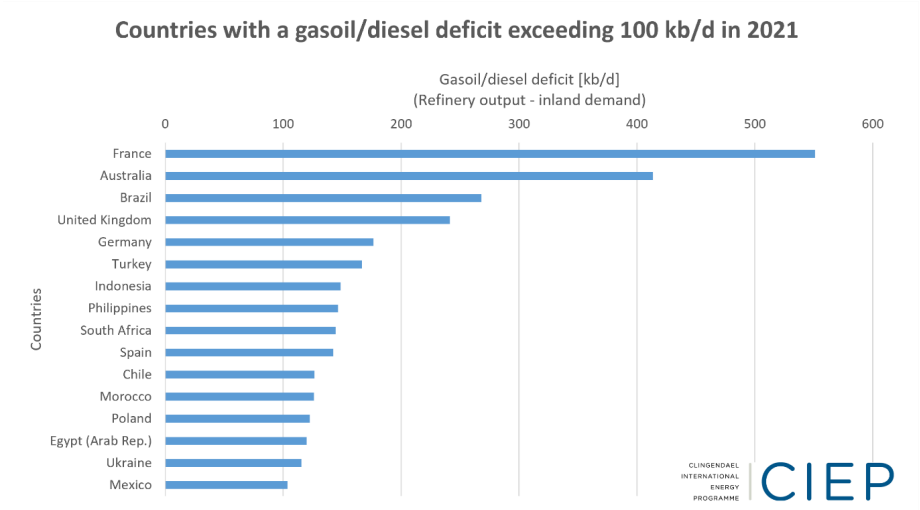
81 https://www.cumela.nl/nieuws/prijsindex_dieselolie



CIEP analysis based on Joint Oil Data Initiative (JODI) data.
Excluding reclassified refinery and blending feedstocks. Only showing countries that report production and consumption data for 2021.

FIGURE 21 POTENTIAL EXPORTERS OF GASOIL/DIESEL

The Netherlands and Greece are the only substantial diesel production surplus countries in the EU. Provided the refineries in these countries can replace their crude and residual fuel oil intake with alternative supplies, the pull from the diesel short countries will be large, leaving these markets more stressed than based on their supply position. From the perspective of local consumers, the Netherlands and Belgium, and to a lesser extent Spain, may be particularly exposed to competion for scarce diesel supplies with a much larger pool of potential consumers than in more regionalised and/or inland production centres. Logistics to carry product inland may be absent to supply in the other direction. Although the hub function of these countries' oil sectors with their large production, storage, and transportation abilities, implies there is a large pool of crude and oil products in their economy, but the openness of the sector also implies that local consumers are not necessarily the ones supplied. The ease with which oil products can be evacuated to higher bidding markets can leave domestic markets drained from for instance diesel. Less connected production centres servicing a localised market may be under less strain, once they have secured crude oil supplies for their refineries, and able to supply their traditional markets. Rotterdam, as a large cluster, services a much wider market, leaving local consumer with more competition.



CIEP analysis based on Joint Oil Data Initiative (JODI) data.
Excluding reclassified refinery and blending feedstocks. Only showing countries that report production and consumption data for 2021.

FIGURE 22 COUNTRIES WITH GASOIL/DIESEL DEFICITS

Much depends in the coming months on the ability to reroute Russian gasoil/diesel cargoes to non-sanction markets and the seasonal turnarounds of refineries (see Annex III).[82] Here, the sanction conditions on the insurance, financing, and other services of oil and oil product transfers to third countries may also play a large role[83], in addition to tanker availabilities.

A danger is that the trade in illegal crude oil and oil products will grow and build on the already large illegal oil trade practises in the world.[84] Although the EU sanctions would require strict oversight, the administrative burden on the one hand and the shrewd tampering with paperwork and ship-to-ship transfers may make this very difficult to avoid.[85]

82 https://www.vortexa.com/insights/article/exceptionally-high-global-diesel-exports-continue-through-september/ accessed at 2-11-22

83 https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32022R0879&qid=1666791499792&from=EN

84 Ian Ralby on Downstream Oil Theft, Global Modalities, Trends and Remedies, Atlantic Council, January 2017 at https://www.atlanticcouncil.org/wp-content/uploads/2017/01/Downstream_Oil_Theft_web_0327.pdf and Ian Ralby and David Soud, Oil on the Water, Illicit Hydrocarbons Activity in the Maritime Domain, April 2018 at https://www.atlanticcouncil.org/wp-content/uploads/2018/04/Oil_on_Water_WEB.pdf

85 https://www.asiafinancial.com/russian-crude-heads-to-china-via-risky-ship-to-ship-transfers: "Chinese buyers have set up a secretive ship-to-ship crude oil transfer hub in the Atlantic Ocean to transport Russian crude oil, according to Lloyd's list. (…) The dangerous manoeuvres have been taking place to disguise the origin of the Russian oil. Lloyd's List said an anonymous entity based in Dalian has bought several very large crude carriers (VLCC) to create the hub off the coast of Portugal. Two of these VLCCs, the Catalina 7 and Natalina 7, were sold for $78 million in May to undisclosed buyers and immediately sailed for the mid-Atlantic, Lloyd's List said. The ships are now in the area off Portugal as they transfer cargoes from tankers that loaded at Russian ports in the Baltic and Black Sea, which are then being taken on to China. Ship-to-ship transfers are legitimately used to avoid the need for vessels enter a port area and incur port fees or when vessels are too big to enter a terminal. Transshipment ports such as Hong Kong and Singapore also transfer many cargoes in a process known as lightering. (…) But such ship-to-ship transfers are also used to disguise cargoes' destinations, although no sanctions are apparently being breached in the case of the Russian oil, according to Lloyd's List."

Moreover, blending of crudes and oil product may obfuscate the origin of crude oil and oil products that is very difficult to monitor and enforce. The process of circumventing sanctions is already in full swing with new traders and insurance companies popping up in Asia and elsewhere and Russia buying up old tankers ready for scrapping and setting up its own services. These developments chip away at the current important position of EU-based companies in international oil transportation and servicing. Depending on the stance of European authorities on enforcing the sanctions, the uncertainties could lead to further self-imposed sanctioning by traders and shippers or, when the supply situation become more dire, a *de facto* acceptance of sanction slippage.

4 THE EU OIL PRODUCT MARKET

The makeup of the EU oil product market reflects a long period of integration with the former Soviet Union's energy system and the post-1990 (Gulf War) reorientation on Russian flows to Western European refineries. The refineries in the former Comecon-countries, including East Germany, are connected by pipeline to the Russian oil system Druzhba (see Figure 23). The EU market for oil products is segmented in several regional markets, with different supply routes.[86]

The dislocation of crude oil flows in central and east Europe will be large after the oil sanctions are implemented since they are connected mainly by pipeline supplies from Russia. Inland refineries will encounter more difficulties to bring crude to their plant, while coastal refineries may encounter difficulties to transport their products deeper into the EU market than is possible with normal transportation modes, due to inland infrastructure and transportation bottlenecks. The capacity of rail, river barges and trucks is not unlimited if flows of oil products require redirection within the EU.

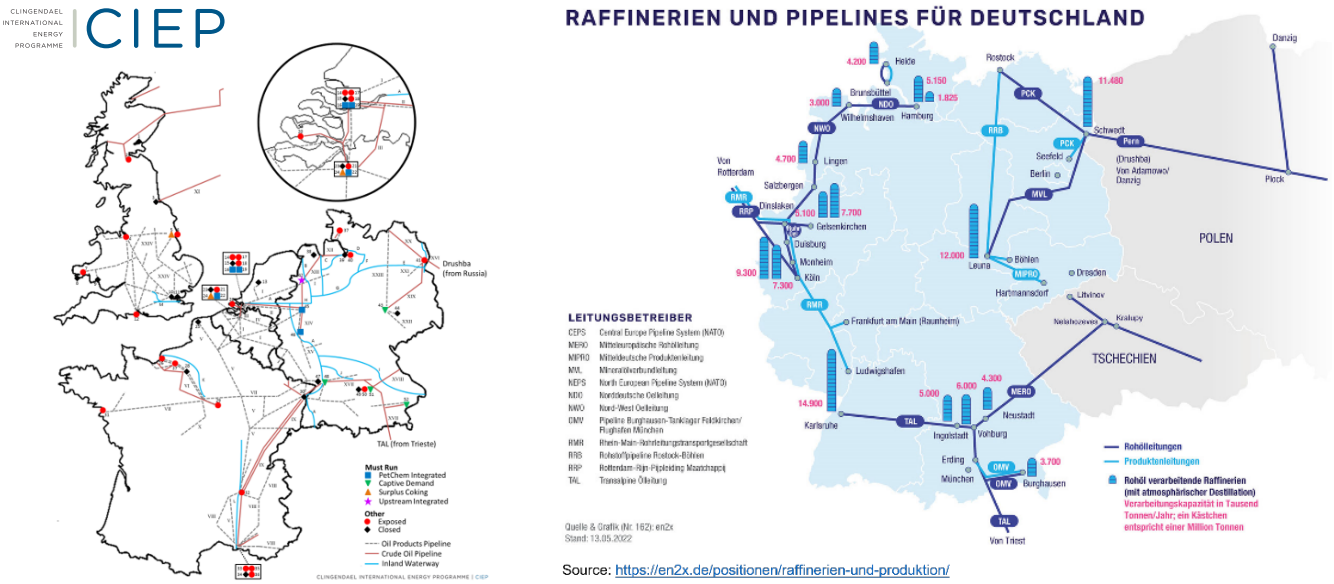


FIGURE 23 EU OIL AND OIL PRODUCT INFRASTRUCTURE. SOURCE: HTTPS://WWW.CLINGENDAELENERGY.COM/PUBLICATIONS/PUBLICATION/THE-EUROPEAN-REFINING-SECTOR-A-DIVERSITY-OF-MARKETS

86 CIEP, https://www.clingendaelenergy.com/publications/publication/the-european-refining-sector-a-diversity-of-markets accessed on 16 October 2022.

The strike in France, when refineries went on strike, showed how quickly the distribution of motor fuels was disrupted, and how it translated in higher prices on the Dutch diesel market. The supply disruptions in France in September/October 2022 do not bode well for easy adaption in the post-sanction period. The Netherlands is a hub, and although it produces more oil products than are consumed in the Dutch market, the connectivity with the hinterland and the evacuation options over sea also imply that demand from elsewhere can quickly drain local supplies. The deeper the diesel is stored in a market (in smaller depots serving more localised users), the larger the likelihood that it can serve local demand, even though it can still be trucked over larger distances from these depots. Back flow into the distribution points in the hub, with more market evacuation options to more markets, is less likely and can perhaps be supported by government policies.

The largest producer of oil products in the EU is Germany.[87] Two of its refineries are connected to the Druzhba system, the south is serviced by the pipeline from Trieste in Italy (transalpine Pipeline or TAL) and the northern and western refineries receive crude oil through Rotterdam and the German North Sea harbours. The supply systems for oil products for local markets in Germany are not connected by pipelines. Here river barges, trucks, and rail play an important role. The 15 refineries in Germany traditionally produced a substantial volume of middle distillates, in part because of the higher diesel/gasoil yield of Russian crude. Nevertheless, Germany still relies on oil product imports. According to Eurostat data, the range of diesel/gasoil imports in Germany from Russia was a share of 25-27% between 2018 and 2020.[88] Recently, Turkey saw its imports of Russian crude increase substantially, but since Turkey is also short on diesel, deriving a higher diesel yield will most likely be absorbed by the domestic market. The Italian market appears more in balance but could come under strain when diesel short countries begin to pull on its supplies. Most of the Italian refineries are on the coast and just like in NW Europe and Spain they can easily evacuate oil products to a variety of markets. The consolidation of the refining industry has been ongoing. In 2021, 93 refineries in Europe were open, of which 75 are mainstream refineries and 18 specialise on lubes, bitumen, or condensates.[89] On the Concawe list, the reduction in the number of refineries over time is listed, as are the

87 https://www.clingendaelenergy.com/files.cfm?event=files.download&ui=CVDL-Rondetafel-25-3-2022-Importen-Russische-olie-en-olieproducten-onrust-int-markt.pdf accessed on 16 October 2022 and Eurostat, Data extracted on 08/11/2022 16:54:37 from [ESTAT].

88 https://www.clingendaelenergy.com/files.cfm?event=files.download&ui=CVDL-Rondetafel-25-3-2022-Importen-Russische-olie-en-olieproducten-onrust-int-markt.pdf accessed on 16 October 2022. In the Energy Post a 15% import dependency on diesel imports from Russia is mentioned. This number possibly is without gasoil: https://energypost.eu/how-could-germany-wind-down-russian-oil-imports-by-the-end-of-2022/ accessed on 16 October 2022

89 https://www.concawe.eu/refineries-map/ accessed at 2-11-22.

current owners are listed, showing substantial refining assets are owned by Russian oil companies.[90]

Besides Germany, also other EU countries depend substantially on diesel/gasoil imports from Russia.[91] This is in part due to the number of vehicles running on diesel, which varies widely among EU member states. In 2020, in Lithuania, Latvia, and France, more than 50% of passenger cars ran on diesel, while in the Netherlands 84% ran on gasoline.[92]

After the implementation of the oil sanctions in December 2022, EU refineries will have to change to crude oil from other sources, and may see their oil product slate change to the detriment of diesel yields.[93] Lower diesel/gasoil yields and replacing Russian diesel imports, will create a larger gap between supply and demand than before. Refineries in the Middle East and India, and perhaps China may be able to fill that gap somewhat. This may also depend on the size of export quota in India[94] and China[95], the ability to meet EU specifications, and the course of the discussion in the US[96] to curb exports. New England in the US is suffering from EU energy prices due to the 1920 Jones Act preventing oil and natural gas supplies from the south of the US to supply them.[97]

4.1 EUROPEAN ENERGY-INTENSE INDUSTRIES UNDER STRESS

Much then depends on the ability of the EU refineries to continue producing. The availability and costs of natural gas and hydrogen, important for the production process, will be a crucial factor, while also the ability to find markets for fuel oil and naphtha may be a concern. Already the chemical industry in the EU is losing its competitive position in world markets[98] and is an important consumer of oil products.

90 https://www.concawe.eu/refineries-map/ and https://www.concawe.eu/oil-pipeline-map/ accessed at 4-11-2022.

91 See https://www.clingendaelenergy.com/files.cfm?event=files.download&ui=CVDL-Rondetafel-25-3-2022-Importen-Russische-olie-en-olieproducten-onrust-int-markt.pdf

92 https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Transport_equipment_statistics accessed 2-11-22.

93 Despite an earlier government statement, the Polish PKN Orlen refinery has indicated to continue supplies through the Druzhba pipeline under a long-term contract running to the end of 2023 and asked Tatneft to supply 3 mln tons. Supplies through the Druzhba pipeline have been exempted from the sanctions, but statement from the Polish and German government in June signalled that the northern leg of the pipeline would be not be used. https://www.reuters.com/article/russia-oil-exports-poland-idAFL1N32C1WH

94 https://www.reuters.com/world/india/indias-export-curbs-tax-hike-exacerbate-global-diesel-gasoline shortage-2022-07-06/ accessed on 16 October 2022.

95 https://tankterminals.com/news/china-to-offer-europe-a-lifeline-this-winter-with-more-diesel-exports/ accessed on 16 October 2022.

96 https://oilprice.com/Energy/Energy-General/Biden-Administration-Urges-Refiners-To-Curb-Fuel-Exports.html accessed at 16 October 2022.

97 https://www.ft.com/content/f9374ff4-3bfd-4b5e-8542-58c3db81514b

98 https://cefic.org/policy-matters/cefics-positions-on-the-eu-energy-crisis/, accessed at 13-11-2022

Although fuel switching (from natural gas to oil products) in industry may help to sustain some demand, the ability of refineries to flexibly manage increasingly unbalanced demand for oil products may be limited.

The IEA report, "Never too early to prepare for next Winter: Europe's gas balance for 2023-2024"[99], predicts a gap in natural gas supplies for winter 2023-2024, creating a stronger incentive to look for alternatives. Already, old coal-fired power plants and oil boilers are brought back into use in Germany, where permits were relaxed to facilitate fuel switching in industry. The complex interaction between crude oil, certain oil products, natural gas, coal, and CO2 prices may stimulate further fuel switches, depending on the availability of equipment and/or permits to make the switch. Fuel switching from natural gas to oil could increase demand for oil products substantially.[100] Such fuel switching will depend on the price of natural gas, now widely used in EU energy intense industries and prices for oil products. In a 17 November 2022 presentation of Equinor's Energy Perspectives[101], in the part on the short-term energy outlook, the issue of lower oil prices per million British Thermal units compared to natural gas prices underlines the predicament of (NW)European industry (see Figure 24). NW Europe's energy intense industries are based on natural gas. The destruction of the Nordstream gas import system in September 2022, has removed the option to return to relatively low natural gas prices when the war is over. This has fundamentally changed the competitive position of European industries exporting to world markets. Strategic investment strategies will reflect this new situation. In Germany, more relaxed permitting allowed industries to switch from natural gas to oil products, but in the Netherlands a discussion to help industry through this difficult period (for instance, by allowing them to switch fuels) is as good as impossible due to the immovable debate on reducing nitrogen deposition in nature. Moreover, the current energy crisis discussion is mainly centred on helping households. Industry in the Netherlands, unlike in Germany and France, is not (yet) featuring as a political priority. Nonetheless, the structural consequences of the energy crisis could be a dramatic change of the industrial landscape, and as consequence a loss or a reduced drive for energy transition projects due to more uncertain demand for low carbon electricity and hydrogen.

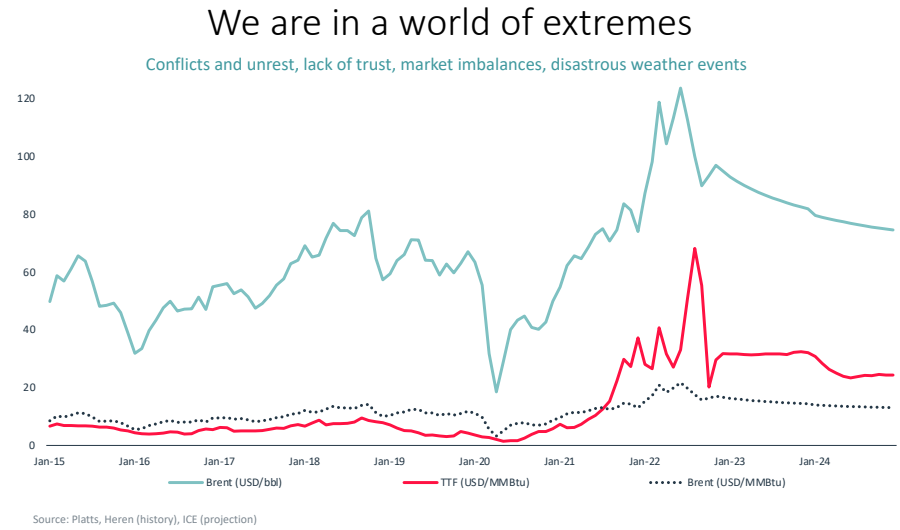
99 https://iea.blob.core.windows.net/assets/cdabad3c-e8c6-4654-b7a8-ba9d5c454461/NeverTooEarlytoPrepareforNextWinter.pdf accessed at 13-11-2022

100 "In Europe, refiners, power producers, and major industries will account for a 308,000 b/d growth in liquids demand in the first quarter of 2023, according to Platts Analytics, equivalent to about half the global share of gas-to-oil switching. The growth figure surpasses the 166,000 b/d, or 47%, in Q3 2022. Asian gas-to-oil switching demand growth will reach 271,000 b/d, or 43% of the total, according to the estimates, up from 136,000 b/d in the current quarter. Residual fuel oil will account for 348,000 b/d, or 60%, of the incremental global shift to oil in Q1 2023, Platts Analytics data showed, with LPG accounting for 32% and gasoil making up the rest of the increase at 8%." See https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/oil/090722-global-gas-to-oil-fuel-switching-to-jump-80-as-european-asian-gas-prices-soar accessed at 20-11-2022

101 https://cdn.sanity.io/files/h61q9gi9/global/217a8926acb0c711120e355d7eae75a80f60c950.pdf?Energy-Perspectives-2022-final.pdf

Already the fertiliser industry and chemical industry have reduced production, while also steel plants have been shuttered or run at a low utilisation rate across Europe. A side-effect of the reduced production of fertilizer plants in Europe, is the lower production of Adblue, a cleaning agent for diesel trucks[102], and led to worries in industry and logistics sectors about the continued availability.

