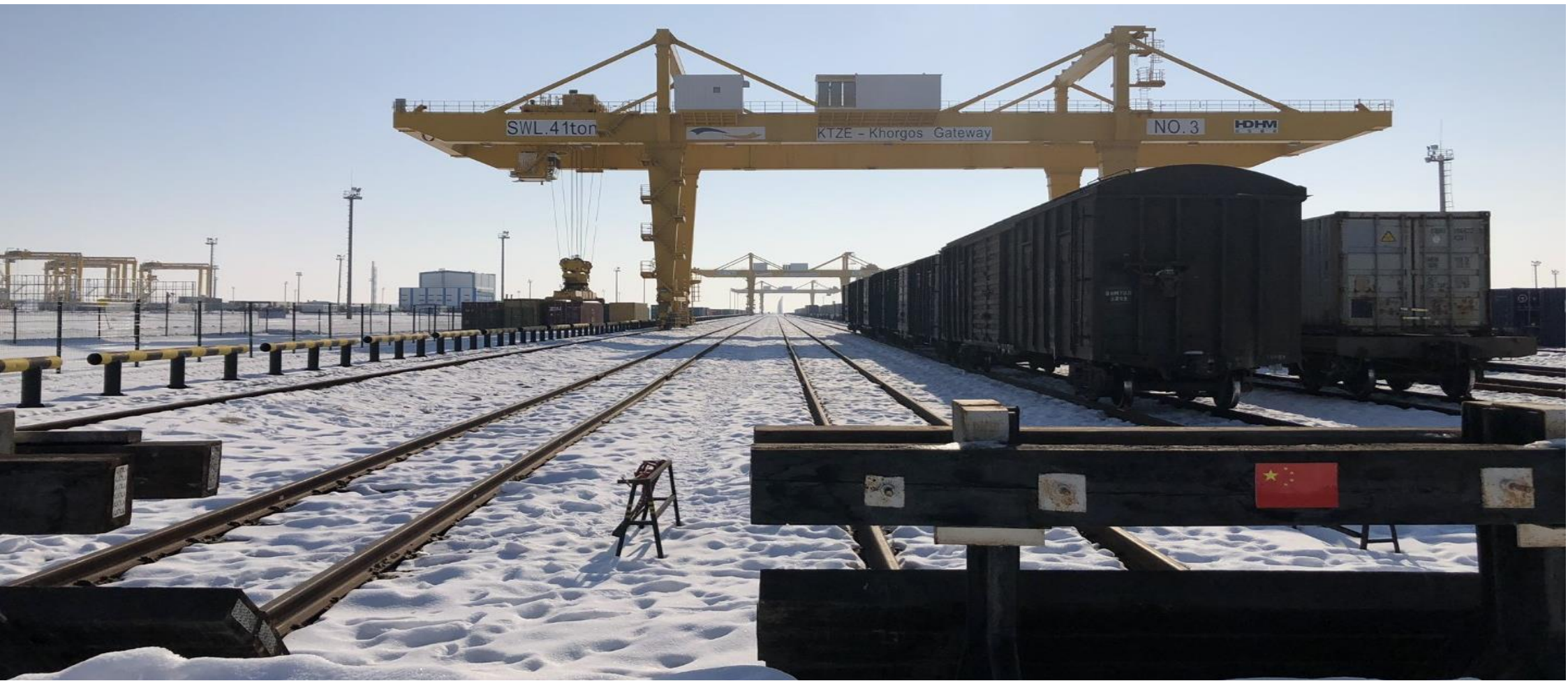


CAREC Middle Corridor Assessment

Transport Connectivity on the Eurasian transit routes

Asian Development Bank September 2022



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Executive summary

The COVID-19 pandemic and the Russian invasion of Ukraine resulted in significant operational bottlenecks on the Eurasian transit routes. The focus of this study will be the so-called Middle Corridor (aka CAREC Corridor 2 and TRACECA), which has seen a significant increase in container traffic since February 2022.

Unprecedented global events in 2020-2022 adversely affected demand of worldwide trade and the supply chains that support transport.

The COVID-19 pandemic illustrated how quickly countries can make unilateral decisions to close borders and protect citizens from external events. The immediate consequential impacts of closed borders resulted in lower manufacturing production as a result of the perceived and actual economic downturns. Financial markets were thrown into confusion by indicators such as industrial output in People's Republic of China (PRC) contracting by 10.9% quarter on quarter in the January-March 2020 period, and forecasts predicting that PRC growth in 2020 would be no higher than 1% (Tardivo, Carrillo, & Sánchez, 2021). This uncertainty of demand for global trade saw massive reductions in transport connectivity and reduced capacity deployed on all modal networks.

Uncertainty in the demand for freight meant transport asset owners and operators reacted by reducing operating costs through reducing services and laying up assets including train rolling stock, long haul road trucks, ocean going container ships, and wide body aircraft. Container shipping especially reacted promptly to the major downturn in freight demand by cancelling sailings in order to minimise operating costs thereby eroding service reliability. In May 2020 it was recorded that 13% of the global container ship fleet equivalent to removing capacity totalling 3 million TEU (20' containers) was laid up as markets fell (Paris, 2020). Similarly, the seaport utilisation index recorded 22% reduction on year to date in April 2020 (Hellenic Shipping News, 2020). Notable examples of seaports downturn in utilisation in Q1 2020 included Shanghai (-6.8%), Hamburg (-14.7%), Le Havre (-29%) and Barcelona (-20.5%) (Cullinane & Haralambides, 2021).

Rebound of demand on manufacturing was rapid of as the world adjusted to lockdowns and consumer demand.

The spectacular rebound in global manufacturing in Q2-Q4 2020 was spurred on by surging consumer demand in the West. In November 2020, PRC exports grew by 21.1% from 2019, representing the largest year-on-year increase by value on record (Birmingham & Leng, 2020). This in turn caused labour shortages in PRC south and east, with many factory owners scrambling to keep pace with overseas orders. Immediately this demand translated to increased demand for seaport services, with many ports reporting record throughput volumes in September, October, and November 2020 (Cullinane & Haralambides, 2021). To a certain extent, the rise in demand related to large-scale restocking, taking place first in North America in Q3 2020, and later in Europe in Q4 2020. As an example of this, the port of Los Angeles registered a surge in throughput of nearly 50% in the second half of 2020, followed by a record period in Q1 2021, with throughput 122% higher than 2020 (Cullinane & Haralambides, 2021).

COVID border restrictions, labour shortages and capacity adjustments combined to create short supply and delays in transport networks.

Combine effects of cross-border restrictions for freight services, delays to quarantine and customs clearances and reduced supply of transport capacity (predominantly ships) created bottlenecks in supply chains and build-up of exports from PRC at ports and terminals. Another key constraint to PRC export shipping was a shortage of empty containers which had built up in Europe and USA due to limited shipping capacity to evacuate to demand ports in the preceding months.