Apart from these short-term concerns about the impact of the energy crisis on industry in (NW) Europe, the longer-term impact should also be a cause for EU Commission and European government apprehension. The boasting by the Eu Commission on the successful reduction of natural gas demand was criticised by European Industry representatives. According to them, lower natural gas demand was not due to energy efficiency gains, but the result demand destruction in industry due to a dramatic loss in competitiveness.[103] The recent US Inflation Reduction Act and the large difference in energy prices is already changing investment plans of European industries to pivot to the US.[104] This includes the investments in low carbon energy technologies, the mainstay of the REPowerEU and Fit for 55 plans.



Source: Presentation Eirik Waerness, Equinor Energy Perspectives, short-term outlook 17-11-2022

FIGURE 24 NATURAL GAS PRICES HIGHER THAN OIL PRICES IN DOLLARS PER UNIT OF ENERGY

102 "Produced in the same plants that make fertilizers, AdBlue is essential for a functioning transport sector and for cleaning the air we breathe. More than 29 million vehicles in Europe require AdBlue, allowing them to run without emitting dangerous NOx from their exhausts. That includes 25 million passenger cars and light commercial vehicles and roughly half of Europe's trucks, lorries, and buses. Without AdBlue, they will not function, and Europe's transport sector would be on its knees." See https://www.yara.com/corporate-releases/yara-calls-for-action-to-secure-continued-supply-of-nitrogen-essentials-such-as-adblue/

103 Europe's energy crisis increases risk of deindustrialisation, https://www.ft.com/content/a047c53e-4d70-4862-af52-66f8905fbd1c#myft:my-news:page accessed on 18 November 2022.

104 European Industry pivots to US as Biden subsidy sends 'dangerous' signal, https://www.ft.com/content/59a8d135-3477-4d0a-8d12-20c7ef94be07.

4.2 EUROPEAN DIESEL CRACK SPREADS

The diesel and jet fuel crack spreads in NW Europe are very high, while those for fuel oil and naphtha are negative (see Figure 25). Also, in other markets the diesel crack spread is unprecedentedly high, indicating the tightness in international distillate markets. The negative crack spread for naphtha is a signal of lower chemical industry demand in NW Europe. Demand in international markets for naphtha cannot make up for this reduced demand. Blending naphtha in other oil products provides some relieve for surplus naphtha production but is not endless. The availability and costs of storage capacities for naphtha may, in a prolonged period of unbalanced demand for oil product, also determine refinery output. This potential bottleneck would then also impact the level of production of diesel, further stressing market supply. A remedy for diesel could be to reduce demand for jet or kerosene and bring it to specification for diesel engines, but the airline industry would disagree after trying to recover from the two covid-19 years. Nevertheless, such product flexibility and blending options may be important when certain strategic sectors become deprived of fuel.

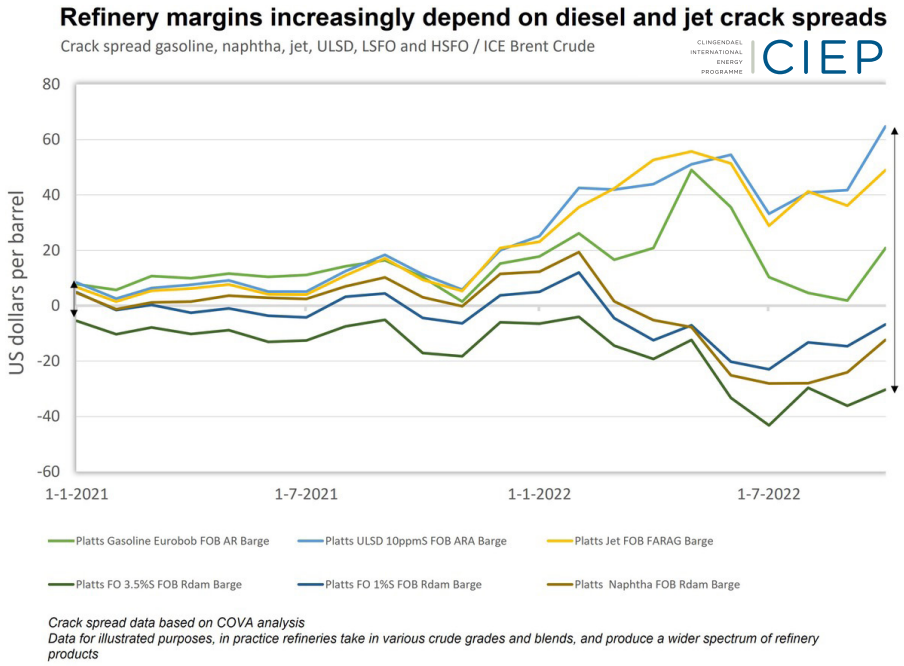


FIGURE 25 NW EUROPEAN CRACK SPREADS

Demand for gas oil/diesel dominates EU demand for oil products (see Figure 26). Demand for LPG, naphtha, and gasoline have been very stable in the past years, while kerosine/jet fuel showed a drop in demand during the Covid-19 travel restrictions. Diesel/gasoil represented by far the largest part of demand for oil products, dwarfing other demand sectors. The loss of imported diesel/gasoil from Russia will translate into a much larger call on the rest of the international markets.

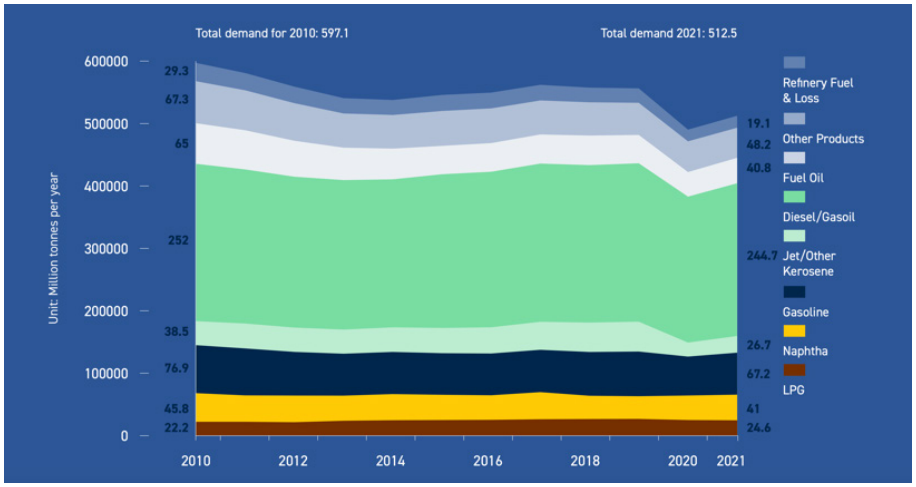


FIGURE 26 OIL PRODUCT DEMAND IN EU-27 2010-2021. SOURCE: HTTPS://WWW.FUELSEUROPE.EU/UPLOADS/FILES/MODULES/DOCUMENTS/FILE/1657719691_VXM2XIWQ48SB9TBVIC63U6IVF012SXQHCDQYYYBJ.PDF ACCESSED AT 6-11-2022.

Depending on the management of production costs (price of natural gas, hydrogen, storage) and the ability to source the proper blend of crude oils to maintain a positive margin, EU refineries can continue producing. Currently, the margin on jet/kerosine and gas oil/diesel is high, but the possibility to gear production towards these oil products has become increasingly difficult because of the different crude oil intake and the cost of hydrogen/natural gas. The complexity of the current energy crisis (spanning the power, natural gas, and oil sectors) and, for instance, the competition between users (air transport (kerosine) viz. road and water transport (diesel) are factors to consider in how the middle distillates are used. The market will deliver the oil products based on demand (highest bidder) and the underlying contracts, while government may want to prioritise certain users.

4.3 DISTRIBUTION

Apart from seaborne and pipeline transportation, also the organisation of distribution is also important. Most EU member states distribute oil products from larger

storage units to smaller deports to supply the widely dispersed service stations. In some cases, large trucking and freight companies have their own service or bunker stations, creating a fine-grained network of smaller storage units all over the country. Supplying these smaller storages requires trucking capacities, and in a tight market this may become crucial to keep these storages well supplied. This is a just-in-time distribution system, which was suitable for the optimised world of before and supported by contracts. The ability to move from a just-in-time system to just-in-case delivery may be complicated. This is due to a shortage in specialised drivers and tanker trucks.[105] The expected strain on these drivers is not helped by EU rules on trucks and drivers to return home every four weeks[106] and their trucks every eight weeks[107], apart from the fuel inefficiency in a tight market for diesel.

The backwardation in diesel prices has left commercial stocks very low, in part because the product is moving immediately in the market due to tightness, but also because the companies working in this part of the value chain need to manage their risk of price changes. This market behaviour prevents commercial storages to be filled, whilst it would be more comfortable for consumers if commercial storages would be fuller in light of the coming oil product sanctions. Currently only strategic storages are replenished, but these are not meant for early release. The market does not provide incentives for more robustness of the distribution system. In Germany and France, strategic reserves are also kept close to or in the dispersed smaller depots.

Once oil products are stored in the distribution depots, the chance of EU oil products flowing back into international markets is very small. This also applies to oil products flowing from one EU member state to another. Only along the borders of EU member states, flows could potentially enter the markets of neighbouring countries. For the Netherlands this could be of some concern, because of the size of the country and facilities close to the border, and the potential of also evacuating product with river barges upriver.

In Germany, the rail capacity is limited and already the energy crisis already led to the decision to prefer freight trains over passenger trains, to ensure that distribution of goods and specially energy can take place. The rail link with Rotterdam (Betuwelijn) is not enough to supply coal and oil products to the German market, and Wilhelm-

105 Google for tank truck driver jobs Europe and the list is long.

106 https://europa.eu/youreurope/business/human-resources/transport-sector-workers/road-transportation-workers/index_en.htm#shortcut-8

107 Article 5(1)b of Regulation (EC) No 1071/2009 as amended by Regulation (EU) 2020/1055, https://transport.ec.europa.eu/transport-modes/road/mobility-package-i/market-rules/rule-return-vehicle-applicable-21-february-2022_en accessed at 9-11-2022.

shafen and Hamburg rail links are indispensable too. River barges are used to supply markets too, but low water levels and competing demand reduced capacities. The coming vulnerability in East Germany, when supplies through the Druzhba pipeline are terminated and the alternative routes fall short. This may increase the call on other German refineries to fill the regional gap. However, the infrastructure in Germany does not support such an action. The locks in the waterways only allow for smaller (older) river barges to pass, while there are no pipelines connecting the western with eastern German markets. This could result in a larger call on rail and trucks, while these systems are already used at full capacity.

The strikes at refineries in France[108] in September 2022, showed that though EU member states with large coastal facilities can be easily to supplied from all sorts of directions, but they are also just as easily drained from oil products supplies. The large oil sector in the Netherlands, with refineries and large storage capacities, was easy to tap due to the easy access to a deep-water port and access to markets in the hinterland. CBS statistics show that the Netherlands is a net exporter of oil products and has a luxurious position in the current tight oil product market, but this disguises the fact that these products may not stay in the Dutch fuels markets and flow elsewhere instead. In normal times, connections to the hinterland and international markets guarantee ample availability, also for the domestic market. However, in an energy crisis, that does not provide security when the oil product is not contracted. The change from 'normal' times where short-term deliveries were easily available and organised to tight markets, requires a different business model along the entire value chain.

The German situation of restructuring from east-west supplies to west-east supplies is not unique for oil alone, it also applies to natural gas. The infrastructure may not be suitable for changing from east-west flows to west-east flows may command the use of infrastructure not suitable for this change in flows.

4.4 SUPPLY GAP AND STRATEGIC RESERVES

Given the uncertainties in crude oil and oil product demand in the world, the EU and in NW Europe, the expedience with which the international oil sector can organise and adapt to redirected flows of crude and oil products will determine the tightness of these markets in the coming months. Also, the uncertainties of national policy-making in reducing oil products for the international market (China) or capturing them for national consumption (India), and fuel switching in electricity generation and heating, the tightness of diesel markets may become larger after the EU sanctions are implemented on 5 February 2023.

108 These strikes have inspired other labour unions across the EU to use the strong negotiation position to realise compensation for the high inflation in the EU in higher wages.

The Ministry of Economic Affairs and Climate Policy recently requested The Netherlands Petroleum Stockpiling Agency, COVA, recently made a first assessment of the potential supply/import shortfall of gasoil/diesel in Europe (see Figure 27), considering both up and down sides. The potential impact on the European diesel balance is based on certain assumptions, which were translated into an estimated missing volume compared to the pre-sanction situation. This potential gap does not address the internal EU dislocations and logistic bottlenecks to distribute diesel to local markets. It does, however, indicate the size of the anticipated shortfall in EU diesel supply that must be filled by imports. The additional European demand for gasoil/diesel from non-Russian sources comes in addition to the switch from Russian natural gas to LNG, also dislocating this market and creating energy supply issues for net importing developing countries in natural gas and oil products such as diesel. Very often diesel generators are used to supplement local electricity shortages or system failures.

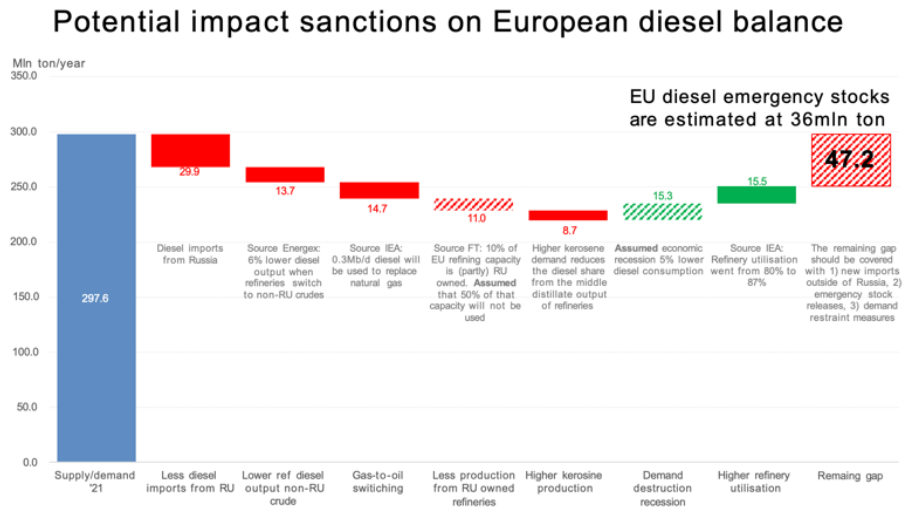


FIGURE 27 POTENTIAL POST-SANCTION EUROPEAN DIESEL BALANCE. SOURCE: COVA, SEPTEMBER 2022 (UNPUBLISHED)

Although the EU strategic gasoil/diesel reserves appear large compared to the expected gap, the efficacy of their employment depends on concerted releases (at least in the NW European market due to regional transportation and distribution constraints), limiting leakage to non-EU markets and the anticipated duration of the supply gap. Also, beggar-thy-neighbour policy responses should be avoided, and markets should be allowed to work as well as they can. Nevertheless, EU member states are struggling with the impact of the oil, natural gas and electricity crisis, and they come up with national plans that may or may not negatively impact neighbouring countries.

For instance, a release from the strategic diesel reserve to stabilise the Dutch market may fail from the perspective of the Dutch consumers when flows are absorbed in neighbouring or international markets. One could argue that the pull of these markets on Dutch regular supplies will subsequently reduce (for a while), but it may nevertheless result in regional distribution bottlenecks that are undesirable. At the same time, a substantial release in Germany, without the Netherlands participating, may create benefits for the balance in the Dutch gasoil/diesel market. It is very important that releases are employed as much as possible in close collaboration with the relevant market for a particular oil product or in the case of a local disturbance with the least leakage possible.

The danger of countries competing rather than collaborating once the stress in the market grows, should not be underestimated. The difference in firing power among EU member states may also indirectly play a role in the distribution of stress in the market. The aid packages aimed at the energy-intense industries may unlevel the playing field in the ARRRA-cluster, despite compliance with the EU Temporary Crisis Framework.[109] The ARRA-cluster involves three EU members states with different policies, or lack thereof, to support their energy-intense industries in the current energy crisis. Antagonism among other EU member states flared up after this plan was launched[110] because not all countries can match this sort of spending. Other beggar-thy-neighbour policies could be caused by the lack of coordination in strategic reserve releases, uncoordinated changes in the road fuel taxation, or changing industrial permits to switch from natural gas to oil products. The latter is the case in Germany, where an increase in oil product demand is expected because of switching away from natural gas.[111] Such uncoordinated measures in the relevant market for crude oil and oil products in the ARRRA-cluster, can harm the delicate balance in a deeply integrated industrial cluster.

109 Press release of Bundesministerium for Wirtschaft und Klimaschutz and Bundesministerium der Finanzen at https://www.bmwk.de/Redaktion/EN/Pressemitteilungen/2022/07/20220714-5-billion-euros-aid-programme-launched-for-energy-intensive-industry.html and Wirtschaftlicher Abwehrschirm gegen die Folgen des russischen Angriffskrieges, Deutschland durch die Krise führen, Verbraucherinnen und Verbrauchern sowie Unternehmen helfen, den Gasmarkt stabilisieren, Versorgungssicherheit gewährleisten https://www.bundesregierung.de/resource/blob/997532/2130920/2046cb91023bbd61eca3f3102c987fe8/2022-09-29-finanzieller-abwehrschirm-data.pdf?download=1, both accessed at 10-11-2022.

110 German €200 bn energy support plan sparks 'animosity' with EU, FT 30 September 2022.

111 https://www.bloomberg.com/opinion/articles/2022-08-04/european-energy-crisis-germany-s-switch-to-diesel-comes-at-a-cost accessed at 10-11-2022.

The levels of strategic reserves are largely in compliance with EU and IEA rules. Nevertheless, ten member states fell below the 90 days of imports rule in July 2022, compared to four non-compliant countries in January 2022 (see Figure 28).[112] The uneven distribution of reserves among the relevant markets and potential issues in transportation and distribution are important because also Ukraine is supplied through the EU system (mainly through Poland).