Freight switched to alternative transport routes to overcome shortage of supply and rising costs of maritime transport from PRC to Europe

The renewed demand for shipping space from PRC to USA and Europe saw market power switch to the shipping lines that imposed sharp rises in sea freight rates for containerised trade. Shipping lines were also thought to be managing available capacity to maintain a shortage of supply thus exacerbating the extreme demand for shipping space. The container shipping indices recorded ocean freight spot-rates in March 2020 at US\$2,000/FEU and in Sept 2021 as high as US\$14,000/FEU from PRC

to Europe main seaports (SSEx, 2022). The primary beneficiary of freight switching modes was the main rail corridor for PRC to Europe via Russia and Belarus northern route which saw an increase of 30% in throughput and was claimed to handle 95% of the 1.5 million TEU transported by rail in 2021 (Knowler, G, 2022). The middle corridor multi-modal transit route via rail and sea via the Caspian Sea and Black Sea ports was the secondary beneficiary of the spill over of container freight from PRC to Europe. This surge of demand for shipping capacity was a testing phase for the Middle Corridor given the steady growth and ambitions it had long held to develop its capabilities as a key freight corridor between PRC and Europe.

Russian Federation invades Ukraine creating new impacts on transport connectivity and exacerbates existing freight costs and delays

On 24 February 2022 Russian forces crossed Ukraine's border and major conflict between the two nations began. The total Black Sea container trade region (Bulgaria, Romania, Ukraine, Russia, Georgia) is minor in global terms with container turnover (laden/empty) at approx. 3.1 million TEU in 2021, including Ukrainian annual volume of a slightly over 1.0 million TEU (HSN, 2022). An immediate effect on sea transport resulting from the conflict was the suspension of vessel calls to Ukraine until further notice and container carriers cut ship carrying capacity assigned to the Russian Federation (UNCTAD, 2022). Another impact on transport was the escalation of the Baltic Dry Index - a global benchmark for dry bulk freight rates that increased by nearly 60% to May 2022 (UNCTAD, 2022). Russian Federation as a leading oil and gas exporter were hit by trade sanctions which in turn escalated global prices for ship bunker fuels. Low sulphur fuel oil (LSFO) reached over US\$1,000 per ton, a 64% increase from Jan to May 2022. Container shipping lines reacted to increase fuel prices by imposing additional fuel surcharges in May 2022 on freight rates by an average increase of 50% compared to January 2022. The Trans-Siberian Rail Link and Trans-Kazakhstan Rail Link connecting PRC to western Europe via Russian railways were immediately affected by sanctions and preferences of cargo owners wishing to avoid using Russian operated infrastructure. The middle corridor offering multi-modal routes via the Caspian Sea gave some relief to the overland freight as a substitute to the routes via the Russian Federation. Increases in demand for the Middle Corridor were immediate with Caspian Sea ports, shipping lines and terminals operating on the Caspian Sea experiencing capacity constraints. Beneficiary countries and transport operators have raised their interest in expanding connectivity and capacity on the Middle Corridor including seaports, terminals and trans Caspian shipping services.

Development of future transport corridors between PRC and EU previously being considered have taken on renewed interest

There are several developments being considered to add capacity to the PRC to Europe trade route. These are both overland and via sea. Some developments have been long in planning but are gathering momentum, such as the proposal for a new rail route from PRC to Turkey via Kyrgyz Republic, Uzbekistan, Turkmenistan and Iran to Turkey and via the Bosphorus rail services to southeast Europe (The Economist, 2022). A proposed sea route so-called Northern Silk Road also known as Northern Sea Route via Arctic waters is being trialled. This route is made possible by projected future global warming and that crosses the Arctic Ocean and allowed to reduce the overall sea transit time from PRC north ports to Europe significantly. The direct transit time between northern PRC ports via the Bering Sea, Kara Sea, Norway coast to northern Europe ports would be 22-26 days as compared to 35-45 days via the existing sea routes that traverse through the South China Sea, Malacca Strait, Arabian Sea, Red Sea, Suez Canal, Mediterranean Sea to Europe (UNCTAD, 2017).

Summary

Covid-19 in 2020 and Russia-Ukraine conflict in 2022 combined to strangle supply chains from PRC to Europe. These events influenced unprecedented levels of price increases and capacity reductions imposed by global shipping lines. These adjustments were rapid and created conditions that channelled an opportunity for other modes of transport to capitalise on the lack of available shipping space from seaports in PRC. The beneficiary's included existing overland multi-modal routes with the Middle Corridor emerging as a contestable solution especially given the limitations imposed on rail via Belarus and the Russia routes to Europe. This scenario could be described as the best opportunity for the Middle Corridor to prove itself as a viable overland route for consistent volume of end-to-end transcontinental transport.

Amongst the heightened enthusiasm of the Middle Corridor the sobering thoughts need to be focussed on the reality of ocean shipping capacity returning to oversupply and pricing returning to competitive levels. Indeed, some commentators are predicting sea freight rates dropping to levels lower than that seen in 2018. Back in 2017-18

PRC to Europe ocean freight rates were reported as low as USD1,374 FEU on 1st Feb 2018 (Drewry, 2022). The conditions serving to stimulate low ocean freight pricing is overcapacity and slowing global trade growth. Indicators are in line with both these factors and talk of ‘stagflation’ is being highlighted.

According to the World Trade Organization (WTO), global merchandise trade plateaued with year-on-year growth slowing to 3.2% the first quarter of 2022, down from 5.7% in fourth quarter of 2021. The WTO downgraded its global trade growth forecast for 2022 to 3% (from 4.7%), while remaining cautious for 2023 at 3.4% (WTO, 2022). A more pessimistic view is offered by the World bank Group (WBG) that’s says; Global growth is expected to slump from 5.7% in 2021 to 2.9% in 2022— significantly lower than 4.1% that was anticipated in January. It is expected to hover around that pace over 2023-24, as the war in Ukraine disrupts activity, investment, and trade in the near term, pent-up demand fades, and fiscal and monetary policy accommodation is withdrawn. As a result of the damage from the pandemic and the war, the level of per capita income in developing economies this year will be nearly 5% below its pre-pandemic trend (WBG, 2022).

Against such background, the Middle Corridor would be well advised to ‘pause and reflect’ on the influences that provided them a surge in freight volumes across the network and consider it a valuable opportunity to prove capability. Thoughts of rapid investments in Middle Corridor hard infrastructure such as new rail networks, enhancing Caspian Sea ports and ferry capacity should be balanced against a more strategic and conservative outlook for investment of future demand-capacity growth.

Transport time is often referred to as being one of the most important cost factors in freight transport. Price is however often considered even more important (Lundberg, 2006). It is therefore important to know how decision-makers determine the trade-off between time and price for specific commodities. One concept that is commonly used in freight transport is Value of Travel Time Savings. The Middle Corridor offers such advantages and would benefit from monitoring the end-to-end transit times and how that translates to an ultimate ‘decision criteria’ of transport mode by those parties controlling the routing. The modal comparisons are shown in Figure 1.

FCL-FCL	FROM CHINA to EU - FORTY FOOT CONTAINER (FEU)	Volume handled 2019 est.	2018-2019	2020-2021	2022-2023
MODE / Days	ROUTE		USD/FEU	USD/FEU	USD/FEU
SEA	Main seaports to West EU Ports container routes.	32m TEU	\$1,500 low	\$9,000 low	\$7,500 low
35-45 days	Tianjin Port/Qingdao Port/Shanghai Port/Ningbo Port. To; Piraeus Port/Rotterdam Port/Port of Hamburg/Antwerp Port		\$3,200 high	\$15,000 high	\$14,000 high
RAIL	Northern rail corridor (PRC, RUS, EU)	400k TEU	\$5,000 low	\$6,500 low	\$ N/A
14-16 days	Tianjin–Manzhouli–Trans-Siberian Railway–Moscow. To; Duisburg or other EU Main terminal.		\$7,387 high	\$9,000 high	\$ N/A
CR Express	From Xi’an to Hamburg (through Horgos or Alataw Pass)	1.49m TEU	\$2,000 low	\$ 8,000 low	\$7,000 low
13-15 days			\$3,000 high	\$12,000 high	\$10,000 high
RAIL/FERRY	Middle Multimodal corridor (PRC, KAZ, Caspian Sea, AZE, GEO, EU).	50k TEU	\$6,000 low	\$7,000 low	\$ 8,200 low
21-24 days	Lianyungang (China) to West EU Terminals		\$8,000 high	\$10,000 high	\$12,000 high

Figure 1 - Comparison of Routes, Prices 2018-2022, Transit, PRC to Europe

Contents

Contents

Executive summary	3
1 Introduction	1
1.3 Scope and limitations	1
1.4 Relevant assumptions	1
2 Demand Overview.....	3
2.1 PRC Manufactured Exports	3
2.2 CAREC Trade context.....	3
2.3 CAREC Major Trading partners	4
2.4 CAREC Region Trade Growth	5
2.4.1 Direct Trade with CAREC Countries	5
3.1.1 Sea freight Rates	7
3.2 Combined Sea Road and Rail Transport	9
3.3 Northern rail corridor (PRC, KAZ, RUS, EU)	9
3.4 Northern Corridor CR Express	10
3.5 Middle Corridor (PRC, KAZ, Caspian Sea, AZE, GEO, EU).....	11
3.5.1 Middle Corridor Capacity	12
3.5.2 Middle Corridor Transit	12
3.5.3 Middle Corridor Pricing	12
3.5.4 Middle Corridor Constraints	13
3.7 GHG Emissions.....	14
3.7.1 Electrification of Railways.....	14

4 Summary	16
4.1 Normalised PRC-EU Transport Scenario.....	18
References	20

Table of Figures

Figure 1 - Comparison of Routes, Prices 2018-2022, Transit, PRC to Europe	5
Figure 2 – PRC Exports to CAREC region 2019, World Integrated Trade Solution (WITS).....	3
Figure 3 - Imports to CAREC Countries 2010-2020 (WITS, 2022)	5
Figure 4 - Exports from CAREC Countries 2010-2020 (WITS, 2022)	5
Figure 5 – PRC eastern-Asia to Europe Container Sea Freight Rates.....	8
Figure 6 - CR Express Designated Rail Network	10
Figure 7 - Middle Corridor Multimodal Routes (railfreight.com, 2022)	11
Figure 8 - Shanghai port to Hamburg port 37 days (Hapag Lloyd, 2022).....	12
Figure 9 - Prediction of the land that will be exposed after a water-level drop in the 9-metre scenario (in red) and the 18-metre scenario (in dark red). Prange et al. 2020.....	13
Figure 10 - Average GHG emissions by mode of freight transport, EU-27, 2014-2018	14
Figure 11 - Different Mode Capacity Estimates	16
Figure 12 - Transit Times by Route Est.	17
Figure 13 - Modal Market Share 2018-2021	18
Figure 14 - FBX Baltic Index PRC to EU Container Rates Jul-Sept 2022	19
Figure 15 - Arctic Sea Route PRC-EU	25

Table of Tables

Table 1 - International Trade Statistics 2021 World Trade Organization	3
Table 2 - CR Express Designated Rail Terminals	10
Table 3 - CR Express Number of Block Trains 2018-2021	10

1 Introduction

This is a rapid Assessment of conditions and situation of the freight movements between PRC and Europe as it relates to the multi-modal Middle Corridor. The COVID-19 pandemic and the Russian invasion of Ukraine resulted in significant operational bottlenecks on the Eurasian transit routes. The focus of this study will be the so-called Middle Corridor (aka CAREC Corridor 2 and TRACECA), which has seen a significant increase in container traffic since February 2022.

1.3 Scope and limitations

This Rapid Assessment report has been prepared by Adrian Sammons (Consultant) under guidance and advice of The Asian Development Bank (ADB). This report is based on the most up to date readily available information. Sources are documented in the report. The Consultant has applied due professional care and diligence in accordance with generally accepted standards of professional practice in undertaking analysis and interpretation of source information. The Consultant is not liable for damages arising from any errors or omissions arising from use of these information sources.

Detailed tasks and outputs included in this Rapid Assessment Report include the following:

1. Collect data and demonstrate the pre-COVID-19 trends in container traffic volumes, costs, and lead times for transportation between PRC and selected EU, Caucasian and Central Asian destinations by different routes, specifically (i) by the combined sea-rail and by sea-road container routes, (ii) by the Northern rail corridor (PRC, KAZ, RUS, EU), and (iii) by the Middle Multimodal corridor (PRC, KAZ, Caspian Sea, AZE, GEO, EU).
2. Explain market positioning of the alternative corridors for value density and perishability of cargo and explain which types of cargo migrated from sea to rail during the pre-COVID and during the COVID period. Which factors contributed to the shift of traffic from sea to rail and what can be expected once the supply chains are normalized after the COVID pandemic?
3. Describe current trends and expected timelines for normalization of the transcontinental sea traffic, costs, and lead times. Describe its possible impact of traffic by the Eurasian railway land bridges.
4. Estimate the total current capacity of the Middle Corridor and its potential market share vis-à-vis the alternatives under two scenarios (i) supply chain disruptions caused by COVID-19 end by 2023, but disruptions caused by the Russian invasion in Ukraine remain, (ii) both supply chain disruptions caused by COVID-19 and by the Russian invasion in Ukraine by end 2023.
5. Describe current bottlenecks and investment opportunities for the Middle corridor towards achieving its full capacity to serve potential demand for the transit freight

1.4 Relevant assumptions

- Key assumptions that are documented below and within the body of the report.
- Assumptions of trade growth within each CAREC country and between PRC and Europe
- Normalization of trade relationships will return by 2025.
- Normalization of shipping capacity from PRC to Europe gateway ports by mid-2024.
- Historical trade statistics prepared by Euro Stats, World Bank and World Trade Organization are broadly correct.
- Criteria used to assess normalized trade activity as of 2018 – 2019.
- CAREC countries refers to Afghanistan*, Azerbaijan, the People's Republic of PRC, Georgia, Kazakhstan, the Kyrgyz Republic, Mongolia, Pakistan, Tajikistan, Turkmenistan, and Uzbekistan.