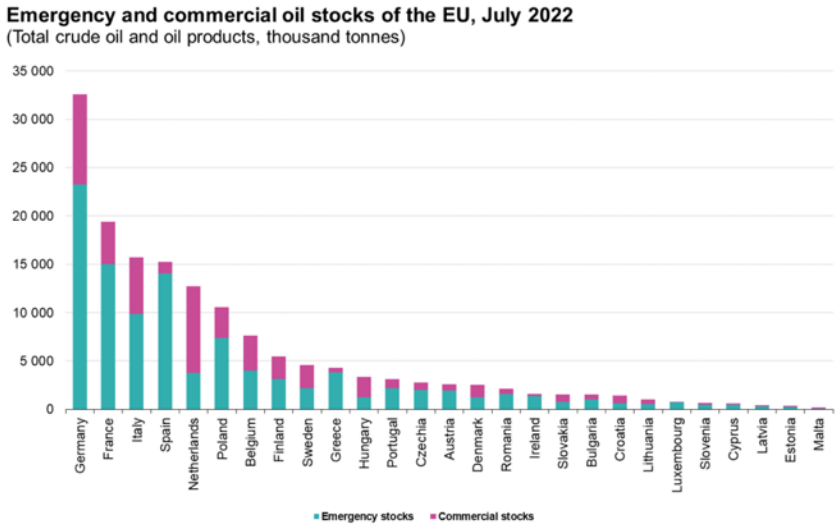


FIGURE 28 LEVEL OF EU MEMBER STATE COMMERCIAL AND STRATEGIC CRUDE OIL AND OIL PRODUCT STOCKS. SOURCE:HTTPS://EC.EUROPA.EU/EUROSTAT/STATISTICS-EXPLAINED/INDEX.PHP?TITLE=FILE:EMERGENCY_AND_COMMERCIAL_OIL_STOCKS_OF_THE_EU,_JULY_2022_(TOTAL_CRUDE_OIL_AND_OIL_PRODUCTS,_THOUSAND_TONNES).PNG (PUBLISHED ON 14 OCTOBER 2022) ACCESSED AT 10-11-22.

The fact that for instance Germany did not participate in a release of gasoil/diesel in May of this year, complicating the effort to stabilise supplies on the Dutch market, is a case in point. Although the IEA (which is competent in oil market crisis measures[113]) stated that induced releases may have jumped the gun in May 2022 (judged by hindsight and compared to what may lie in store for EU crude oil and oil product markets

112 "In July 2022, the Member States with the largest quantity of commercial stocks were Germany (9.3 million tonnes), the Netherlands (8.9) and Italy (5.8). Followed by France (4.3) and Belgium (3.6). The proportion between commercial stocks and total stocks were highest in Netherlands (70.2 %), Hungary (62.7 %) and Croatia (58.0 %), followed by Malta (53.9 %) and Sweden (52.2 %)." See https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Emergency_oil_stocks_statistics#Emergency_oil_stocks_statistics

113 "The Agency's collective response system is designed to mitigate the negative economic impacts of sudden oil supply shortages by providing additional oil to the global market. The system focuses on alleviating short-term oil supply disruptions either by increasing supply (e.g. releasing emergency stocks) and/or reducing demand (e.g. implementing demand restraint measures). The IEA emergency response system is not a tool for price intervention or long-term supply management, both of which are more effectively addressed through other measures such as oil import reduction, energy supply diversification, and/or the development of alternative energy technologies." https://www.iea.org/reports/oil-security-policy accessed on 26-10-22

when the sanctions come into force), strategic reserves in crude oil and especially those in diesel/gasoil will be important to remedy potential shortfalls in the period that markets are re-adjusting.

The confidence of consumers in the ability of the government to guide consumers and companies through this period of scarcity is important. A change in sentiment of consumers of diesel/gasoil expecting more scarcity could change behaviour at the filling station. If more trucks, cars, and river barges are filled more often, substantially increasing the average litres in the fuel tank, supplies may become disrupted by hoarding; first locally, but quickly also nationally and across the border because the just-in-time supply system may fail. A government may then be forced to intervene and implement its crisis and restore plan, a situation that could have been averted when the psychology in the market had not turned.

Strategic reserves are a blessing for the European oil market, a luxury that the European gas market does not have. The natural gas storage directive of this year concerned the obligatory filling of seasonal storages in all EU member states, but these storages are meant for handling cold snaps in winter and not for fixing supply gaps like the strategic oil reserves. The recent IEA report *Never too early to prepare for next Winter: Europe's gas balance for 2023-2024* issued a serious warning about a shortfall in gas supplies for winter2023-2024. Compared to the stress in the European gas market, the oil market can rely on the strategic oil reserves to help manage the gaps while the international re-organisation of supplies is underway. The strategic oil reserves both contain crude oil and oil products. Since re-routing is already underway, the strategic oil reserves can be used to overcome bottlenecks during that period, while managing demand in the stressed oil product markets. The potential gap in gasoil/diesel also depends on international demand for middle distillates, the willingness of China and other gasoil/diesel surplus countries to export to international markets, and the ability of Russia to evacuate oil products to non-sanctioned markets.

4.5 REFLECTION[114]

Where the crude oil market appears relatively successful in redirecting flows, market signals regarding oil products are different. Imports of Russian gasoil/diesel show little sign of changing yet, while there is less than three months to go to the 5 February 2023 sanction date on oil products. The tightness in international markets for gas oil/diesel could make finding alternative sources difficult or too expensive, delaying current sourcing from elsewhere. The increase in Chinese export quota until the end of the year may help, but the quota for 2023 remains uncertain, and alternative trade flows might not easily materialise to fill the gap.

114 These reflections are a based on the analysis of this chapter and insights from discussions with market participants.

The uncertainties about demand destruction among industry and households, the efficacy (and administrative) cost of the price cap on Russian crude oil and national oil market interventions may still throw a spanner in the 'crude-oil-wheel', but these uncertainties appear less pertinent than the uncertainties in certain oil product markets. If imports of diesel/gasoil decline, the pressure on EU refineries, already running at very high utilisation rates, increases.

At the same time, refineries will have to go in maintenance, and/or other issues may arise that (temporary) reduce EU refinery production or impact transportation and distribution. Coordination to optimise the value chain, including supplying regional depots and filling stations, and stimulating more commercial storage, may be helpful in avoiding more drastic measures. To facilitate coordination, companies should be temporarily exempted from competition law under a crisis-provision to coordinate continuity of the value chain and manage potential scarcity in oil product markets in the EU and NW Europe. Besides, temporarily widening permits to manage fuel choices in industry could help, just like in Germany, and may help reduce tightness in the natural gas markets. International gas prices have been much higher than oil prices, and this could be repeated in 2023 and 2024. The interrelationship between natural gas, power and oil markets is strong.

In a way the Netherlands is like a bathtub, oil products easily flow in and out, perhaps complicating the situation for Dutch oil security of supply policymaking. The information on current flows in and out of the Netherlands and neighbouring countries should be improved, and the analysis of market developments in NW Europe, the EU and international regularly updated to avoid surprises.

The Netherlands is integrated with the hinterland and international markets. Oil products are produced, imported, and exported. The energy-intense industry in NW Europe is an important client for some of the oil products of refineries, and the equilibrium between fuel markets and industrial off takers should not become too upset. This is important to maintain a high level of production and avoid additional bottlenecks. Furthermore, it is important for the energy transition investment plans to stay on course. The energy intense industry is an important flywheel for these investments to materialise. Companies remain committed to their energy transition plans (electrolysis hydrogen, biofuels, and low carbon hydrogen imports), despite the increasing uncertainty of future demand and cost of capital.

Much will depend on producing more diesel/gasoil, while markets for other oil products won't see an increase in demand that justifies refining an additional barrel.

The costs of refining have increased substantially in the EU due to high natural gas and electricity prices. Along with the cost of producing hydrogen, important for crude oil and biorefineries, has increased substantially, and is translated in the price at the pump. The high refining margins in the first few months of 2022 have already declined as a result. The unlevel playing field in the world may prove a complication to sell the surplus oil products in international markets and change the refining margins to the detriment of diesel/gasoil production. This is an issue for coastal refineries integrated in world oil product markets, such as those in the Netherlands. The dynamic of economic recession leads to declining demand for specific oil products, such as naphtha (used in the chemical industry, also a large natural gas consumer). Declining demand for this and other oil products, might lead to further increases in diesel/gasoil prices or even to the bizarre situation in which refinery production may be lowered, depending on the development of production costs (natural gas, hydrogen, electricity). The dynamic of a high oil product price, but negative refining margins is often not understood.

5 CONCLUSION

The current energy crisis is unprecedented in the post WWII era. It involves all fossil primary energy markets, effecting the natural gas, oil, and coal sector. The natural gas supply crunch in Europe has pushed up prices of electricity, low and high temperature heat, and the cost of industrial production of, amongst others, fertilisers, and hydrogen. As a result of these raised prices, the processing cost of converting crude oil into oil products has also increased. The European refining industry is in a process of consolidation and transformation. The dynamics of the current energy crisis, the interplay between the various primary energy sources, and the impact on demand create a lot of uncertainty.

The developments in natural gas (reduced or no Russian supplies, high LNG prices) also impact the outlook of the oil sector in Europe because the chemical sector, an important client of oil-based feedstocks, is struggling in this high price environment. Competition for products in the middle distillate range is already fierce, while increased demand for kerosene affects the availability of diesel, while also demand for low-sulphur marine fuels impacts the balance among oil products.

Dependency on Russian supplies is traded in crude oil for dependency on Middle East, Norway, US, West Africa, and Brazil, while for oil product supplies Europe will depend on the Middle East, India, and China. Crude oil flows with an unknown destination are growing, while also the dark fleet is increasing. It is possible that because of opportunistic international trading some of the Russian flows may enter the European market after the sanction date. High sea transhipment is increasing, and new, unknown market participants are entering the market, increasing the size of the shadow market for crude oil and oil products.

LOGISTICS

The longer distance crude oil and gasoil/diesel will have to travel and uncertainty about compliance with the coming oil price cap, implies a shortage in ocean-going vessels, while also logistic bottlenecks will increase in the EU markets. The longer distances also infer more storage in the market to maintain oil system resilience. At the same time, market fundamentals hamper more storage of gasoil/diesel and although capacity is booked, the high turnover leaves relatively little volume in the tanks.

The oil product supply situation in Germany is more pressing, particularly in the east and may cause additional pressure on the West German refineries and the Netherlands to fill the gaps. Here, also logistical bottlenecks may play a big role in preventing local shortages in supply.

It is important to see the potential shortages in a European context. The Netherlands plays an important role in supplying neighbouring countries. The Dutch harbours play a crucial role as an entry point for crude oil and oil product imports, just like the refining, storage and transportation and distribution sectors are important to bring the products to end-user markets. The Netherlands is a net exporter of several oil products. The oil crisis and the impending sanctions have already reduced the international bunker market in the Netherlands. This has diminished the role of the Netherlands as an international hub and changing the Netherlands more into a regional hub for NW Europe for international marine fuels. The rapid reorganisation of parts of the NW European oil product markets is bound to structurally change the outlook for the Dutch oil sector. The current upsurge in demand due to the oil crisis may disguise these underlying trends.

In the Netherlands and the rest of Europe, the tight markets will test the just-in-time distribution systems. Re-routing oil products may be very difficult due to river barge, rail, and truck bottlenecks. The tightness of diesel markets may become more extreme in certain parts of the EU market, creating additional pressure on other parts of the EU market, like the Netherlands. It is possible that governments in EU member states feel compelled to take policy measures that may reduce the free flow of crude oil and oil products in the EU to remedy the local supply situation. The EU oil product market is composed of various local/regional markets that are not interconnected very well. Even though the European Commission is not competent in oil product markets, it may decide to intervene when regional markets, most likely in central Europe encounter problems. One of the decisions that could be taken at a European level is to increase strategic reserves. In the already tight crude oil and middle distillate markets such a move could drive up international prices further and/or deprive other markets even more of supplies. Developing countries are vulnerable to such policy measures, witnessed by similar impacts in LNG supplies.

HUB

For the Netherlands it is important to maintain its position as a hub, also because the low carbon hydrogen imports are seen a natural successors to the current oil and gas flows because of the existing infrastructure. The high level of interconnection, surplus production in refineries compared to domestic demand, and a large storage sector

cause crude oil and oil products to easily flow in and out of the Dutch market. The Netherlands is like a bathtub with many competitors trying to syphon oil products into their markets, causing Dutch consumers to compete with EU and world markets. The current low commercial inventories are not helpful. The competition may become unfair for Dutch consumers when other governments support purchasing these imports. For the Netherlands this may lead to security of supply problems in the domestic market and earlier use of strategic reserves than without uncoordinated policies in NW Europe.

The anticipated gap in gasoil/diesel supplies will test NW European collaboration and policymaking. The Netherlands is a net exporter of gasoil/diesel. The logistic problems of supplying gasoil/diesel short markets in NW and Central Europe may grow, and the pressure on governments to intervene may increase. The openness of the Netherlands oil product markets and additional demand for oil products in other European markets, may strain the Dutch oil sector. Specific logistic bottlenecks may provide the Netherlands with some natural protection against such moves, but this requires very vigilant monitoring to make sure the Dutch market does not become undersupplied.

FUTURE OF ENERGY-INTENSE SECTORS

One recurring theme stands out as an overarching barrier to a proper energy crisis response in the EU and Netherlands. This is the observation that the silo approach used in this energy crisis (that is looking at natural gas, power, crude oil, and oil products in isolation rather than as an integrated energy system), which prevents understanding and properly weighing government interventions.

Affordability of natural gas, crude oil and oil products and power is becoming a strategically important issue for European energy-intense industry and the consumers of oil products. Demand destruction and potentially structural changes in the EU energy economy, may cause a rethink on industrial production in Europe. Such a restructuring of the EU economy may take years and change the economic landscape of Europe. The efforts to replace natural gas, crude oil and oil product flows with solar and wind electricity, renewable carbon and low carbon hydrogen may have to develop in a completely different context than anticipated. Import dependency may shift from Russia to China and the US, reducing the leading role in energy transition the EU had designed for itself. Much will depend on the ability to help European industries to survive the energy crisis in the coming years. At the same time, the international oil sector will adjust to the new market conditions, maybe with a smaller role for European companies in transportation and insurance, a different hub function for the Netherlands and with more stress on all sorts of European companies to adjust

to the new circumstances. In the short term, the adjustments in the logistics of the international oil value chain will lead to price volatility and perhaps physical shortages in parts of the European markets.

POLICYMAKING

The oil sanctions test the Netherlands's security of supply situation, not because it processes too little oil, but because the Netherlands is an open market for crude oil and oil products with a wide variety of interconnections. The change from an East-West oriented energy supply system (in oil and natural gas) to a West-East energy system may cause local shortages in energy supply, including in oil products in the EU. The German government recently issued such a warning for diesel, after earlier warnings for natural gas. Although the location of the Netherlands on the North Sea and the availability of various ports, positions the country positively to play a larger role in supplying energy to neighbouring countries, this is not a guarantee that security of supply and safety can be taken for granted. The open character of the Dutch economy in times of crisis requires the Dutch government to look further than production, storage, and transportation capacities, but also look at the flows. Measures to maintain a sufficient supply level in the domestic market must take account of the function of the Netherlands in the wider energy system of NW Europe, but also of the desired function of the future energy system. Potentially reducing flows to neighbouring countries must be proportional to the problems deeper into the NW European market (or differently put, the Netherlands carries some responsibility for their security of supply) and would be best done in close coordination. The reliability of the Netherlands as an entry point, conversion and storage centre will also influence the course of energy transition choices in the hinterland of the Netherlands. This is particularly the case for imported flows of low carbon hydrogen carriers and the potential location to convert them.

Notwithstanding the responsibility for NW European flows, the Dutch government is also responsible for security of supply in the Netherlands. In the current market circumstances, the low commercial inventories, the high utility rates of refineries and high turnover of flows in the storage sector, organising more supply for the Dutch market is difficult, unless market participants are ordered to so under crisis provisions. At the same time, the Dutch strategic reserve organisation COVA has been tasked with replenishing strategic diesel reserves. If the gasoil/diesel market remains in backwardation this may be the only remedy available for the duration of this crisis. Continuing such a policy of an unceasing replenishing of strategic reserves, may be the befitting role for the Netherlands as a hub, without having to resort to more drastic trade restricting measures. Doing this together with the strategic reserve authorities in the relevant market in NW Europe and/or EU-wide would help even more.

The EU council has sanctioned Russian oil and oil product supplies without sufficiently looking into the complexities of the (international) crude oil and oil products system and the interdependencies between primary energy supplies in the EU member states. The disruption in gas supplies and the subsequent increase in the price of natural gas also impacts the cost of refining crude oil, while the disruption in international crude oil and oil product markets is also felt outside the EU. Some countries benefit from the discounted crude oil supplies from Russia, such as China and India, but other non-EU oil product importing countries suffer from the impact of the oil sanctions and the subsequent reorganisation of crude oil and oil product flows. Moreover, the oil sanctions may have resulted in a further reduction of gas supplies to Europe, as Russian politicians warned, reported in Russian newspapers, already early in May 2022 they would promote export restrictions when the oil sanctions were implemented. Publicly, the EU nor most of the EU member states heads of state seem to have taken much heed of possible counter sanctions and the combined impact.

The impending oil price cap, initiated by the G-7, is intended to soften the impact of the EU oil sanctions on international markets. The intended rapid and complete disintegration of the Russian and EU oil sectors sounded alarm bells in the US over the summer. The price cap idea was initially launched in the US to replace the sixth sanction package, witness the discussion in US newspapers. Instead, the oil price cap intends to soften the impact of the oil sanctions on third countries and the European service and insurance industry in their non-EU oil flow activity. The EU market remains closed for Russian crude oil and oil products after 5 December 2022 and 5 February 2023 respectively.

The geopolitical and economic war between Russia and the West may have left few options other than to completely disengage. The disintegration from Russian energy supplies takes place before an alternative EU energy system is sufficiently underway and causes not only households a lot of economic pain (and governments to soften the impact), but also may cause more deindustrialisation than perhaps anticipated in the Fit for 55 packages.

The EU has been a growing net energy importer and relied on short-term supplies from international markets. These markets were less diversified than security of supply policies would warrant. Other substantial net-importing countries secure supplies with long-term contracts and investment in energy relations. The structural change in energy relations requires a rethink on managing future dependencies and security of supply policy options in the short, medium and longer-term.

ANNEX I: SANCTIONS OVERVIEW AND TIMELINE

EU SANCTION AGAINST RUSSIA – TIMELINE AND BRIEF OVERVIEW

6 October

8th sanction package, including:

- Introduction of a **legal basis** for a **price cap** and **further restrictions** related to the **maritime transport** of **Russian oil for third countries.**
- Introduction of an **exemption** from the prohibition to provide technical assistance, brokering services or financing or financial assistance, related to the **maritime transport to third countries** of Russian **crude oil** or **petroleum products**, **purchased below the price cap.**
- Introduction of provisions to conduct **assessments** before and after a price cap would come in force as well as a **monitoring system** which would assess **circumvention practices**, such as reflagging of vessels, and their impact on the effectiveness of the cap. Based on these assessment 'appropriate solutions' will be proposed.

21 July

7th sanction package, including:

- Introduction of a new prohibition to purchase, import or transfer Russian-origin gold.
- Extension of the existing port **access ban to locks**.
- Extension of the exemption of transactions for specific transfers of crude oil and petroleum products to third countries.

30 May – 3 June

6th sanction package, including:

- A **ban** on **purchasing, importing or transferring of** Russian **crude oil and refined petroleum products,** with a **temporary exceptions** for crude oil delivered by **pipeline** and specific derogations for Bulgaria and Croatia.
- A probation on providing **technical assistance, brokering services, financing or financial assistance** or any other services related to Russian crude oil and petroleum products.
- Introduction of a **wind down period** ending on **5 December** and **5 February** for crude oil and petroleum products, respectively.
- A SWIFT ban for an additional three Russian bank and one Belarusian bank.
- Suspension of broadcasting in the EU for three more Russian state-owned outlets.

8 April

5th sanction package, including a ban on:

- **Imports** from Russia of **coal** and **other solid fossil** fuels (including **CN2707** type fuel oil).
- All Russian vessels from accessing EU ports.
- Russian and Belarusian road transport operators from entering the EU.
- **Exports** to Russia of **jet fuel** and other goods.

15 March

4th sanction package, including a ban on:

- All transactions with certain state-owned enterprises.
- The provision of credit rating services to any Russian person or entity.
- **New investments** in the **Russian energy sector.**

28 February - 2 March

3rd sanction package, including:

- A ban on transactions with the Russian Central Bank.
- A ban on the overflight of EU airspace and on access to EU airports by Russian carriers.
- SWIFT ban for seven Russian banks, suspension of broadcasting activities in EU.

25 February

2nd sanction package, including:

- Freezing the assets of the Russian President and Minister of Foreign Affairs.
- Restrictions on **the sale, supply, transfer or export to Russia** of specific goods and technologies in **oil refining**.

23 February

1st sanction package, including

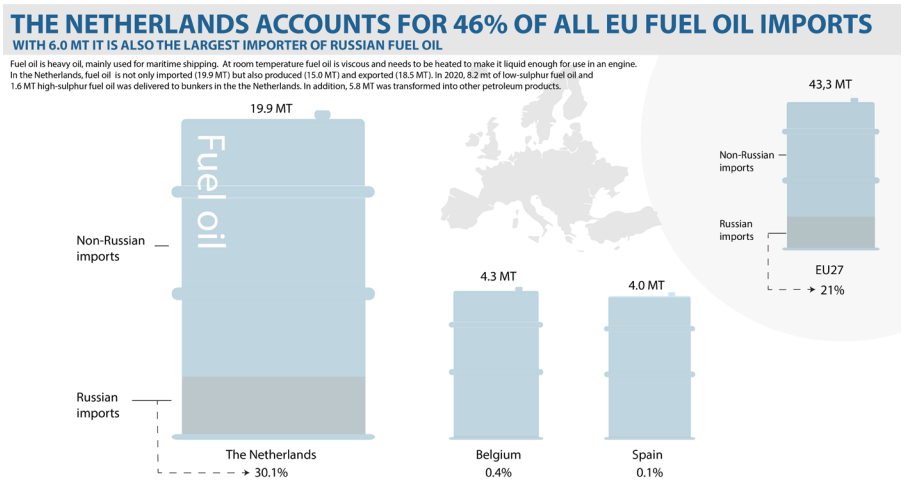
- Sanctions against 351 members of the Russian State Duma and 27 individuals.
- Restrictions on economic relations with the non-government-controlled areas of Donetsk and Luhansk oblasts.
- Restrictions on Russia's access the EU's capital and financial markets and services.

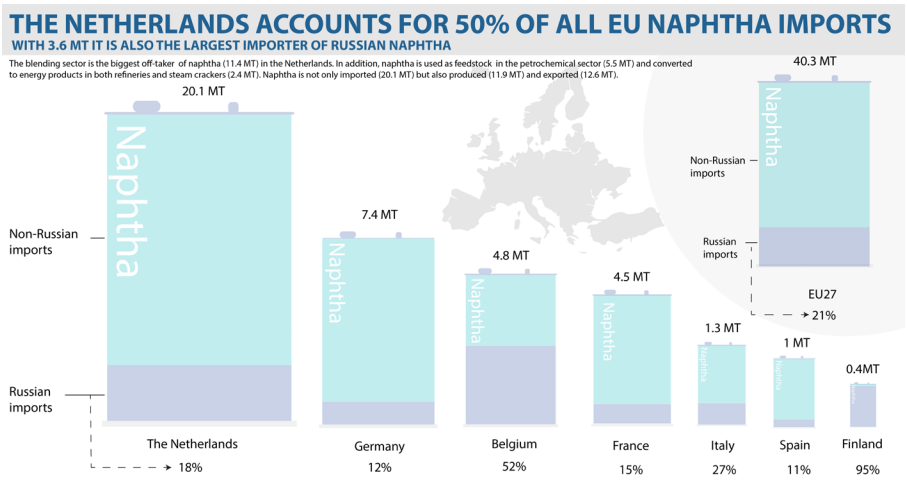
2014 - 2022

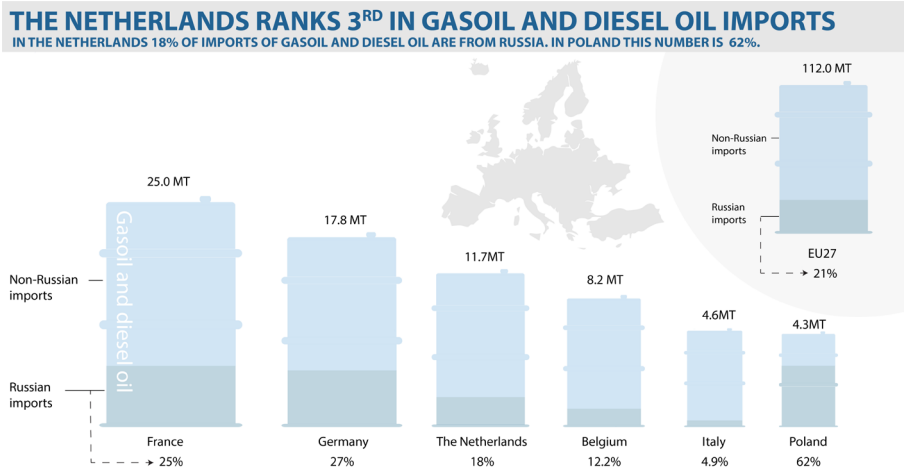
Pre-war sanction packages.

CLINGENDAEL INTERNATIONAL ENERGY PROGRAMME | CIEP

ANNEX II: IMPORT DEPENDENCY



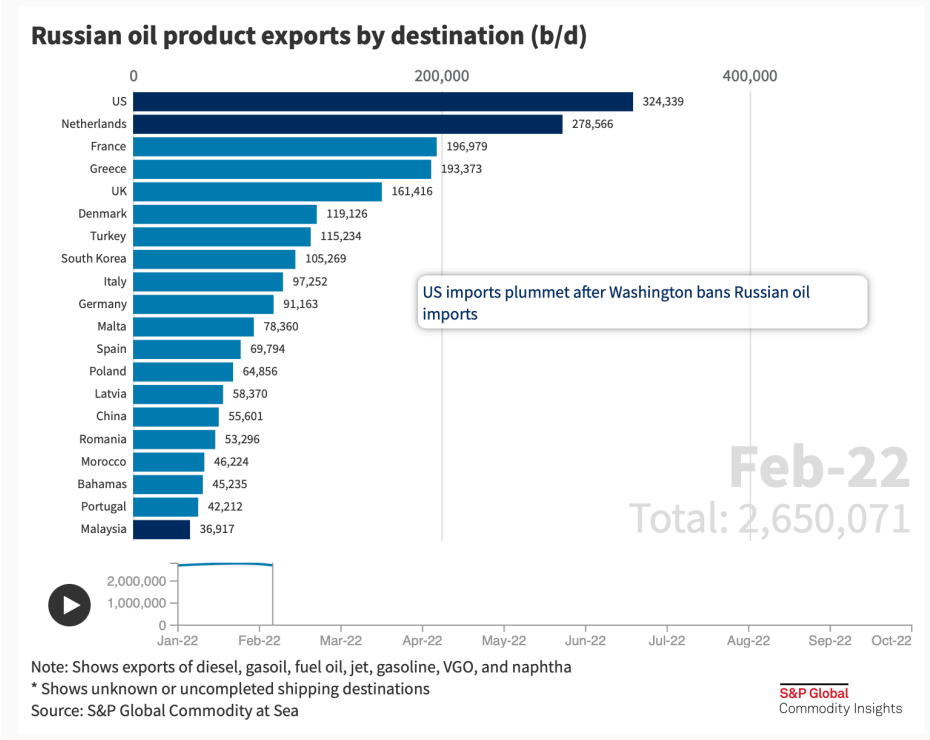


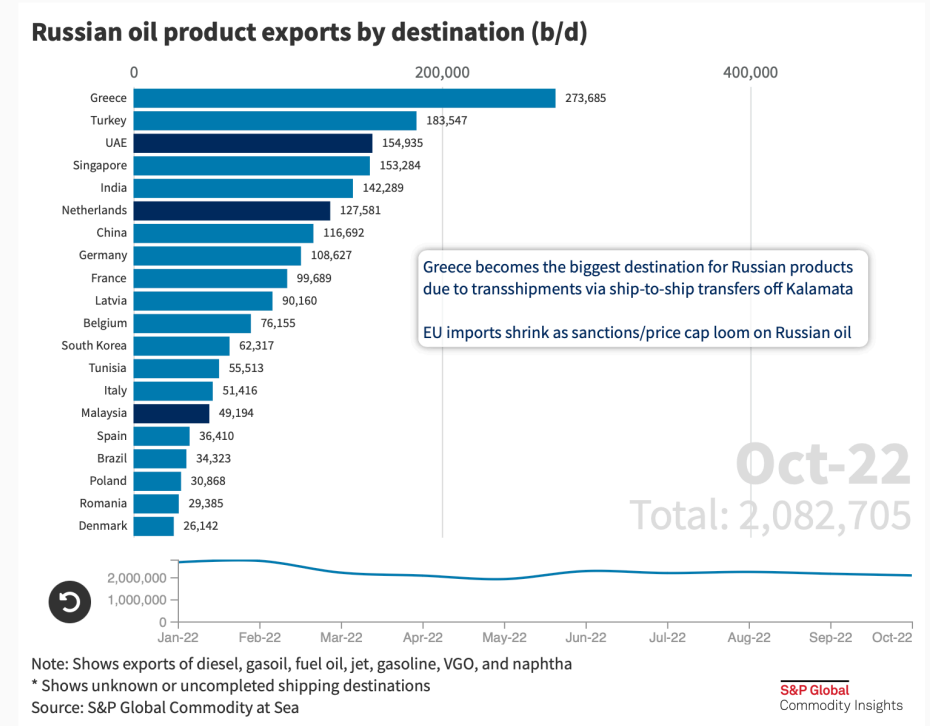


CLINGENDAEL INTERNATIONAL ENERGY PROGRAMME | CIEP

IMPORTS FROM RUSSIA OF CERTAIN OIL PRODUCTS IN THE NETHERLANDS AND EU MEMBER STATES AT THE START OF THE UKRAINE WAR. SOURCE: HTTPS://WWW.CLINGENDAELENERGY.COM/FILES.CFM?EVENT=FILES.DOWNLOAD&UI=CVDL-RONDETAFEL-25-3-2022-IMPORTEN-RUSSISCHE-OLIE-EN-OLIEPRODUCTEN-ONRUST-INT-MARKT.PDF (25 MARCH 2022)

ANNEX III: CHANGING DESTINATION OF RUSSIAN OIL PRODUCT EXPORTS





SOURCE: HTTPS://WWW.SPGLOBAL.COM/COMMODITYINSIGHTS/EN/MARKET-INSIGHTS/VIDEOS/MARKET-MOVERS-EUROPE/112822-OIL-G7-RUSSIA-EU-BAN-GERMANY-ENERGY-BILL-SUPPORT-PACKAGE-CARBON-CONFERENCE-BARCELONA-EMISSIONS-UNITS-METALS-MINING-EVENTS (ACCESSED ON 30-11-22)

ANNEX IV: THE NETHERLANDS OIL SECTOR

1 SHORT HISTORY OF THE DUTCH SECTOR

The oil sector in the Netherlands expanded rapidly after WWII. Activities before the war had been relatively small and focussed on servicing the early market for road and marine fuels for inland shipping. Before WWII, European oil companies were internationally active in Asia and the America's, but also in the early Eurasian market.[115] The development of the oil value chain deepened and accelerated from the 1950s onward.

POST-WAR DEVELOPMENT/1950s

The oil sector in the Netherlands began to grow in the early 1950s. At that time, the European economy was recovering from WWII, and imports of all sorts of oil products were increasing to satisfy demand for gasoline and diesel. The US Marshall Plan (1948-1952) payments for economic reconstruction were largely spent on these imported volumes of oil products. In part, this was because oil and oil products were traded in US dollars. The inconvertibility of the European currencies until 1958, and the ending of the Marshall Plan Funds in the early 1950s, strained the balance of payments of the European countries when oil product imports continued to grow.

Rotterdam was used by the Allied forces to supply fuels to Germany – as was Antwerp, to some degree. Germany was under occupation, and Cold War tensions with the Soviet Union were a further impetus for the Allied forces (later NATO) to develop an oil product pipeline system to supply various airfields and military bases in Northwest Europe. This pipeline system is still in place today and is now commercially exploited by NATO in the absence of military conflict in the region. The system in the Netherlands connects refineries and storage facilities with Schiphol and other pipeline routes in Belgium and Germany.

In the 1950s, decolonialisation inspired oil-producing countries to aspire to having more say in their oil sectors. In the late 1940s and early 1950s, production in countries that are now members of the Organisation of Petroleum Exporting Countries (OPEC) exported oil products to Europe. With the growing nationalistic aspirations of oil-producing countries like Venezuela, Iraq, Iran (note the 1953 Mosaddeq crisis) and Saudi Arabia, oil companies in the US and Europe began to develop new refinery sites in their own main markets. This development served several purposes. Apart from evading the political developments in producing countries, the economics of importing crude rather than products made more sense because of the growing demand for a wider array of oil products. Switching to crude imports also eased some of the balance of payments strain due to the monetary make-up of the world at that time and the fact that most European currencies were inconvertible until the late 1950s.

115 Daniel Yergin, The Prize, The Epic Quest for Oil, Money & Power,1991.

Three European countries were early in making the switch from a coal to an oil and gas economy: Italy, France, and the Netherlands. These three countries struggled with poor coal mines and declining productivity in their coal sectors. In Italy and France, the then state-controlled oil companies were short of crude and worked to build up the oil sector in their countries. In the Netherlands, international oil companies with producing facilities in the Middle East (part of the Seven Sisters and active in Iran, Iraq, Kuwait, and Saudi Arabia) and later North Africa (Independents) began to expand their oil and petrochemical activities in the Netherlands and Germany. Rising gas production in the 1960s created further synergies for this development. From the early 1970s onwards, refining activities in Antwerp also expanded rapidly to cater to the fast-growing oil and petrochemical markets in Europe.

In 1958, the European Economic Community (EEC) was launched, stimulating regional trade. The launch of the new customs arrangements was accompanied by the introduction of convertibility of the national currencies, which also helped trade. The 1960s were a period of rapid economic expansion in Western Europe. This was undoubtedly further stimulated by the relatively low crude oil prices.

EXPANSION OF THE OIL SECTOR IN THE NETHERLANDS/1960s

In the 1950s, oil supply from the Middle East and North Africa grew quickly, and American crude oil production experienced increasing difficulty in competing with the low-priced imported oil. In the late 1950s the US imposed a mandatory import quota system for crude imports to protect the domestic oil industry, and oil prices in the Atlantic basin declined even further. As a result, competition to supply the growing European market was high, which led to a rapid expansion of the oil-based economy. Oil products were used in everything from power stations to low-temperature heating systems and transportation, while the petrochemicals industry – which had previously been coal-based – quickly transformed into an oil-based industry.

Slowly an interconnected oil-based industrial complex arose in Rotterdam, aided by the expansion of other transportation modes (highways and rail links). Since the European currencies had become functional under the Bretton Woods exchange rate system, there was increasing pressure to create a trade surplus with the United States to maintain a stable currency (interventions had to be done in dollars) and to pay for the oil imports in US dollars. The establishment of the Customs Union among Germany, Italy, France, and the Benelux also stimulated foreign direct investments by various American companies in production in the EEC rather than exporting from the US.

IMPACT OF THE 1973 OIL CRISIS

In the late 1960s and early 1970s, when oil demand was growing rapidly in Europe, crude oil tankers became larger and larger. Only Rotterdam was suited to receive these new very large crude oil carriers. When refining capacities in Antwerp expanded in the 1970s, they received their crude through a pipeline from Rotterdam because these large ships could not reach the Port of Antwerp due to navigation issues on the river Scheldt and the size of the docks in Antwerp. The expansion of the pipeline corridor to Antwerp also made it possible for the Moerdijk petrochemicals location to expand by tapping into some of the oil product lines. In the same period, Dow Chemical built a large production site on the coast of the river Scheldt near Terneuzen, with a deep-water jetty to receive naphtha by ship. Most of this (cheap) naphtha came from the Soviet Union.

The Dutch economy was also growing rapidly, and in the late 1960s when wages began to grow, mobility increased and demand for gasoline expanded. In the late 1960s/early 1970s the investment decisions to expand the refining activities in both Antwerp and Rotterdam reflected the growing demand for gasoline, diesel, and naphtha. Moreover, fuel oil was used in a growing number of electricity generation plants, using even more grades of oil and replacing coal. With the growing economy, oil demand from shipping also grew. Before the refinery expansions were realised, however, the oil crisis of 1973 broke out, and many years of very low or negative margins followed for the downstream industry. Fuel oil was banned from the electricity generation sector during the 1970s to reduce the energy system's dependence on imports. This government decision impacted the refining sector, which had to either upgrade the fuel oil to products at the lighter end of the barrel, deliver to the bunker market, or export the fuel oil to elsewhere. High crude oil prices and stagnating oil product demand in Europe created difficulties for the refining sector when the new capacities came on stream. These problems were exacerbated by the oil price increase of 1979, and both the refining and petrochemicals industries had large oversupplies and had to restructure. Under an EEC restructuring programme in the mid-1980s, capacities were slapped, and plants closed, marking the first round of restructuring and consolidation for the sector in Europe. Only after these two oil price increases had been digested and the North Sea was developed into a major producing area, and oil prices began to decline (also in dollar terms), did positive margins return to the sector – from the mid-1980s onward.

CONSOLIDATION/1980S-1990s

Until the First Gulf War in 1991, most oil in Northwest Europe was imported from the Middle East. Russian crude oil and oil products also reached the Northwest European market, but to a much lesser extent than in later years. Two coinciding events, the First Gulf War and the collapse of the Soviet Union, had a large impact on the routing of crude oil and oil product flows delivered in Rotterdam. The occupation of Kuwait and the ensuing conflict with Iraq impacted flows coming from the Persian Gulf. Since refineries are usually sensitive to oil quality (viscosity and sulphur content) and have little flexibility to switch to other crude oil qualities in the short term, a replacement for Persian Gulf oil was found in Russian Urals crude.

This crude oil was available in the market due to the economic collapse in many Eastern European countries starting in 1990 and their inability or unwillingness to purchase this crude oil in dollars rather than rubbles. Many Northwest European importers switched to Russian crude oil (which was cheaper) and fuel oil imports to diversify supply away from Middle Eastern crudes. Rotterdam had always been a centre for trading Russian mazut, or fuel oil, and this position was greatly expanded in the 1990s when refineries gained the capacity to upgrade this fuel oil to premium lighter oil products. Both gasoline and diesel demand were stable in the Netherlands due to substantial tax levies and a road tax on these oil products. Diesel cars were first negatively impacted by these levies, requiring a lot of milage to make them economical to drive as a passenger car, but in the 1990s this tax effect was undone by the relatively low product prices. After 1995, when the Dutch economy began to grow faster again and the prices of gasoline and diesel were relatively low, demand increased again, in part also because large sports utility vehicles became popular and fuel prices claimed a smaller share of incomes than before.