Demand overview

2 Demand Overview

2.1 PRC Manufactured Exports

The development of Peoples Republic of PRC (PRC) as a major manufacturing origin had its genesis with the economic reform agenda that commenced in earnest in 1978. This economic system reform rapidly moved ahead under the PRC national congress multiform market economy systems development. By 1994 the PRC manufacturing output achieved 4.48 trillion yuan, which was six times that recorded in 1985 (Li & Du, 2017). Thereafter, the reform agenda for PRC manufacturing took on productivity targets aimed at technological advancements and improvements to labour skills. By 2010 PRC manufacturing output value achieved 60.96 trillion yuan, 11 times that in 1995 (Li & Du, 2017). In 2010, PRC's manufacturing sector contributed 7% of the added value of the global manufacturing sector, ranking fourth globally after the US, Japan, and Germany. The most recent reports list PRC's manufacturing output at 31.4 trillion yuan in 2021, having expanded from 16.98 trillion yuan in 2012, its share of global manufacturing rising from 20% to 30% (SCIO, 2022).

Export volume (unit: 1 billion US dollars)						
Year	1990	2000	2010	2012	2019	2020
PRC	44	220	1477	1925	1953	1727

Table 1 - International Trade Statistics 2021 World Trade Organization

2.2 CAREC Trade context

Trade partners with CAREC Countries includes a variety of country origin and destinations with PRC, EU and Russia featuring with the main trade volumes. The following trade data sourced from World Integrated Trade Solution (WITS, 2022)

- AZERBAIJAN – Total merchandise trade 2019 US\$ 33,303 million. PRC 10.5% / R. Federation 16.7% / Turkey 12%
- GEORGIA - Total merchandise trade 2019 US\$ 13,315 million. PRC 9.0% / R. Federation 10.0% / Turkey 17%

- KAZAKHSTAN - Total merchandise trade 2019 US\$ 95,066 million. PRC 17.0% / R. Federation 36.6% / S. Korea 9%.
- KYRGYZ R. - Total merchandise trade 2019 US\$ 6,975 million. PRC 34.7% / R. Federation 28 % / Kazakhstan 13%.
- MONGOLIA - Total merchandise trade 2019 US\$ 12,870 million. PRC 33% / R. Federation 28% / Japan 9.5%.
- PAKISTAN - Total merchandise trade 2019 US\$ 73,683 million. PRC 24.8% / UAE 12.6% / USA 5%.
- UZBEKISTAN - Total merchandise trade 2019 US\$ 35,890 million. PRC 23.1% / R. Federation 18% / S. Korea 11.5%.
- TAJIKISTAN - Total merchandise trade 2019 US\$ 4,523 million. Trade share data not available.
- TURKMENISTAN - Total merchandise trade 2019 US\$ 12,608 million. Trade share data not available.

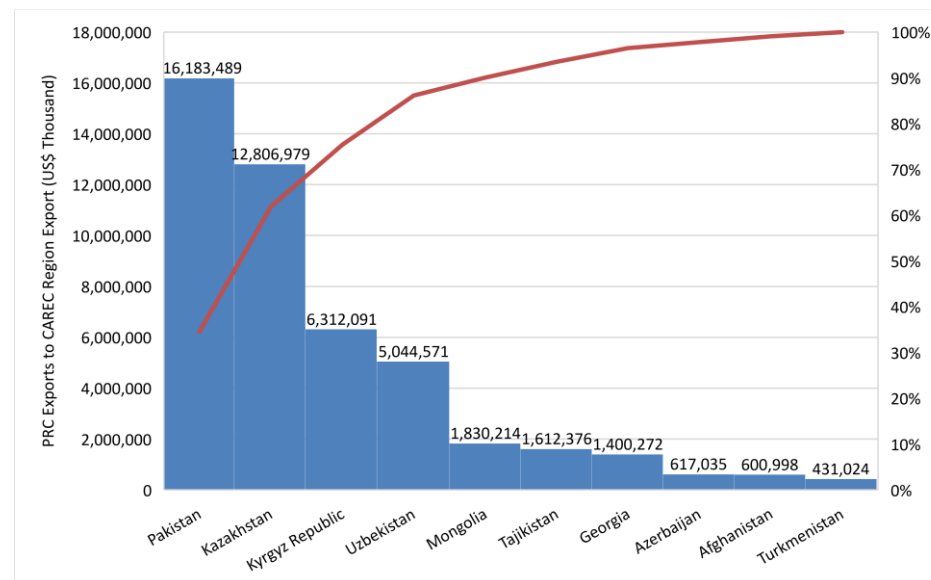
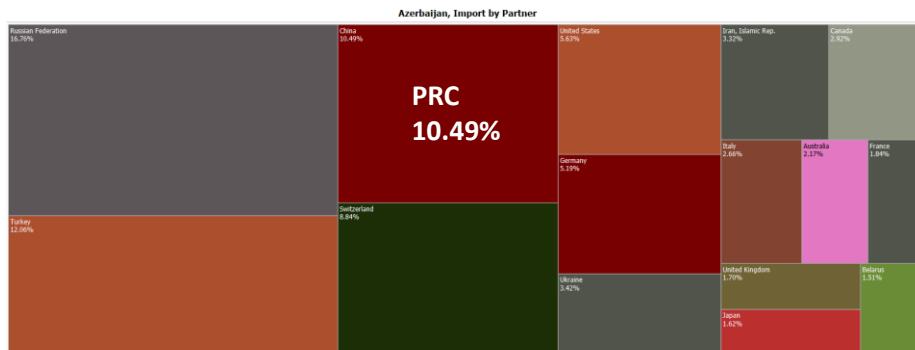


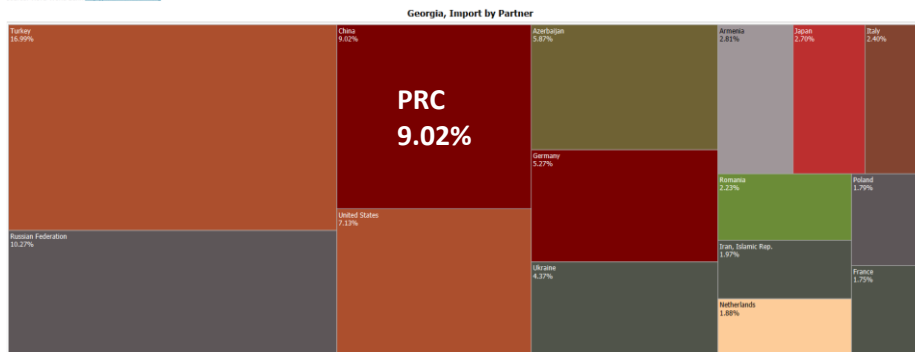
Figure 2 – PRC Exports to CAREC region 2019, World Integrated Trade Solution (WITS)

2.3 CAREC Major Trading partners

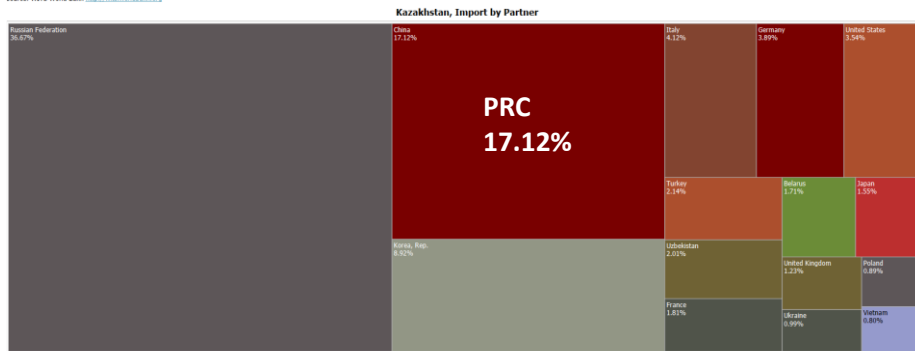
Import trade shares for selected CAREC partner country are displayed below.