Fuel efficiency of vehicles, which was a main driver from the 1970s onward, became less important (for consumers) and added to the phenomenon that every efficiency gain was translated into more use. The growing population further played a role in the increasing mobility demand, as did the fact that the labour market was growing, with more and more women working. The departure of employers asking employees to move close to their work – a reason for regional labour market inflexibilities – allowed people to increase the work-home distance. Housing markets also played a role in this change in mobility demand. Demand for diesel grew so much that the EU became a net importer of diesel and the Netherlands a large net exporter of gasoline.

RESTRUCTURING/2000s

Smaller refineries in Europe, which had suffered in the 1980s, were back in the money in this period. This period lasted until 2003, when a new conflict in Iraq drove prices of crude oil up and refinery margins down. The price increase in 2008 was very large indeed. The financial and economic crisis reduced oil demand, except in China, where government spending programmes kept the economy growing and the demand for oil remained high. A substantial number of refineries did not survive the price increase of the 2000s; some changed hands, others were closed indefinitely (see CIEP refining studies). The competition with the larger and more modern refineries in the Middle East and India was becoming in issue for the relatively small and older refineries. Some managed to continue life as trading refineries, also in the Netherlands (Vitol, Gunvor). The rise of China as a large importer had helped them through the difficult years, but when China completed the expansion of its own refining sector the most exposed refineries met with difficulties. The expansion of the EU with Eastern European countries led to an increase in migrant workers and trucking, again increasing demand for motor fuels.

In the period 2000-2010 various smaller refineries were closed in the EU, while large international oil companies began to actively concentrate their downstream activities in a few centres around the world. Stand-alone refineries were particularly exposed, while integrated (with petrochemicals) and more complex refineries were upgraded. Most Dutch refineries (and the Antwerp/Rhein-Ruhr areas) benefitted from this new consolidation wave in the EU and solidified their positions for the time being.

SHALE OIL/2010s

The latest big development that impacted the business model of the Dutch refineries was the rapid increase in shale oil production in the US. The impact in the Dutch oil sector was felt in two ways: (1) there were more imports of light tight oil quality by refineries, and more production of oil products at the lighter end of the barrel and less at the darker end; and (2) there was more competition from American refiners in the Caribbean and South American markets as long as the American government maintained the ban on crude oil exports and the excess supply had to be delivered as oil products in foreign markets. Ultimately, the ban was lifted by the Obama Administration. From then on, shale supply increased and found its way to international markets, displacing light crude oils from West Africa from the Atlantic basin market, forcing them to move east towards Asian markets. The relatively low prices in the period from 2014-2020 again stimulated demand for motor fuels and relieved some of the pressure on refineries that had been exposed to competition from international markets. At the same time, biofuels entered the market both for direct use and

blending purposes to comply with fuel quality directives and emissions standards. Raising the fuel specifications to meet the requirements of the various markets in and outside the EU stimulated various parties in the sector to develop these services for the Dutch market and other markets.

CLIMATE CHANGE POLICIES/2020s

The next large impact on the industry will be the EU's ambitious 2030 emission reduction targets, forcing the oil-based industry and the transport sector to adopt low-carbon technologies and renewable inputs for fuels. The expansion of biorefineries, already mentioned, is a case in point, but the growth of electric passenger cars, synthetic fuels and hydrogen for heavier transportation uses also fit within this development. Depending on the speed and size of the changes, the oil-based sector will go through a profound change. It is likely that a period of hybrid development and use of transportation infrastructure will follow because it will take a while before Internal Combustion Engine (ICE) vehicles have been replaced by other technologies.

The expected slow decline of demand is one of the reasons why crude oil, oil products and the infrastructure remain very relevant in the near-term. The complexity of the interconnections of infrastructure and installations, owned by various companies, will continue to grow. This also includes the integration of offshore wind and the conversion to hydrogen, which will increasingly connect with refineries and petrochemical sites.

One development that is beginning to surface is the integration of offshore wind production and the production of hydrogen, which will also find its way to refineries and petrochemical sites. Another development is that low carbon hydrogen carriers are being developed (e.g. liquid organic hydrogen carriers (LOHC), methanol, LH2) that could potentially use the (refurbished) oil infrastructure or the discussion to blend hydrogen in the gas system. These developments will also impact the current fuel-by-fuel approach to appointing companies or certain functions as being crucial in terms of cyber security risks.

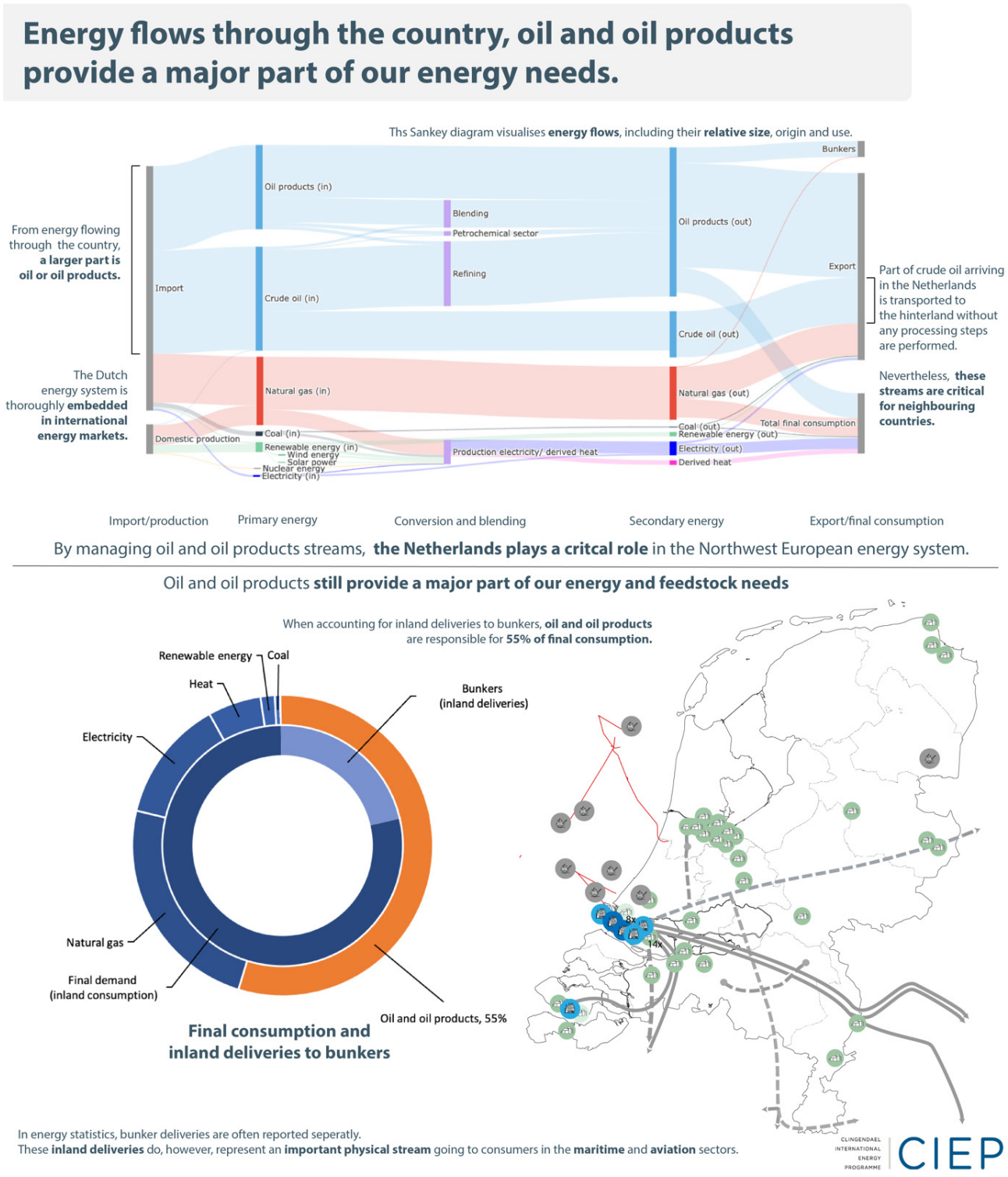


FIGURE 1 ANNEX ENERGY IN THE NETHERLANDS[116]

116 For an overview of the consulted sources for this and other figures included in this study, see appendix 1.

2 THE DUTCH OIL VALUE CHAIN

The above-mentioned historic developments led to the emergence of large-scale refining and blending activities in the Netherlands. While demand for oil products is expected to change in the coming decades because of energy transition policies, even the most ambitious net-zero emission scenarios include consumption of hydrocarbons. In the transition phase that has commenced, parties active in the fuel market are challenged to continue managing this part of the energy system in a reliable manner, while production volumes are expected to decrease, and business models, customs and relations are prone to change. A complicating aspect in this challenge is the reality that larger parts of society seem to treat the fuel industry as if it will become obsolete soon, instead of as a critical piece of the energy and resource system. The international dimension of the oil and oil products industry is an additional complicating factor. Assets located in the Netherlands provide services for a wide number of international markets, not just the domestic market. Especially Belgium and the German hinterland are largely dependent on infrastructure located in the Netherlands but also markets outside the EU. Dutch policy changes may therefore affect neighbouring countries and countries in Africa and North America, as the main export markets.

This chapter describes the functions in the value chain for oil-based fuels in the Netherlands, including key actor types that play an important role in managing it. We first clarify the relatively large size of energy streams that flow to the country in the form of crude oil or oil products. In the next chapters, key characteristics for the production, refining, storage, blending, distribution, transportation and use in the value chain are discussed.

FUNDAMENTALS: HOW ENERGY FLOWS THROUGH THE NETHERLANDS

The historic developments described in the previous chapter created a situation in which crude oil and oil products have become the major energy carriers in the Netherlands. The Sankey diagram displayed in Figure 1 annex shows the energy flows in the country in 2019. This figure enables a comparison of energy carriers and illustrates production, imports, primary energy, conversion, secondary energy, and final energy consumption and exports. It shows how energy carriers are first imported or 'produced', then become available as primary sources of energy, after which they are converted (e.g., processed from crude to an oil product, or from gas to electricity and heat) and become available as secondary sources of energy. The far-right side of the figure shows where the energy carriers end up, either in an export stream, bunker stream, or final consumption.

The lion's share of the energy now flowing through the country takes the form of crude oil or oil products. Part of the crude oil is transported to Germany and Belgium without any processing taking place in the Netherlands. Continued throughput of crude through the Netherlands is essential for the energy supply of these two countries. As a country, the Netherlands is also deeply embedded in international energy markets, creating a unique responsibility for parties in the Netherlands to manage the reliability of the Northwest European energy system.

Box 1: Oil and oil products provide the bulk of energy for final consumption and bunker deliveries

The Netherlands is not just a transit, trading and conversion hub for crude oil and oil products; it is also the world's third largest marine bunker port and an important supplier of the aviation sector, including supplying a lot of energy to many consumers via inland bunker deliveries. In fact, crude oil and oil products provide more energy to consumers via consumption and bunkers in the Netherlands than all other energy carriers combined.[117]

To grasp the role of oil products, it is important to look beyond just final consumption statistics. Reporting conventions in energy statistics stipulate that energy consumed by ships and airplanes departing to foreign destinations is presented in a dedicated 'bunkers' category. This category is seen as a form of export, not as domestic consumption. While logical from a standpoint of accounting to determine what energy is consumed where, excluding kerosine and fuel oil destined for international transportation blurs the picture of which fuels must be delivered by whom. Despite the 'bunkers' denomination, parties in the country of departure have a special responsibility in guaranteeing that these products are physically delivered to (air)ports. Responsibility for physical rather than administrative energy streams is the focus in this study. For this reason, Figure 2 shows the contribution of energy carriers to the combined metric of final consumption and inland deliveries to bunkers. Here, crude oil and oil products are the largest suppliers of energy, illustrating the continued importance of oil for society.

117 CBS StatLine (2022) Energy balance sheet; supply and consumption

To conceptualise the oil value chain[118], its various activities have been categorised as: 'production', 'refining', 'storage, blending & transshipment'[119], 'distribution & retail' and 'transportation'[120]. In Figure 2 annex this approach is used to conceptualise the oil value chain in the Netherlands. The figure also shows different types of actors that are associated with the different steps in this value chain. The figure also shows the transport modalities used in the various parts of the value chain. Transportation is an important part of the value chain and is included in this report as a separate segment.

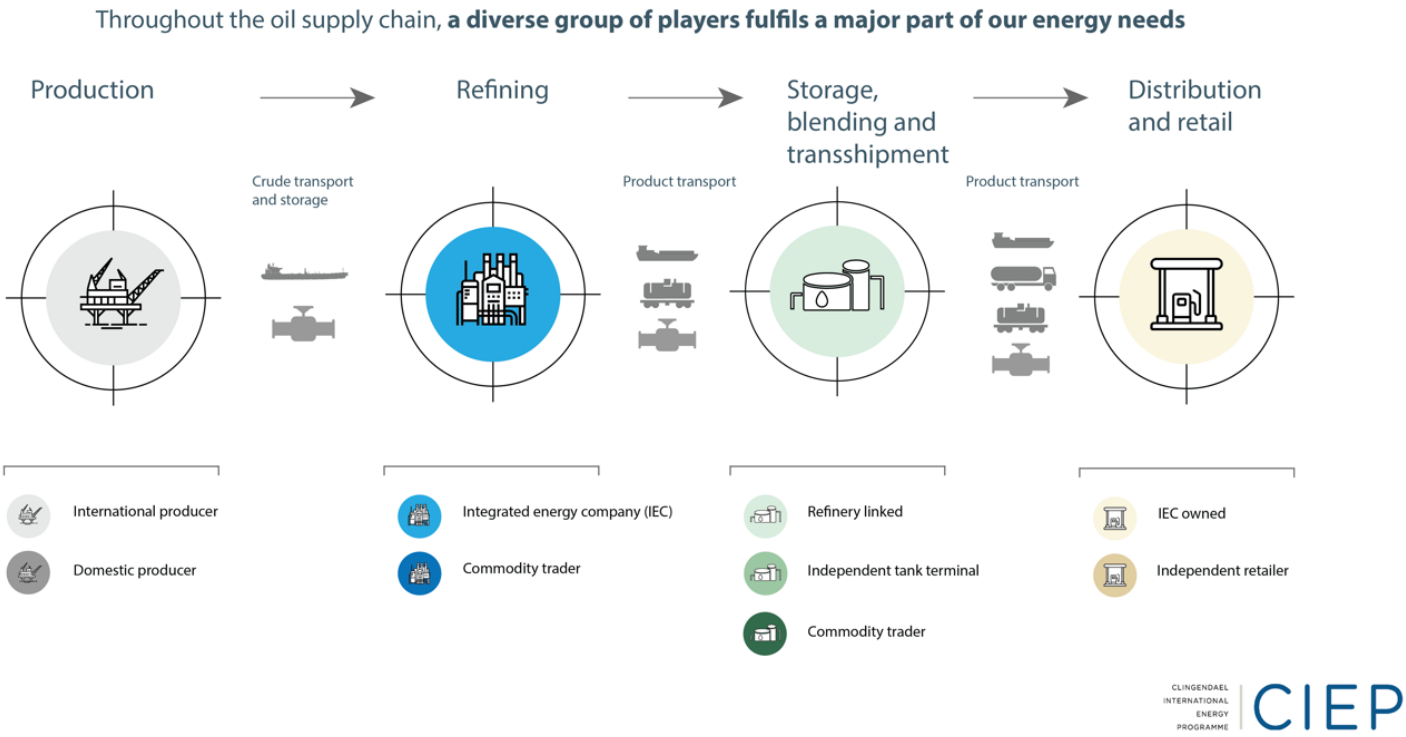


FIGURE 2 ANNEX CONCEPTUAL REPRESENTATION OF THE DUTCH OIL VALUE CHAIN, INCLUDING ACTOR TYPOLOGY

118 There are multiple ways of conceptualising the oil value chain. A conventional way is to distinguish upstream, midstream, downstream, and marketing activities. This method differentiates the 'upstream' activities that take care of exploration and production of crude oil. 'Midstream' activities connect upstream with downstream activities through pipeline connections, among others. Downstream activities perform various refining and other processing and conversion steps. Marketing activities ensure that products are sold to various customers through retail and other activities.

119 Transshipment (sometimes also trans-shipment or transhipment) means the unloading of goods from one ship and their loading into another to complete a journey to a further destination, even when the cargo may have to remain ashore for some time before its onward journey. The term can also be applied more generally to other transport modes, such as freight transport by road, rail or air, or any combination of these. Eurostat statistics, explained at Eurostat (2022) Statistics Explained

120 Eurostat (2022) Transport (including oil pipelines)

CONCEPTUALISING THE OIL VALUE CHAIN

We have identified five distinctive functional segments in the oil value chain: production, refining, storage, blending & transshipment, distribution & retail, and transportation. Each is so different that no uniform analysis can be applied for all segments of the oil value chain. Still, a structured approach to the analysis of each part in the oil value chain is useful, to ensure that sufficient perspectives are adopted in the review. While illustrating the oil value chain in an adequate manner, it must be noted that, relations are often more complex than Figure 3 annex suggests, among others because storage and blending are performed throughout the oil value chain for various purposes.

When analysing one segment of the oil value chain, it is important to identify the special features and functions of refineries, storage terminals, etc., so that essential characteristics can be highlighted. For instance, one refinery may serve a very particular and essential role for functions further down the oil value chain. Also, storage terminals cannot easily be uniformly categorised, since different types may perform very different functions in the oil sector or sites may perform various functions in the system, of which some may be crucial.

Production takes place globally and complements modest levels of domestic production

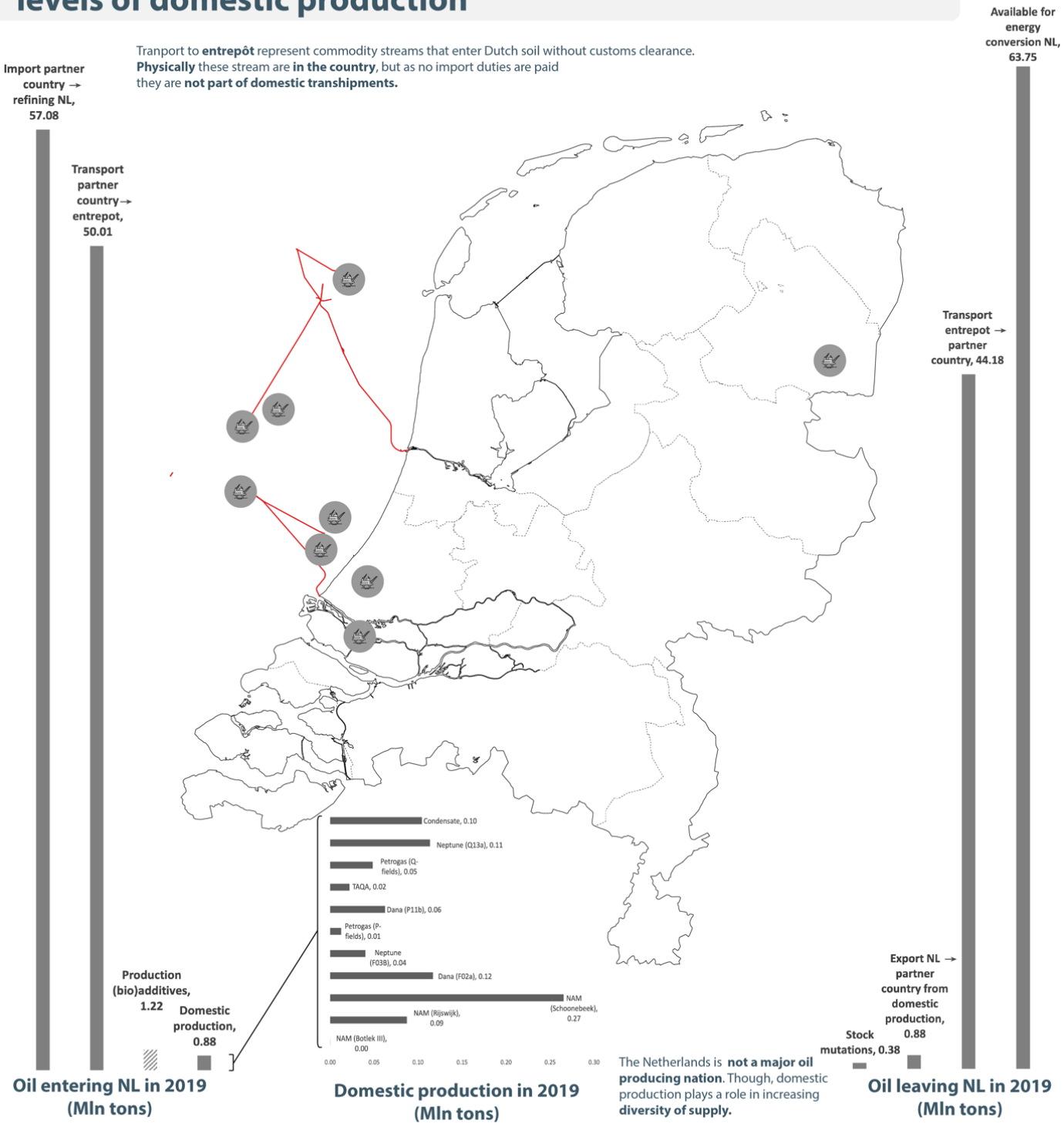


FIGURE 3 ANNEX OIL PRODUCTION AND IMPORTS IN THE NETHERLANDS

PRODUCTION AND IMPORTS

In the Netherlands crude oil is predominantly imported through the Port of Rotterdam. Origin of import streams change over time and highly depend on applicable price-costs structures. Figure 4 annex illustrates from which partner countries oil was imported in the pre-covid year of 2019. Russia has been a major oil supplier for years.[121] In addition, North Sea oil is refined in Rotterdam, as well as crude imported from the Middle East, Africa and, since the recent shale oil boom in the 2010s, also the US.