Source: WITS World Bank <http://wits.worldbank.org>

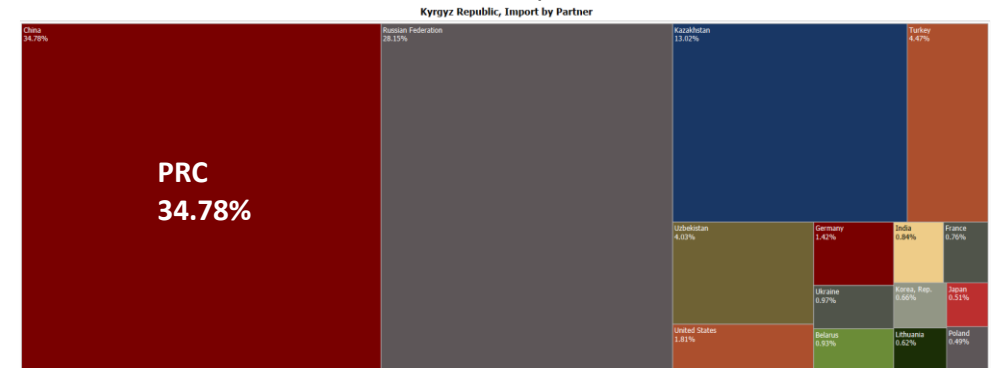


Source: WITS World Bank <http://wits.worldbank.org>



Source: WITS World Bank <http://wits.worldbank.org>

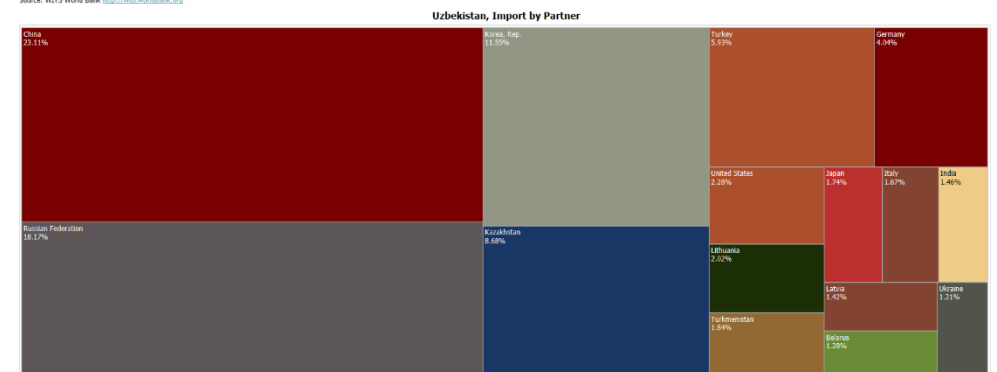
An emphasis is shown towards import volumes of merchandise freight to the selected CAREC countries from PRC and traditional suppliers in Russian Federation and bilateral trade from CAREC partners.



Source: WITS World Bank <http://wits.worldbank.org>



Source: WITS World Bank <http://wits.worldbank.org>



Source: WITS World Bank <http://wits.worldbank.org>

2.4 CAREC Region Trade Growth

The significance of trade activity generated by CAREC countries is a relevant factor in the aligned development of transport connectivity to the region. It may be considered that new overland rail and road projects being evaluated that link to CAREC countries and through the CAREC region are partially focused on transit trade from PRC to Europe and from PRC to CAREC and inter-CAREC trade.

2.4.1 Direct Trade with CAREC Countries

As identified in the previous section the largest trade partners for the CAREC countries is PRC, Russian Federation and inter-CAREC trade partner nations. The geographic nature of the CAREC region with some landlocked nations results in preference for connectivity via rail and road as a primary transport mode.

Merchandise trade from PRC westbound to CAREC countries is mostly carried by rail as having advantages in transit time and efficiency and cost over that provided by air and from sea. Air freight has limited capacity and is expensive and sea freight links to CAREC nations is lengthy and subject in many cases has to traverse through several transshipment seaports and move through various transit trade arrangements to its final destinations for example in Uzbekistan, Tajikistan, Kazakhstan and others.

As identified in the ADB 2021 report 'Ports and Logistics Scoping Study in CAREC Countries' the reality for CAREC countries is that not all countries are naturally at the same position to benefit or promote at the same level from railways inherited from the former Soviet Union. Typically, the Kyrgyz Republic and Tajikistan railways are captive to Kazakhstan and Uzbekistan and act as end-lines to these bigger networks. While in Tajikistan, the primary line is for Talco Plant connecting to Uzbekistan, the network in the Kyrgyz Republic consists of short distance split lines connected to Kazakhstan.

Unless new lines with the PRC are constructed, they would continue to be dependent on countries with bigger networks. However, due to mountainous terrain and small national markets, the financial feasibility of these new lines is dubious (Ragas, Sammons, & Khodjaev, 2021).

Representation of trade flow for merchandise trade as imports and exports for CAREC countries indicates stable growth particularly for imports. Covid related downturns in trade can be identified from 2019-2020, shown in Figures 2-3.

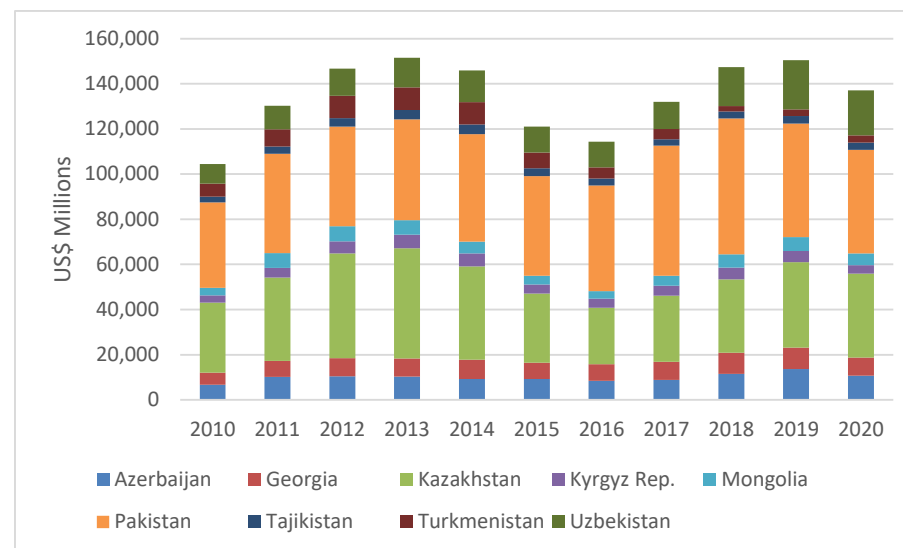


Figure 3 - Imports to CAREC Countries 2010-2020 (WITS, 2022)

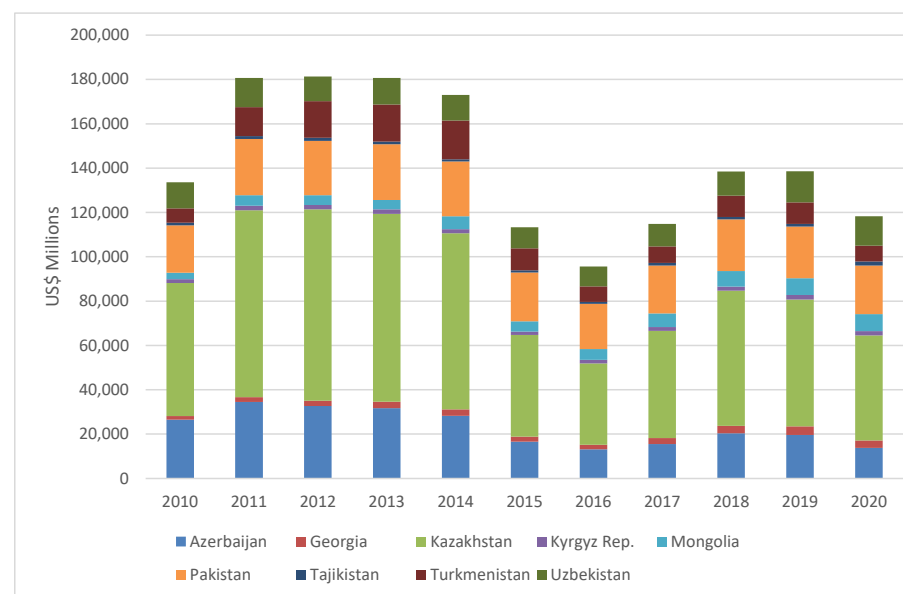


Figure 4 - Exports from CAREC Countries 2010-2020 (WITS, 2022)



Transport Trends

3.0 Trends in Transport 2019-2022

This section details the pre-COVID-19 trends and effects of COVID-19 and the Ukraine conflict in container traffic volumes, costs, and lead times for transportation between PRC and selected EU, Caucasian and Central Asian destinations by different routes;

- i. Sea transport,
- ii. Combined sea-rail by sea-road container routes,
- iii. Northern rail corridor (PRC, KAZ, RUS, EU), and
- iv. Middle Multimodal corridor (PRC, KAZ, Caspian Sea, AZE, GEO, EU).

3.1 Sea Transport PRC to EU

The significance of ocean transport between PRC and EU must firstly be identified as the dominant mode of transport on this route. Trade overwhelmingly departs PRC for the European economic zone by sea, later transferring from European seaports to other forms of transport for final delivery to hinterlands in western Europe. In 2019, sea freight from PRC to Europe represented around 98% of merchandise exports (Ragas, Sammons, & Khodjaev, 2021). However, the market share of rail freight has risen from almost zero to 2% in the space of five years (Wanderpepen, 2017). It has been cited that PRC hopes to increase conversion to overland rail to EU destinations between 5 and 7% in the post covid period, and to 25% of exports from the west and central China (Lasserre, Huang, & Mottet, 2020) .

Pre-Covid, total container traffic between PRC and EU is estimated to be between 30-35 million TEU per annum. Average monthly container volumes carried via sea is 2.5 to 3.2 million TEU with peak season volumes increasing to 3.3 to 3.7 million TEU per month (consultants estimates and published data (Knowler, 2022).

Shipping capacity provided pre-covid to meet the container freight task required daily sailings of ultra-large container (ULC) ships with capacity up to 18,000-

¹ Exporters shippers with at least 500 TEU per year on port-pair basis.

21,000 TEU per ship from main container ports in PRC. The container ports capacities in PRC have been upgraded consistently and new ports and terminals developed since 2010 to meet growing demand.

3.1.1 Sea freight Rates

Maritime transport is efficient and cost-effective, which are its key characteristics that has enabled this transport mode to occupy the central role in global trading that handles around 90% of world trade volumes. Ocean freight is the best indicator of what consequences an increase in freight rates in maritime container shipping can have on many economies. Maritime industry has always played a key role in driving prosperity. Transport can have considerable impact on international trade, and the transportation cost is the variable that determines whether or not trading will happen and to what extent.

Transport economics has determined that an approximation of the increase in cost to trade volume ratio, a 10% increase in transport costs reduces trade volume by 20% (Roži, Naletina, & Zaja, 2022). Hummels in [8] explains costs by relating language, distance and adjacency to trade barriers, preferences and production composition.

Pre-COVID sea freight rates globally were considered to be competitive by the users (importers/exporters) and depressed by the shipping lines. This was no exception for ocean freight rates from PRC to western Europe.

Contract¹ freight rates in 2018 from PRC main ports to western European main ports were recorded at USD1780/40' general container, subject to port handling and ancillary surcharges (UNCTAD, 2021).

In 2018 ocean freight rates from PRC to western Europe were 25% lower than 2013 levels. This fall in freight rates was largely driven by overcapacity on the Asia/Europe maritime routes which in 2018 saw vessels adding an additional 530,000 TEU and in 2019 an additional 1.1 million TEU of container capacity as shipping lines deployed larger ULC vessels into the global trade routes. (FW News, 2019). When freight rates remain low over an extended period the traditional reaction is for shipbuilding to pause. However, in 2017-2019 the order books for new and larger container ships never stopped (UNECLAC, 2017).

3.1.2 Sea Freight Rates – Covid and Ukraine Conflict

Covid-19 impacted sea freight globally immediately that border lockdowns were announced by governments worldwide. The border closures and lockdown mandates in PRC included the closure of many of its manufacturing facilities. Corresponding lockdowns in Europe and North America that followed, substantially reduced the demand in the west for PRC imports as consumer sentiment altered to one of extreme caution. The combination of these events led to serious disruptions in global supply chains, demonstrating the pivotal role of PRC as the major driver of global industrial and merchandise production (Cullinane, K; Haralambides, H, 2021).

Container shipping lines were quick to adjust service supply to the lower demand commencing in the first half of 2020. The mechanism used to reduce container ship capacity was to 'withdraw' ships from serviced which accounted to a reduction of 20–30% of container space from the main trade routes, otherwise known as blank sailings.

By October 2020, blank sailings during the year reached 515. This impacted global trade connectivity with cancelled port calls, less frequency of shipping space, and decline in quality of service. By May 2020 the volume of laid-up ships (tonnage) reached record levels at 11.6% of deployed cellular container ship fleet. To further reduce supply, additional measures were adopted by shipping lines, such as slower speeds and longer routes, via Cape of Good Hope rather than the Suez Canal. In May 2020, containership transits of the Suez Canal had fallen by 32% year-on-year, to settle at an all-time low of 330 passages (BIMCO, 2020).