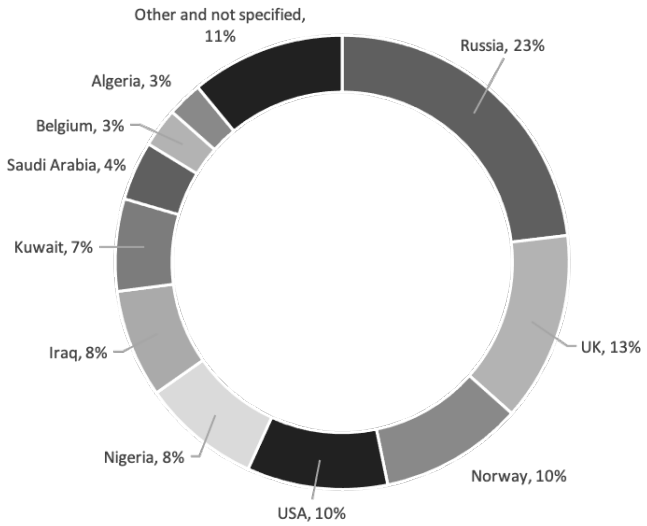


FIGURE 4 ANNEX: IMPORT PER PARTNER COUNTRY IN 2019 (SOURCE: EUROSTAT[122])

Roughly half of the crude oil entering the Netherlands through the Port of Rotterdam is registered as imported, while the other half enters the system without customs clearance since it is destined for re-exports. This oil physically passes through the country, but it can be stored for years, and no import duties are paid. These volumes are not part of national energy system. Instead, they are referred to as transshipments to *entrepot* or the 'bonded area'. Typically, these streams make their way to Germany and Belgium, where they are imported and refined. In 2019, 57 million tons of crude oil were imported for refining in the Netherlands. In addition, 50 million tons

121 Since the break-up of the Soviet Union and the First Gulf War, oil trade with Russia has increased substantially, to the detriment of some Middle Eastern crude import.

122 Eurostat (2022) Imports of oil and petroleum products by partner country, total imports of crude oil, NGL, refinery feedstocks, additives and oxygenates and other hydrocarbons (excluding biofuel portion).

of crude were transported from exporting countries to the bonded area in the Netherlands. In that same year, 44 million tons were taken from the bonded area, leaving 64 million tons of crude that was available for conversion to oil products in the Netherlands (see figure 4 annex). These crudes can also be stored in the Netherlands as if they were residing on a tax-free side of an airport and imported if needed. As a main entry-point for import and entrepot streams, Rotterdam provides a key service for the energy system in Northwest Europe.

The Netherlands itself is a very minor oil-producing country. Yet oil is produced in several on- and offshore locations (see figure 4 annex for locations and the relation between imports and domestic production), including the well-known Schoonebeek oil field. This field is directly connected by pipeline with a refinery located in Lingen, Germany. New projects for onshore production typically encounter fierce local opposition.[123] Although the level of domestic production is very modest, it does contribute to security of supply, especially in a crisis. At the same time, it is important to stress that volumes are so modest that Dutch society cannot depend on it.

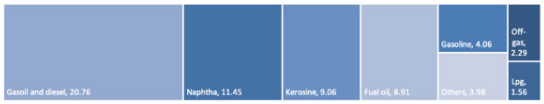
123 See e.g., AD (2021) Rotterdam woest over oliewinning onder de stad: 'Totaal ridicuul'

Refining assets are owned by integrated energy companies and commodity traders

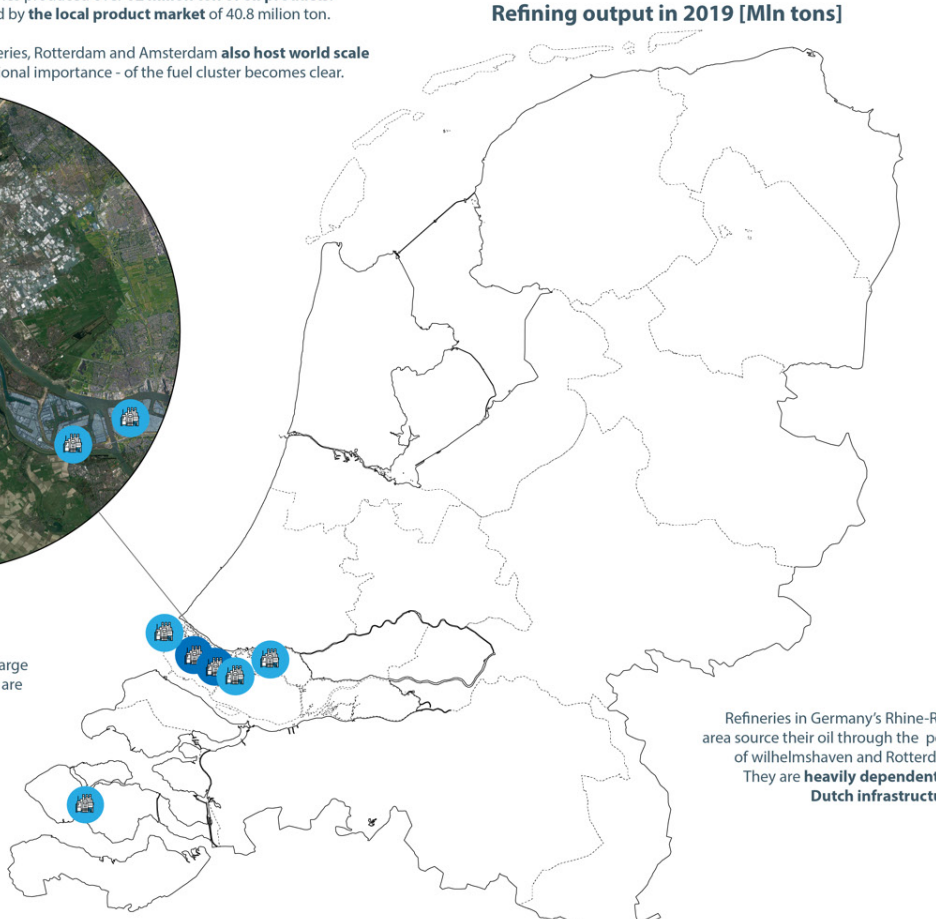
Refinery capacity is typically measured in **1000 barrels of crude oil a day** or kb/day. Total refinery capacity in the Netherlands is **1318 kb/day**, this equals about **65 mln tons/year,** enough to fill more than **2.4 milion tank trucks.**

In the pre-covid year of 2019, the six refineries produced over **62 milion ton of oil products.** This is considerably **more than** is requested by **the local product market** of 40.8 milion ton.

Considering that, in addition to these refineries, Rotterdam and Amsterdam **also host world scale fuel blending hubs**, the size - and the regional importance - of the fuel cluster becomes clear.



Refining output in 2019 [Mln tons]

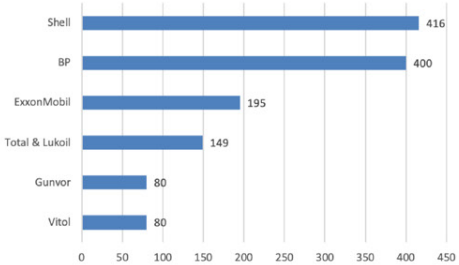


Oil is supplied to The Netherlands by very large crude carriers (VLCCs) and ultra large crude carriers (ULCCs). These supertankers are among the **largest ships ever built.**

Refineries in Germany's Rhine-Ruhr area source their oil through the ports of wilhelmshaven and Rotterdam. They are **heavily dependent on Dutch infrastructure.**

Integrated energy companies typically own assets, across the entirety of multiple energy value chains, located all over the world.

Refineries owned by **commodity traders**, also refered to as merchant refineries, are companies that combine refining activities with outsized oil trading portfolios.



Refining capacity [kb/d]

Within their **refinery portfolios,** owners constantly look for an optimal allocation of assets and resources.

CLINGENDAEL INTERNATIONAL ENERGY PROGRAMME | CIEP

FIGURE 5 ANNEX OIL REFINING IN THE NETHERLANDS

REFINING

Oil refining forms an essential part of the downstream side of the oil value chain. Refineries convert crude oil into useful products through a series of large chemical processing units. The combined refinery capacity in the Netherlands amounts to 1318 kb/day (Figure 6 annex), which is a uniquely high capacity relative to the national demand for fuels and products. At full utilisation the refineries can process over 65 million tons of crude oil a year. The refineries do not only serve the national market but also the hinterland and overseas markets. This is reflected in the production numbers for the pre-covid year of 2019. In this year, combined production was roughly 62 million tons of oil products, considerably more than the 41 million tons of products that is consumed domestically. The refining sector converts crude oil into oil products for further processing in the chemical industry and for transportation fuels (plane, truck, ship, and car).

All six oil refineries in the Netherlands are located near the coast, five in the Rotterdam industrial cluster and one in Flushing (Zeeland). The Rotterdam refineries can be supplied by Very Large Crude Carriers (VLCCs) or Ultra Large Crude Carriers (ULCCs). The refinery characteristics, including ownership category and configuration, are presented in Table 1.

TABLE 1 ANNEX: OVERVIEW DUTCH REFINING SECTOR CHARACTERISTICS

Refinery	Owner	Location	Capacity [kb/d]	Classification[124]
Shell Pernis Refinery	Shell	Rotterdam	416	Integrated and complex
BP Rotterdam Refinery	BP	Rotterdam	400	Limited downstream integration, relatively simple configuration
Botlek Rotterdam	ExxonMobil	Rotterdam	195	Integrated and complex
Zeeland Refinery	Total/Lukoil	Flushing (Zeeland)	149	Integrated and complex
Gunvor Refinery Europoort[125]	Gunvor	Rotterdam	80	Limited downstream integration, relatively simple configuration
VPR Refinery	Vitol	Rotterdam	80	Limited downstream integration, relatively simple configuration

124 Simple hydro skimming refineries mainly execute the distillation process. Complex refineries perform two additional functions: conversion of the hydrocarbon fractions produced in the crude distillation process into other products, and the processing of intermediate products to obtain higher value products. See: Galp (2022) Refining fundamentals

125 In April 2021 Gunvor confirmed that it has permanently closed its crude distillation units at the Europoort Refinery. Gunvor's chief executive Torbjorn Tornqvist said last October [2021] that the Europoort site would focus on desulphurisation, gasoline production and biofuels processing. Argus (2021) 'Gunvor confirms permanent closure of Europoort CDUs'.

As Table 1 annex shows, the ExxonMobil, Zeeland Refinery and Shell refineries are considered 'integrated and complex' refineries because they are integrated with petrochemical activities downstream (world-scale aromatics units and steam crackers) and equipped with units for secondary conversion. The BP refinery is large but not considered 'complex and integrated' (it has no hydrocracker and has limited downstream integration). The existence of extensive storage and blending facilities in Rotterdam helps to alleviate the dependence on specific refineries and increases the resilience of the cluster.

International companies operate all these refineries as part of larger portfolios, which are optimised based on company-specific criteria. Four of the six refineries are owned by one or more integrated energy company, of which most have other refineries in Northwest Europe. The two smaller refineries are owned and operated by commodity trading companies that use refineries for arbitrage[126].

Rotterdam is also home to multiple biorefineries. While most of them have a relatively modest capacity compared to the oil refineries new capacity additions are announced. Neste operates a large biorefinery and recently decided to invest in new renewable products production capacity[127], and Shell is building a large biorefinery at Shell Pernis. Moreover, UPM of Finland aspires to build a third biorefinery in Rotterdam, but a Final Investment Decision is not expected in 2022.[128]. Also, other companies in Rotterdam active in refining vegetable oil are interested in expanding their capacities and markets.

Apart from the biorefineries producing bio-end products for the diesel and kerosene market (HVO and HEFA), some of the other biorefineries and imported products deliver the biobased products and additives that by government policy need to be blended into gasoline and diesel. These products are a crucial and growing component of the oil value chain. Moreover, chemical plants are increasingly interested in bio-naphtha and expanding the integration of biorefineries into the oil value chain. In the coming 8 years, the importance and integration of the biofuels sector into the oil value chain will grow further, with more investors interested in expanding the business.

126 "Arbitrage is the simultaneous purchase and sale of the same asset in different markets in order to profit from tiny differences in the asset's listed price. […] Arbitrage can be used whenever any stock, commodity, or currency may be purchased in one market at a given price and simultaneously sold in another market at a higher price. […] Arbitrage provides a mechanism to ensure that prices do not deviate substantially from fair value for long periods of time." See Investopedia (2022) Arbitrage

127 Neste (2022) Neste invests in its world scale renewable products refinery in Rotterdam.

128 Port of Rotterdam (2022) UPM sets its sights on Rotterdam for new biorefinery

The production of biofuels in the Netherlands is growing, and further expansion of capacity is expected. Although the annual blending requirement looks relatively small, biorefineries play a crucial role in providing this service to the oil sector in the Netherlands and abroad, since biofuels are increasingly traded as a commodity. Due to climate change policies of both the EU and the national government, expansion of the biorefinery sector is likely to occur in the coming years.

The labelling 'biorefinery' suggest a rather homogeneous plant. Biorefineries come in various forms and sizes and produce different products. Differences in configuration are relevant as, for example, an ethanol plant cannot replace production of a FAME, ETBE, HVO or HEFA plant. Nevertheless, these products can be imported from international markets and are also stored in tank terminals.

Another evolving dependency induced by government policy (EU and national) is the supply of (low-carbon) hydrogen, the pipelines to transport the low-carbon hydrogen to the plants and the CO_2 pipeline and storage system, for the ability of (bio)refineries and refinery products to claim their low(er) carbon footprint.

Storage operated by independent tank terminals and terminals linked to refineries

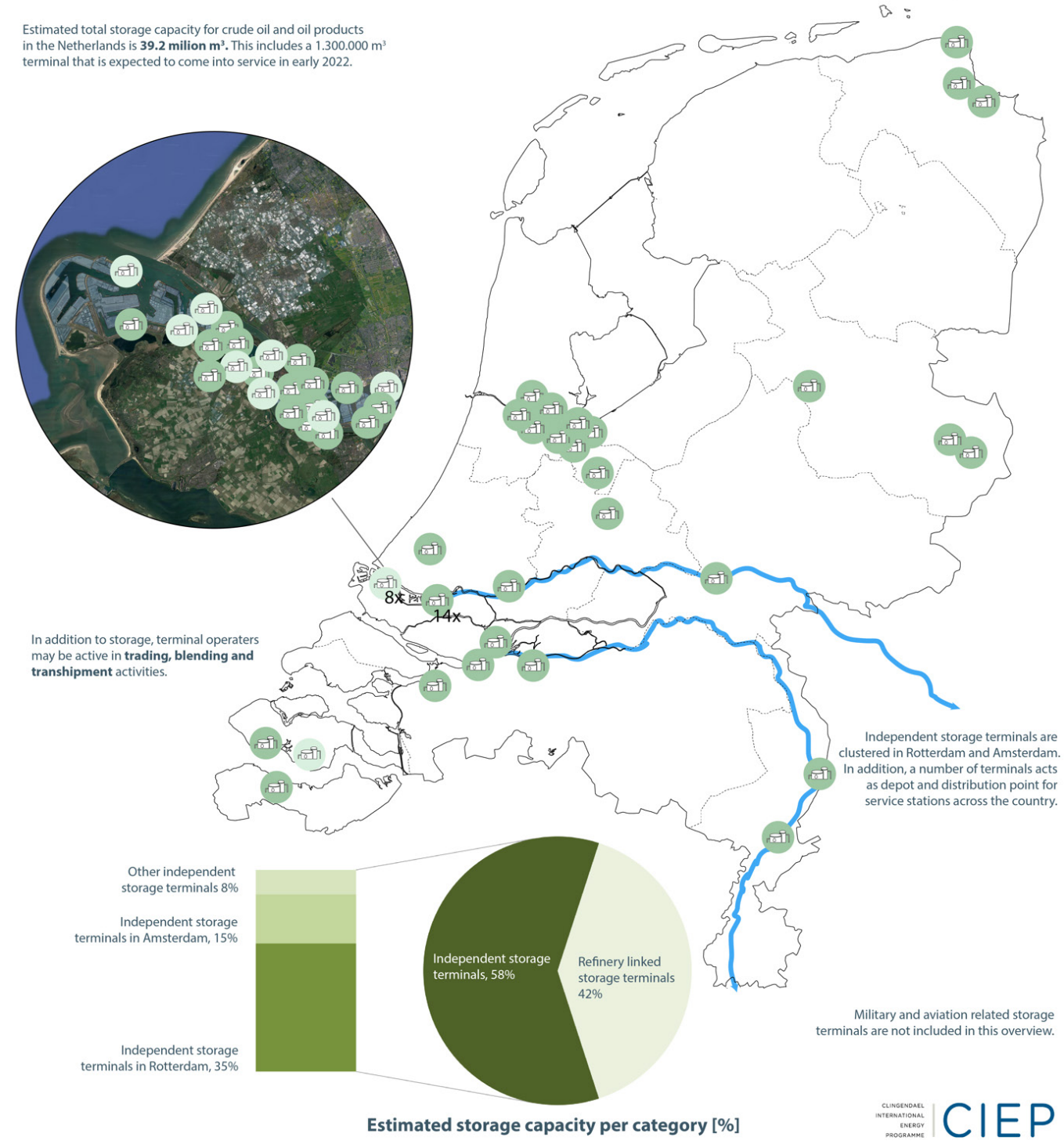


FIGURE 6 ANNEX STORAGE IN THE NETHERLANDS

STORAGE, BLENDING, AND TRANSSHIPMENT

Both oil and oil products are stored, blended, and transshipped at various stages in the oil value chain. These services are performed by a range of actors that are at times also active in other sectors, such as the processing of chemical products or vegetable oils.