Coming from an era of overcapacity on main trade routes, shipping lines had faced depressed freight rates from 2013 to 2019 resulting in job losses, growing corporate debt, financial losses and in some cases bankruptcy or mergers and acquisitions. This background and Covid trade conditions was the stimulus for shipping lines to increase prices for ocean freight. In Dec 2020, a weekly change in the World Container Index (WCI) of 23% equivalent to an increase of +USD 793 was registered, 166.6% higher than the same period in 2019. In Jan 2021 the WCI further escalated to USD 5221, an increase of 185% year-on-year resulting in the price from Shanghai–Rotterdam at USD 8882/40' (Drewry, 2022).

The Russian invasion of Ukraine saw an immediate effect on sea transport resulting from the conflict with the suspension of vessel calls to Ukraine until further notice and container carriers cut ship carrying capacity assigned to the Russian Federation (UNCTAD, 2022).

The tracking of container pricing can be seen from world container index values for the period from Jan 2019 to August 2022. It shows that the index value began to grow in the last quarter of 2020, when it grew exponentially until Sept 2021. During Sept and Oct of 2021 there were no major oscillations, and the beginning of Nov recorded a drop after a longer period of stability, which is related to the COVID-19 pandemic and its influence on the maritime container industry.

Freight reductions stopped with the Russian invasion of Ukraine when the index started to rise again, (Roži, Naletina, & Zaja, 2022). Research shows that current freight rates on the PRC to Europe shipping routes commenced to reduce from March 2022 to August 2022. This trend has been consistent in this period as shown in Figure 5.

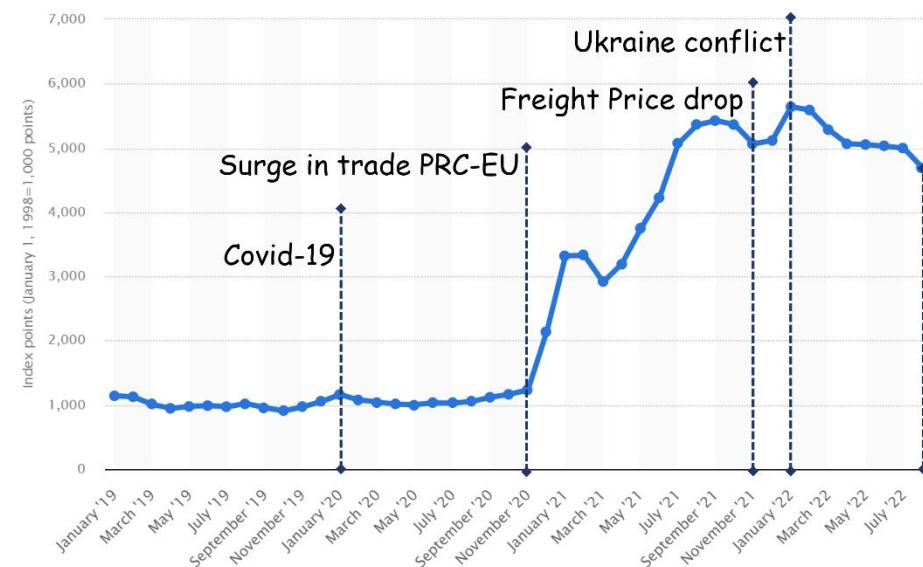


Figure 5 – PRC eastern-Asia to Europe Container Sea Freight Rates

3.2 Combined Sea Road and Rail Transport

Pre-Covid and Pre-UKR conflict there were various freight alternatives to the single modality of sea transport from PRC to Europe and Central Asian destinations. These included traditional overland routes using rail to Central Asian hub ports and terminals where the services changed modes to sea freight for short distances to connect with various forms of overland routing to their final destinations.

Pre-UKR conflict saw new multimodal routes being developed. A good example was the new Xi'an-Hamburg-Neuss, a cooperation between DHL Global Forwarding and Xi'an International Inland Port Investment & Development Group Co. Ltd. In 2019 they announced cutting transit time from 17 to between 10 and 12 days on this route. This significant lead time reduction was made possible by travelling through the Mamonovo-Braniewo railway border between Russia and Poland (Railfreight.com, 2019).

Other new routes and links, include the multimodal connection via Kaliningrad, a Russian enclave between Poland and Lithuania, which Pre-UKR conflict was gaining importance and not only as a rail transit country, but also as a maritime gateway. For example, in November 2018 UTLC inaugurated the multimodal connection between the PRC city of Chengdu and the port of Rotterdam. This includes the facilities of Kaliningrad seaport. First, the containers are delivered to Kaliningrad by rail, where freight is loaded delivers to Rotterdam by sea.

There are various other routes and pricing for inter-modal transport and this study will concentrate on the customary routes.

Rail in most CAREC countries is still dominated by bulk cargo of minerals, grains, oil, and derivatives, etc. Accordingly, there are few and sometimes inappropriate facilities to handle intermodal, i.e., combined transport rail-road of containers, swap bodies, etc. Container traffic developing in flows with PRC but still marginal across the trans-Caucasus/ trans-Caspian routes as well as in the north-south corridors across Pakistan or Iran (Ragas, Sammons, & Khodjaev, 2021).

3.3 Northern rail corridor (PRC, KAZ, RUS, EU)

The northern corridor had become the dominant overland route using rail networks traversing from Chinese rail terminal to Central Asia and Europe. This route runs through Chi'an and Urumqi. From there the line splits heading to two crossing points with Kazakhstan: Alashankou-Dostyk and Khorgos-Altynkol. This forms part of CR Express West routes. It is to note that a substantial share of container trains from the PRC to Central Asia and Europe do not originate at Pacific ports but at industrial and commercial clusters in inland PRC such as Chongqing, Chengdu, and Yiwu. Also, an important note is China Rail runs on standard 1,435mm gauge while both Kazakhstan and Mongolia use 1,520mm, change of gauge facilities exist at all the above-mentioned crossing points. The PRC and CIS countries are members of OSJD and apply SMGS consignment note for international freight that facilitates communications procedures across borders (Ragas, Sammons, & Khodjaev, 2021).

The number of container block trains has substantially increased from 14 per year in 2011 to average 14 trains per day in 2019. A substantial part of this traffic consists of PRC-Europe trains. Average time to axle change is 4.5 hours. Transshipment capacity in Dostyk is 760 TEU per day or about 275,000 per annum (KDTS, 2022).

The bulk of rail shipments from Asia to Europe are for industries such as automotive, consumer, retail and fashion, industrial manufacturing and technology. Most of the products are destined for Germany, the largest market, but deliveries also go to the surrounding countries: Belgium, the Netherlands, France, Denmark, Switzerland and sometimes stretch to the UK, Spain and Norway. The rail transit from PRC to Europe, from terminal to terminal depending on the route, takes between 15 and 18 days. Which compares favorably against that of 35-45 days to move containers by sea.

The pre-Covid freight rates using the northern rail corridor were cited at USD7,387/40' Chongqing-Munich (via Duisburg) terminal to terminal with a transit time of 18-20 days (Lasserre, Huang, & Mottet, 2020).

3.4 Northern Corridor CR Express

The following is a viewpoint from the CR Express perspective.