STORAGE

A thorough bottom-up assessment of the Dutch storage sector shows that the total estimated storage capacity for crude oil and oil products in the Netherlands is 39.2M m^3 (see figure 7 annex). This includes a 1.3M m^3 terminal that is expected to come into service in 2022.[129] Military-related storage and terminals located at airport grounds are not included in this estimate.

A distinction can be made between two types of oil terminals: (1) crude oil terminals, which to a large extent are utilised to import crude oil for domestic refining, whereas the rest of the imported crude is stored in the bonded area (entrepot) and destined for re-export; and (2) product storage terminals that are utilised for import/export/blending/reexport and inland deliveries of final products.

The lion's share of storage terminals is clustered in the Rotterdam and Amsterdam region. Many of the storage terminals in the Rotterdam cluster are linked with pipeline infrastructure connecting them to refineries. In general, terminals located in the Ports of Amsterdam and Rotterdam have higher capacities. Depots and products distribution hubs for tank trucks are specifically used to directly supply service stations and are spread across the country.

129 Port of Rotterdam (2022) HES Hartel Tank Terminal

Box 2: Compulsory Storage Obligation (CSO) stocks

The Netherlands fulfils its stockholding obligation in compliance with the requirements set by the International Energy Agency (IEA) and the European Union (EU). In the Netherlands, these requirements have been laid down in the Petroleum Products Stockpiling Act (Wva).[130]

The total national compulsory oil stock consists of stocks held by the Central Storage Entity (CSE) COVA and a portion of the oil stock that is to be maintained by the oil sector based on their inland sales in the reference year. COVA is required to hold the difference, being approximately 80% of the national compulsory oil stock.

Emergency stocks on Dutch territory (Figure 7 annex) consist of:

- Emergency stocks held by COVA (constituting 47%, the remainder of COVA stocks are stored abroad)[131]
- Emergency stocks held by industry under obligation
- Emergency stocks held for other countries that are stored in the Netherlands: the level of emergency stocks dedicated specifically to the Netherlands is a different accumulation, as these emergency stocks are also stored abroad and exclude the emergency stocks on Dutch territory held for other countries.

The decline in emergency stocks stored on Dutch territory is due to Brexit. Since the UK left the EU, its minimum stockholding obligation (set by the EU Stockholding Directive) was eliminated, which led to a significant decrease of their emergency stockholding obligation. Consequently, the amount of emergency stock that was held for the UK on Dutch territory dropped by approximately 2.5M tons.[132]

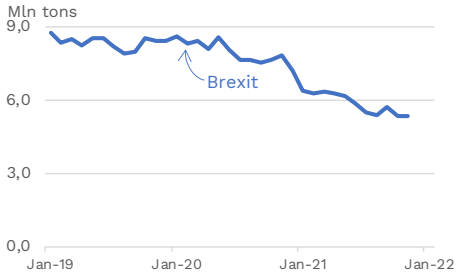


FIGURE 7 ANNEX. EMERGENCY STOCKS STORED ON DUTCH TERRITORY, HELD FOR NL AND OTHER COUNTRIES (SOURCE: EUROSTAT)

130 See Overheid.nl (2022) Wet voorraadvorming aardolieproducten 2012
131 See Cova (2020) Operations
132 Eurostat (2022) Oil stocks held for other countries - monthly data

Blending of oil products, using imported and refinery-sourced blending components

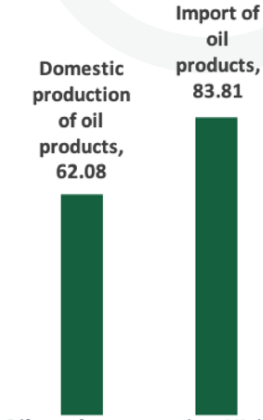
Amsterdam is the **world's largest gasoline port,** facilitating many gasoline blending and trading activities.

Gasoline is a complex **blend** of many different refinery intermediates, non-refinery-sourced blending components and additives.

The **Port of Rotterdam** is a major international blending and trading hub for **fuel oil**.

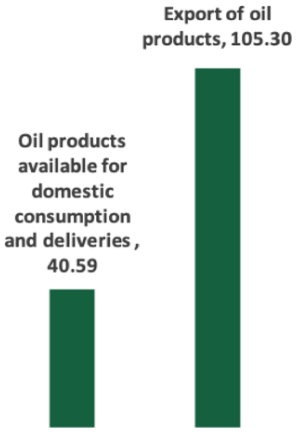
Fuel oil blended in Rotterdam is not only used for ships bunkering in this port, it is also exported to other parts of the world.

The blending and trading activities performed in the Amsterdam and Rotterdam hubs, are partly performed by commodity traders that also own refinery and storage assets.



Oil products entering NL in 2019 (Mln tons)

Overall, inputs and outputs of blending activities are equal, as the sector neither produces nor consumes fuel. Instead, it blends components to change the specifications of the products.



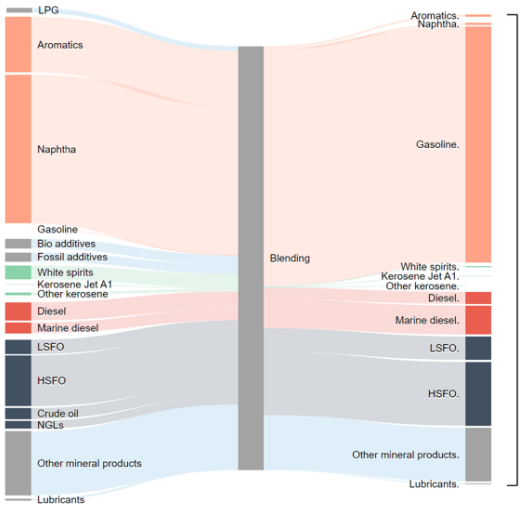
Oil products leaving NL in 2019 (Mln tons)

This Sankey shows **blending inputs and products**:

Large volumes of **aromatics** and **naphtha** are blended into the **gasoline** pool.

There is a **netto production** of (high and low sulfur) **fuel oil** in the blending subsector.

These fuels are mainly blended with **crude oil** and **natural gas liquids** (NGLs).



Total blending activities in the Netherlands accumulated to **33.75 mln tons** in 2019.

For comparison, **domestic refining production** in 2019 accumulated to **62 mln tons** and the **total inland fuel demand** (incl. bunkers) sums up to **40,8 mln tons.**

FIGURE 8 ANNEX BLENDING IN THE NETHERLANDS

BLENDING

The Netherlands, as an international oil hub, hosts legal entities of practically all large international oil trading organisations, and a lot of crude and oil products are physically traded, stored, and blended here. In addition to storage activities, terminal operators may be active in trading, blending and transshipment activities as well. Total blending activities in the Netherlands amounted to 33.8M tons in 2019 (see Figure 8 annex). For comparison, domestic refining production in 2019 was 62M tons and total inland oil product demand (incl. bunkers and chemicals) amounted to 40.8M tons.

For gasoline in particular, Amsterdam is a major export-oriented international hub. It is the world's largest gasoline port for product blending, storage, and trading. Of the 22.8 million tons of gasoline output in the Netherlands in 2019, only 4.3M tons were destined for domestic road transport, leaving the rest for export.[133] Gasoline typically is a complex mix of many different intermediate products, blending components and additives. A substantial part of these components can be categorised as naphtha and aromatics. Other mineral products used in gasoline are, for example, MTBE, ETBE, Reformat, Alkylate, Isomerate and Pygas. The gasoline mixture can vary strongly based on pricing of the individual blending components.

In recent years the practice of blending by the trade and storage sector has increased significantly. Gasoline output (or production) in the Netherlands increased by more than 50% in four years' time, from 15.0M tons in 2015 to 22.8M tons in 2019 (Figure 10 annex)[134]. The main reasons for the increased use of naphtha & aromatics as gasoline blending components are:

- A substantial share of Dutch gasoline is exported to countries with low octane requirements, leading to the more obvious use of lower octane naphtha & aromatics for blending. Such regions typically include, but are not limited to, Africa, Latin America, North America, and the Middle East.
- The increasing policy-driven biofuel blending requirements in the EU (e.g., the Netherlands' 2022 Renewable Energy Act) leads to (high octane) ethanol blending into gasoline, which is compensated with (low octane) naphtha components to meet the fuel's octane quality standards.
- Market dynamics oftentimes lead to gasoline blends sourced with naphtha components if the price spread between naphtha and gasoline increases.

133 CBS Statline (2022) Crude and petroleum products balance sheet; supply and consumption
134 CBS Statline (2022) Crude and petroleum products balance sheet; supply and consumption

- The increased worldwide supply of lighter oils (Light Tight Oil and Natural Gas Liquids) has an impact on refinery processes. Refinery yields in the Netherlands are moving towards the lighter-end of the barrel with a higher output of naphtha and aromatics, making them an attractive blending component.[135]

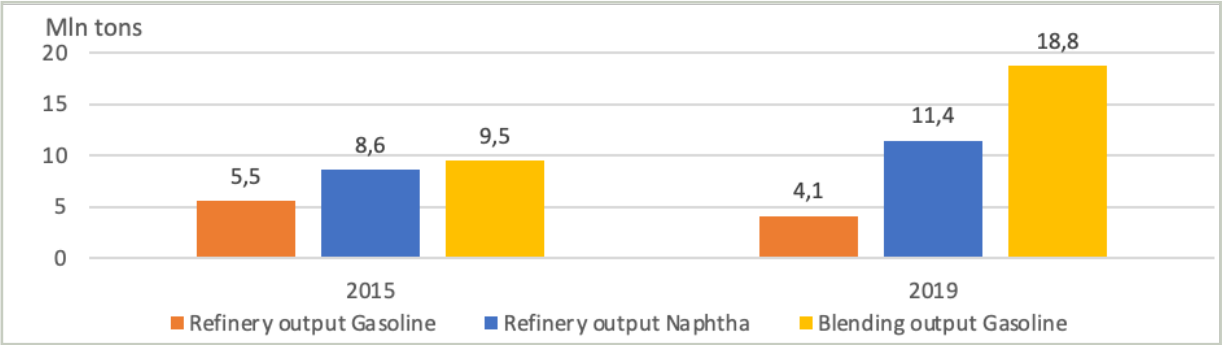


FIGURE 9 ANNEX: PRODUCT OUTPUT IN 2015 AND 2019. GASOLINE OUTPUT IN THE NETHERLANDS INCREASED BY MORE THAN 50% IN FOUR YEARS (SOURCE: CBS STATLINE)

As shown in Figure 9 annex, most of the gasoline in the Netherlands is blended at storage facilities instead of refinery sites. The additional gasoline production is facilitated by the increased naphtha output at refineries.

TRANSHIPMENT

Transhipment pertains to the shipment of crude oil or oil products from one transport entity to another. Various companies offering storage and blending services also offer services to transhipping commodities. This can either be direct, e.g., board-to-board, but also via intermediate storage, e.g., ship-to-tank-truck or ship-to-rail-tank-car transhipment. Storage facilities can be equipped with jetties to receive larger sea-going vessels and/or smaller river barges. Moreover, they may or may not have a loading station for block trains and/or tank-truck loading equipment. Offering a multitude of transhipment services adds to the connectivity of a terminal.

Characteristic for this segment of the oil value chain is that some of the assets needed to perform storage, blending and transhipment are often developed specifically to service the main clients of these facilities. Also, dedicated storage facilities sometimes serve the specific needs of a client but may also be able to supply a more generic service at some of the storage sites. Blending takes place at the behest of traders for both domestic and international markets.

135 CBS Statline (2022) Crude and petroleum products balance sheet; supply and consumption

A distinction should be made between activities for crude oil and for petroleum products. Crude is stored in enormous storage tanks of up to 114,000m³ each, while oil products are stored in tanks with smaller capacities, up to 60,000m³, which also may provide additional services such as heating for fuel oil or certain specific services for instance at airports (see figure 10 annex).

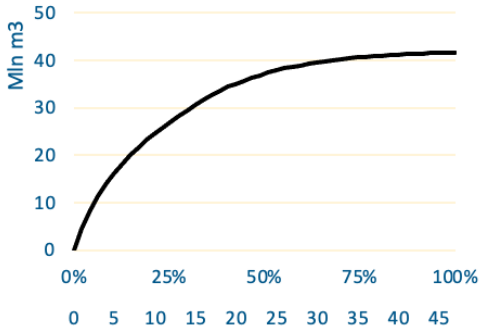


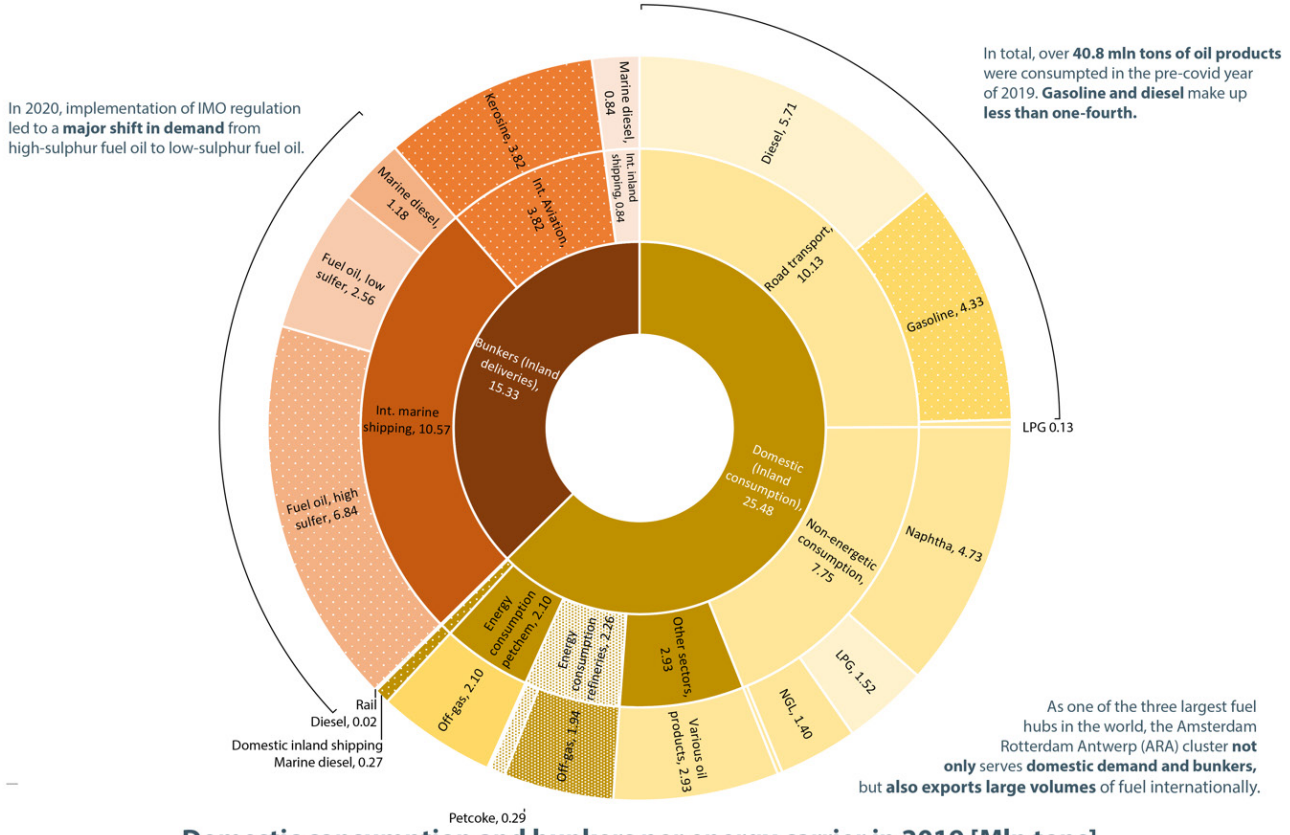
FIGURE 10 ANNEX: SHARE AND NUMBER OF TOTAL STORAGE TERMINAL ENTITIES VS. STORAGE CAPACITY IN M³ (SOURCE: CIEP ANALYSIS)

The storage sector distinguishes the large volumes of crude oil and oil products handled in Rotterdam and Amsterdam, the storages in the provinces of Zeeland and Groningen, and the smaller storages (depots) dispersed throughout the country that serve the domestic fuel market. These smaller, dispersed storage sites serve as distribution hubs for the local markets of petrol service stations. In general, one regional distribution hub can take over the role of another in the event of an delivery issue at the depot, although some delays should be expected due to the limited availability of loading racks for tank trucks. A delivery issue at a larger hub in Amsterdam, with multiple loading racks, would perhaps be harder to mitigate and could impact supply in the provinces of North and South Holland. The question then is whether regional shortages will change consumer behaviour. If consumers, also those outside the region affected, increase the average level of fuel in their tanks from less than half to more than half (e.g. due to hoarding[136]), this additional demand can exacerbate and spread scarcities to other provinces.

Storage and blending activities are a crucial link in the oil value chain in the Netherlands – not only because some of the strategic reserves of the Netherlands and those of other countries are stored here, but also because they function as an operational buffer for refineries and a buffer for oil products between refineries and the market. For crude oil storage, a few large storage actors are active in the Rotterdam cluster. Oil product storage takes place at several sites in both Rotterdam and Amsterdam and is often combined with storage of chemical products and/or liquid vegetable products. Also, here the largest ones and those with special services like blending, heating, loading racks and jetties should be distinguished from the smaller operators in the distribution hubs. Nevertheless, this crucial segment includes a larger number of players than the refining segment.

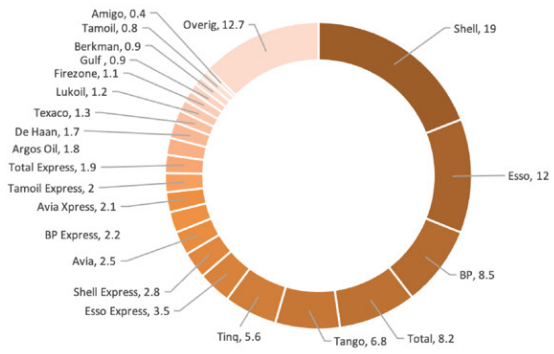
136 AP news (2021) UK gas stations ran dry as shortages sparked hoarding

Distribution of petroleum products to meet a wide range of customer needs



Domestic consumption and bunkers per energy carrier in 2019 [Mln tons]

Fuels are sold at more than 4000 locations, under a wide range of brands



Market share service stations brand in 2021 [%]

FIGURE 11 ANNEX PRODUCT DISTRIBUTION AND RETAIL IN THE NETHERLANDS

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DISTRIBUTION AND RETAIL

After being imported or processed, oil products must be distributed and sold to consumers. A common misunderstanding is that oil products are only used as fuel for cars, trucks and planes with internal combustion engines and that distribution is mainly limited to petrol service stations. Oil product distribution is deeply ingrained in modern society, as it involves consumers in a wide array of subsectors that all rely on oil products with different specifications, timeframes, and locations.

In the pre-covid year of 2019, 41 million tons of petroleum products were consumed in the Netherlands and delivered to bunkers.[137],[138] Figure 12 annex provides a breakdown into three categories: inland consumption/inland deliveries, sector consumption, and energy carriers.

The inner ring of this sunburst diagram shows that in 2019 25M tons of oil products were consumed inland and 15M tons were delivered to bunkers for consumption by the international maritime and aviation sectors. These numbers are broken down into subcategories in the middle ring. Domestic inland consumption consists of road transport, non-energetic consumption, energy consumption in refineries, energy consumption in the petrochemical industry, and consumption in other sectors such as agriculture, construction, defence, and services (e.g., asphalt as roof topping or white spirits as a solvent in paint or fuel for tractors). Deliveries to bunkers can be broken down into fuels that are used for international marine shipping, international aviation, and international inland shipping (e.g., Rhine bunkers). The outer ring shows which petroleum products are used for which purpose. The products range from LPG, NGLs and off-gasses at the light end of the barrel to diesel, fuel oil and bitumen at the heavy end.

Figure 11 annex shows that less than one-fourth of oil products are used for road transportation by passenger cars, trucks, or other road vehicles. It also shows that the non-energetic or feedstock consumption of naphtha is higher than the consumption for gasoline in road transport. Moreover, the figure shows the considerable quantities of off-gasses that are both produced and consumed in the petrochemical and refinery sectors. These plants consume off-gasses that they co-produce themselves.

Different fuels serve different purposes and require different distribution methods. Petroleum product streams for energetic and non-energetic consumption in refineries and petrochemicals plants are distributed by relevant industrial players via pipelines through the cluster.

137 Final demand and inland deliveries to bunkers are combined. See box 1 for an explanation.
138 CBS Statline (2022) Crude and petroleum products balance sheet; supply and consumption

What stands out when considering inland deliveries to bunkers are the relatively large fuel oil streams being delivered in Rotterdam. In 2020, implementation of IMO regulation led to a major shift in demand from high-sulphur fuel oil to low-sulphur alternatives. These effects are not reflected in the data used for Figure 12 annex, since that figure is based on 2019 data. In 2015, the overall size of the bunker market amounted to 16.57M tons of petroleum products. In 2019, this number was 15.32M tons. While regulation led to significant levels of fuel switching to less sour products within the bunker market, the decrease in the overall size of these markets was less pronounced.

Distribution of bunker fuels for ships is managed by approximately twenty independent private suppliers, twelve of which are in the Port of Rotterdam.[139] Rotterdam is positioned among the world's top three bunker ports. Many container vessels plan their refuelling in Rotterdam for their entire Europe-Asia-Europe round trips. Most of the bunker fuels for international aviation (kerosene – more specifically, Jet A1) is supplied via one entity, Aircraft Fuel Supply BV, which has a monopoly position at Schiphol International Airport. Schiphol, and Eindhoven airports can be supplied via the CEPS pipeline network. Other Dutch airports are supplied via tank trucks. It is unclear from public information whether the other airports along the CEPS pipeline route can be supplied by this pipeline. The majority (>85%) of commercial flights in the Netherlands are carried out via Schiphol International Airport.[140]

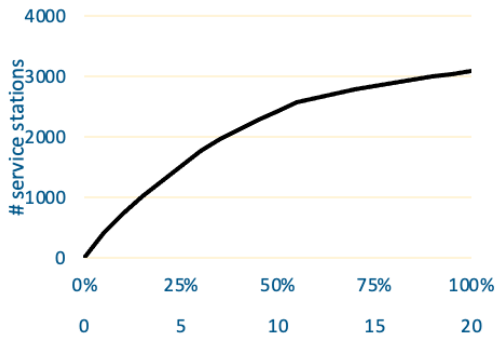


FIGURE 12 ANNEX: SHARE AND NUMBER OF SERVICE STATION BRANDS VS. NUMBER OF FUEL SERVICE STATIONS (SOURCE: BOVAG)

The distribution methods of kerosene differ from the distribution for road transport, as the latter involves a dense network of geographically distributed petrol service stations. In the Netherlands, gasoline and diesel is sold at more than 4000 locations (see figure 12 annex for locations and market shares of different brands that are used by the stations). That a station uses a specific brand does not imply that it is also owned by this brand. Many service stations are operated as a franchise, ownership- and operator structures can be differentiated[141] between dealer owned &

139 See, for example, NOVE (2022) Bunkering seagoing vessels
140 CBS Statline (2022) Aviation; monthly figures of Dutch airports
141 See, for example, Shell operator structures: Shell (2021) Be a Shell station operator with us

operated and company owned & operated.[142] Figure 13 annex shows the share of petrol service station brands versus the total number of individual petrol service stations.

Company groups that sell oil products to end-users may also use other outlets than petrol service stations alone. Oftentimes there is a larger retail, wholesale, or distribution entity behind a brand. Companies that deliver oil products such as gasoline, gasoil/diesel, LPG, CNG or biofuels to end-users for various transport modes, such as road, rail, pleasure crafts, agriculture, and stationary devices, are obliged to declare excise duty. Companies that have a cumulative excise duty declaration on oil products exceeding 500m^3 per annum must report those deliveries to the Energy for Transport Registry at the Dutch Emission Authority (Nea).[143] Of the 82 reporters in the Registry, only 37 companies deliver duty-paid fuels to the transport sector.[144],[145,146] Of these 37 companies, a smaller number (about 15, five refineries and 9 traders back in 2016[147]) of oil product distributors have an obligation to hold part of their stocks as strategic stock – defined by the 2012 Stockpiling Act[148]. The compulsory oil stock level of these companies is calculated in accordance with their inland sales of diesel and gasoline and inland deliveries of jet fuel, with a threshold of 100,000 tons per annum in cumulative sales in the reference year (Y-1).[149] Of the companies that have a stockholding obligation, a few large companies represent a substantial market share of the distribution and sales of oil products to the Dutch market.[150]

142 BOVAG Rai (2021) Mobility in Figures Cars 2021-2022
143 Emissions authority (2022) Registry - Energy for Transport
144 Emissions authority (2021) Overzicht rekeninghouders REV november 2021
145 Emissions authority (2021) Rapportage Energie voor Vervoer in Nederland 2020
146 Emissions authority (2021) Rapportage per inboeker 2020
147 Trinomics (2018) Evaluatie Wet voorraadvorming aardolieproducten (Wva 2012)
148 Overheid.nl (2022) Wet voorraadvorming aardolieproducten 2012
149 Overheid.nl (2022) Regeling voorraadvorming aardolieproducten 2013
150 The largest companies selling oil products to the domestic market and bunkers are, amongst others, Aircraft Fuel Supply, AVIA, BP, Catom, EG retail, Enviem, Esso, Finco, Gulf, Hametha (Haan), Den Hartog, van Kessel Olie, Lukoil, Sakko Groep (OBOT), Schouten olie, Shell, Tamoil, Tango, Texaco, Total, Varo Energy, Vissers Energy Group, Vollenhoven.

Transportation by pipeline systems and waterways, as well as by road and rail, in smaller volumes

In the Netherlands most energy in transported through pipeline systems. Pipelines tranported **6647 PJ of crude oil** in 2018. This is **almost twice as much** as the **3380PJ** that is transported through the entire **natural gas system**.

The amount of energy that is transported through pipeline systems for **crude oil** outstripes the amount of energy going through the **Dutch elektricity system** (428 PJ) with a **factor 15**.

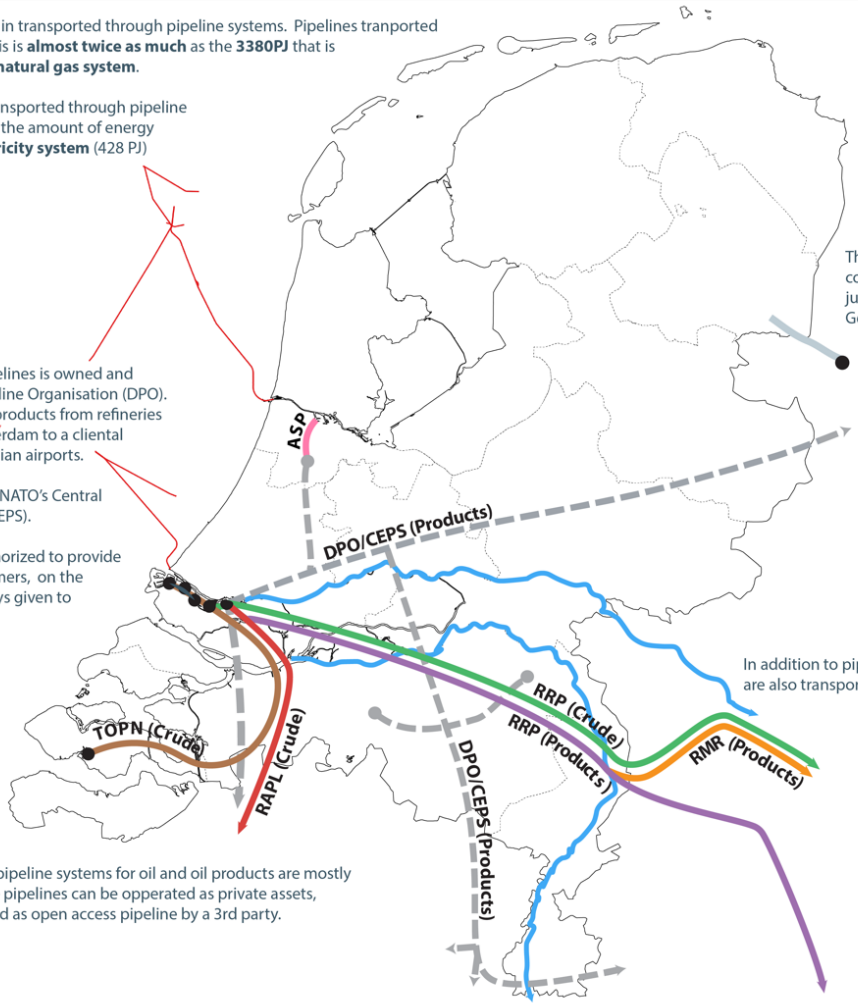
Not only crude oil is transported through pipelines, pipelines are also used to transport oil products such as gasoline, naphtha, diesel, heating fuel and jet fuel.

The Schoonebeek oil field is directly connected to the Linge refinery, just across the border in Germany.

About 550 KM of product pipelines is owned and operated by the Defense Pipeline Organisation (DPO). These pipelines transport oil products from refineries and storage terminals in Rotterdam to a cliental that includes military and civilian airports.

The DPO pipelines are part of NATO's Central European Pipeline Systems (CEPS).

In peacetime, the CEPS is authorized to provide services to commercial customers, on the condition that priority is always given to military requirements.



In addition to pipeline systems, oil and oil products are also transported by river barge and trains.

Apart from the DPO pipelines, pipeline systems for oil and oil products are mostly owned by private parties. These pipelines can be opperated as private assets, held in joint venture or managed as open access pipeline by a 3rd party.

Pipeline systems:

Abbr. - Name (Product)	Capacity (mln tons/year)	Length (Km)
RAPL - Rotterdam Antwerp Pipeline (Crude)	30	68.2
TOPN - Zeeland Refinery (Crude)	Undisclosed	138
RRP - Rotterdam Rhine Pipeline (Crude)	22	177
SL - Schoonebeek Lingen (Crude)	Undisclosed	38 Approx.
RRP - Rotterdam Rhine Pipeline (Products)	12	155
RMR - Rhein Main Rohrleitung (Products)	34,7	50
ASP - Amsterdam Schiphol Pijpleiding (Jet)	Undisclosed	16
DPO - Defensie Pijpleiding Organisatie part of	Undisclosed	550
CEPS - Central European Pipeline System (Products)	Undisclosed	5120 Cross border

Refinery
Airport
Offshore pipeline systems
Navigable river

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FIGURE 13 ANNEX CRUDE AND PRODUCT TRANSPORTATION IN THE NETHERLANDS

TRANSPORTATION

Oil and oil products are transported by various transport modalities, ranging from Very Large Crude Carriers (VLCC), coasters and barges for transport over water, to rail and road tank truck and pipeline systems. In the Netherlands, the latter category is responsible for a large volume of transport movements, while water, rail and road are used for smaller and more specific – but not necessary less crucial – shipments.[151]

Figure 13 annex shows the approximate locations of the pipeline systems for crude oil and petroleum products.[152] Crude flows southward from the Port of Rotterdam to the Zeeland refinery and to the refineries in Antwerp through the Rotterdam-Antwerp Pipeline (RAPL). Oil and products flow west to east through two pipeline systems owned by Rotterdam-Rijn Pijpleiding Maatschappij (Rotterdam-Rhine Pipeline Society, RRP).[153]

In addition, petroleum products are transported through the Central European Pipeline System (CEPS). During peacetime, this NATO pipeline system[154], consisting of over 5120 kilometres of pipeline running through France, Germany, Luxembourg, Belgium, and the Netherlands, is also used for commercial purposes. In the Netherlands, the system is operated by the Defensie Pijpleiding Organisatie (Defense Pipeline Organisation, DPO) and transports kerosine between the Port of Rotterdam and military and civilian airports. As capacity of the DPO pipeline to Schiphol is dimensioned to NATO requirements, it is too small to deliver the airport's requested volumes under full commercial use. As transport via barge is deemed undesirable, kerosine is also delivered to Schiphol via a second pipeline. This Amsterdam-Schiphol Pipeline (ASP) connects the airport to storage terminals in the Port of Amsterdam (EVOS Amsterdam East).

In addition to the larger pipeline systems and several offshore pipelines, one other onshore crude pipeline transports crude in the Netherlands, namely in the province of Drenthe. This relatively short pipeline connects the Schoonebeek oil field, operated by NAM, to BP's Lingen Refinery in northwest Germany.

151 As exact numbers on the use of various transport modalities are missing, the Dutch Central Statics Bureau started a project to better quantify these transport flows. While recently published data show the significance of pipeline transport, data on, for example, petroleum product flows are – now – not publicly available. For this reason, this paper takes pipeline capacities as a starting point to assess pipeline systems.

152 Crude oil and petroleum products are by no means the only goods transported by pipeline. In addition to pipelines for natural gas and heat, several pipelines transport industrial gases and petrochemical products between industrial clusters. See, for example: CIEP (2021). Dynamic The Dynamic Development of Organic Chemistry in North-West Europe.

153 At the Dutch-German border at Venlo, The RRP product pipeline is connected to the Rhein-Main-Rohrleitungstransportge sellschaft (RMR). This pipeline transports petroleum products to Frankfurt and Ludwigshafen am Rhein.

154 https://www.nspa.nato.int/about/ceps/ceps-network

Smaller volumes of crude and oil products are transported by barge, rail, and road tank truck. These modalities are also used to supply fuel depots because, apart from those in the Rotterdam and Amsterdam blending hubs, fuel depots are not connected to pipeline systems. In addition to sufficient barges, rolling stock and tank trucks – including the personnel to operate them – these transport modalities depend on the conditions on rivers, railways, and highways. For river transport, low water levels can hinder normal operations, as was witnessed in 2018, when low Rhine River water disrupted petroleum product shipments.[155,156] A similar situation may occur in 2022 with water levels already forcing shippers to reduce their cargo.[157]

In the Netherlands, flexibility to divert flows is limited, not only because pipeline capacity and technical possibilities to switch between products are limited, but also because regulations and permits stipulate that pipelines only be used for specific products.[158] One large pipeline can transport more than 100,000 tons in a single day. It would take more than 4,000 trips by road, 80 trains a day or 45 ships on inland waterways to replace these volumes.[159] Even if it were possible to find this many additional tank (rail) trucks or ships, the highways, railroads, and waterways would be unable to accommodate the increased flow of traffic.

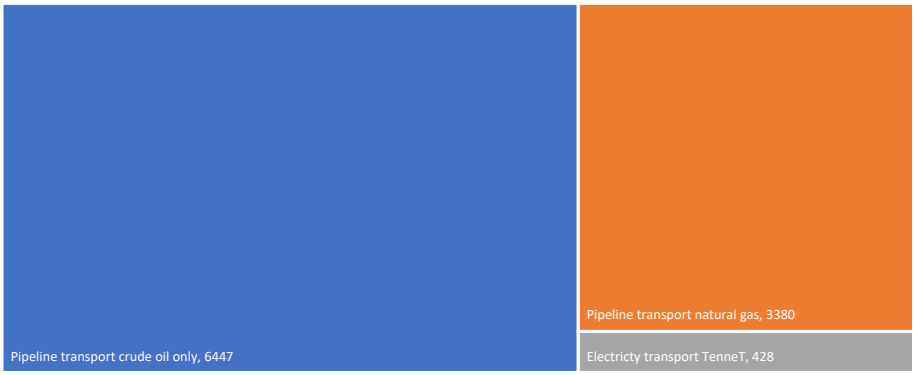
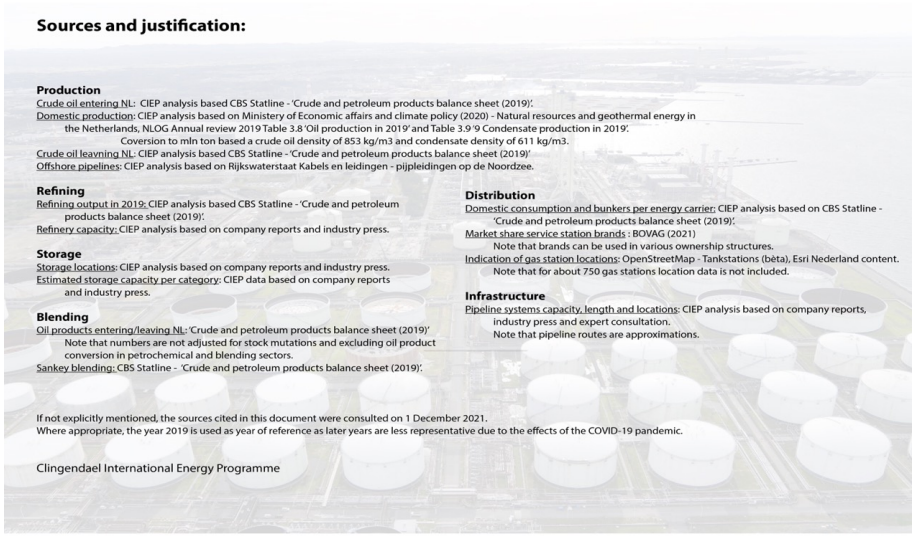


FIGURE 14 ANNEX: TRANSPORTED ENERGY CARRIERS SORTED BY ENERGY CONTENT, IN PETAJOULES, FOR THE YEAR 2018

155 EIA (2018) Low Rhine River water levels disrupt petroleum product shipments to parts of Europe
156 Transport online (2018) Tientallen pompstations Shell zonder brandstof
157 https://www.dw.com/en/low-water-again-threatens-to-sink-industries-along-the-rhine/a-62550672
158 Occasionally, discussions emerge about new product shipments using existing pipeline systems. An example is the transportation of aviation fuel with high levels of biocomponents and/or sustainable aviation fuels by the CEPS. Here, agreement by all partner countries is required. More recently, a discussion started on the construction of a new west-east pipeline corridor (Delta corridor). Research focuses on transport of hydrogen, CO2, LPG and/or propane.
159 CBS (2021) CBS brengt transport via buisleidingen in kaart.

When comparing pipeline transportation capacities among energy carriers in terms of energy content, large differences materialise. The transported energy, expressed in petajoules, for crude oil alone throughout in the Netherlands is twice the size of transported natural gas and fifteen times the size of transported electricity (see figure 14 annex).[160]



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160 Calculations: 151M tons of crude oil was transported throughout the Netherlands in 2018 (CBS Statline), using a calorific value of 42.7 PJ/million tons. This equals 6447 petajoules; Gasunie transported 939 TWh of natural gas throughout the Netherlands in 2018, which equals 3380 petajoules; TenneT transported 119,015 GWh in 2018, which equals 428 petajoules.

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