The Northern Corridor originates from the gateway ports and rail terminals of PRC using nodes, rail track and rolling stock predominately supplied and under control of the CR Express rail network. Cited in official PRC reports the annual CR Express block trains increased from 1,702 in 2016 to 15,183 in 2021, an average annual growth of 55%. The annual value of goods transported increased from USD8 billion to USD74.9 billion over the same period, accounting for the share of total trade between PRC and Europe increasing from 1.5% to 8%. The categories of goods transported by CR Express expanded from time sensitive high value IT hardware products such as mobile phones and computers to more than 50,000 types such as auto parts and complete vehicles, chemicals, mechanical and electrical products, food, wine and wood products (<http://www.gov.cn>, 2022).

From the perspective of CR Express the rail network is shown in Figure 6 and designated as follows.

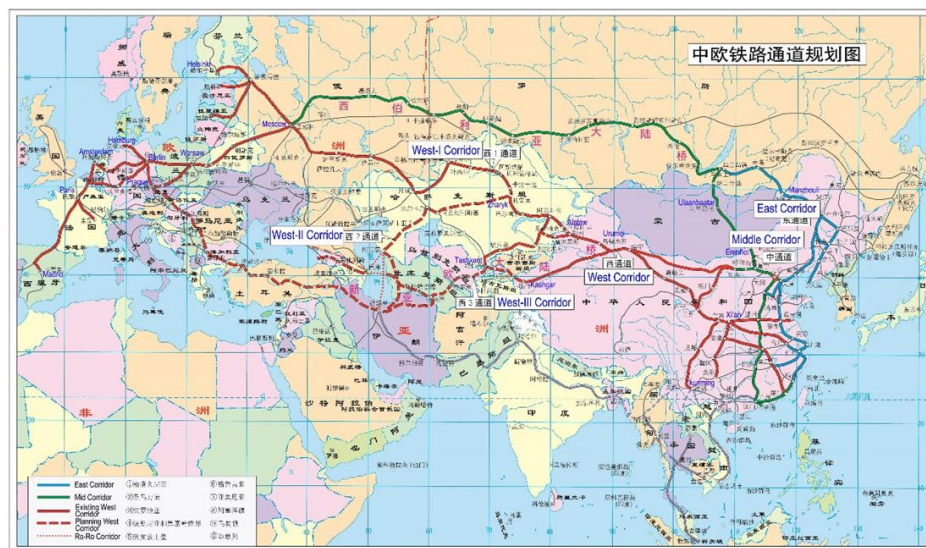


Figure 6 - CR Express Designated Rail Network

The East Corridor starts from Manzhouli and Suifenhe ports and reaches Germany via Russia, Belarus and Poland, mainly transporting the import and export goods between the east and south coastal areas and northeast region of PRC and Europe.

The New Eurasian Land Bridge forms the West Corridor of CR Express, which starts from Alataw Pass and Khorgos to Europe via Kazakhstan, Russia, Belarus and Poland, mainly transporting import and export goods between central and western PRC and Europe. The Middle Corridor starts from Erenhot port, connecting to Trans-Siberian Railway through Mongolia, and then reaches Germany through Belarus and Poland, mainly transporting the import and export goods between north and central PRC and Europe. The list of railway ports for CR Express is shown in Table 2.

East Corridor		Mid Corridor	West Corridor	
Manzhouli	Suifenhe	Erenhot	Alataw Pass	Khorgos

Table 2 - CR Express Designated Rail Terminals

	East Corridor		Mid Corridor	West Corridor		Total ^a	
	MANZHOU LI	SUIFENHE	ERENHOT	ALATAW	KHORGOS	VOLUME(OUTBOUND)	
Year	Block Trains					1,000 TEU	Trains
2018	1,074	-	1,052	2,388	2,055	541	6,569
2019	2,582	120	1,516	3,564	3,044	725	10,826
2020	3,585	217	2,297	5,027	4,652	1,135	15,778
2021	4,235	549	2,600	5,848	6,362	1,460	19,594

Table 3 - CR Express Number of Block Trains 2018-2021

Shown in Table 3 the operational data of five inland railway ports of CR Express from 2018-2021, Khorgos and Alataw in West Corridor have played the most important role in railway freight transport between Europe and PRC. In particular, the throughput of Khorgos has maintained the highest annual growth rate of all five railway ports (CR Express, 2022).

CR Express block train freight rate Xi'an to Hamburg (through Horgos or Alataw Pass) is low USD7,000/40' and high rate at USD10,000/40' (Ffwr., 2022).

3.5 Middle Corridor (PRC, KAZ, Caspian Sea, AZE, GEO, EU)

The Middle Corridor was originally a EU-sponsored initiative was launched in 1993 with the strategic objective of bringing members of the former Soviet Union closer to Europe by developing infrastructure and trade routes on land and across the Black and Caspian seas. The Transport Corridor Europe Caucasus Asia (TRACECA) was established as an Intergovernmental commission with a permanent Secretariat in Baku (Ragas, Sammons, & Khodjaev, 2021).

TRACECA has pioneered the concept of transnational cooperation for corridor development in this region and some of its key objectives have been achieved;

- i. Construction of direct rail link between Central Asia and Turkey through Baku–Tbilisi–Kars (BTK) railway.
- ii. Upgrading of most major Caspian ports in Azerbaijan, Kazakhstan, and Turkmenistan, permitting much more efficient cargo flows.
- iii. Lay the seed for more operational corridor promotion organizations such as TITR/TMTM that is actively promoting cargoes on the corridor (“Middle Corridor”) Kazakhstan–Black Sea/Turkey (TRACECA , 2022).

The Middle Corridor has been developed as an alternative to the overland Northern Route and sea transport. It has a fundamental challenge in that it is a multimodal operation traversing 4,256 km of railways and 508 km of sea transit and it crosses a number of borders that require transit trade agreements or bi-/multilateral trade agreements to allow efficient freight flows.

The designated route extends from the PRC-Kazakh border to Europe, passing through Kazakhstan, and via the Caspian Sea through Azerbaijan and Georgia. From there, a choice of routes is offered with one branch across Turkey and through the Marmaray Tunnel under the Bosphorus Strait while the other route runs across the Black Sea (ships) to Ukraine and Romania (Calabrese, 2019).

The impact of Covid saw demand on the PRC-Europe rail network increasing more than 30% in 2021 to 1.46 million TEU as shippers were forced out of heavily congested ocean shipping, rising sea freight prices and severely constrained air cargo (Knowler, 2022). Added to this shift is the Russian – Ukraine conflict whereby most Western companies exited the northern route via Russia and

Belarus. Thus, the middle corridor is eager beneficiary of redirected and overflow traffic making it a key option for overland rail link between PRC and Europe.

Volume across the Middle Corridor is cited as about 150,000 TEU in 2021. It is estimated the volume this year could increase by about one-third, but congestion is being reported at modal switch points along the route because the existing infrastructure is overwhelmed (Knowler, 2022).

The Middle Corridor is networked along multilateral and multimodal transportation system that has connections via the Caspian and Black Sea ports and multimodal terminals with rail systems in the Asian and European countries, Figure 7.

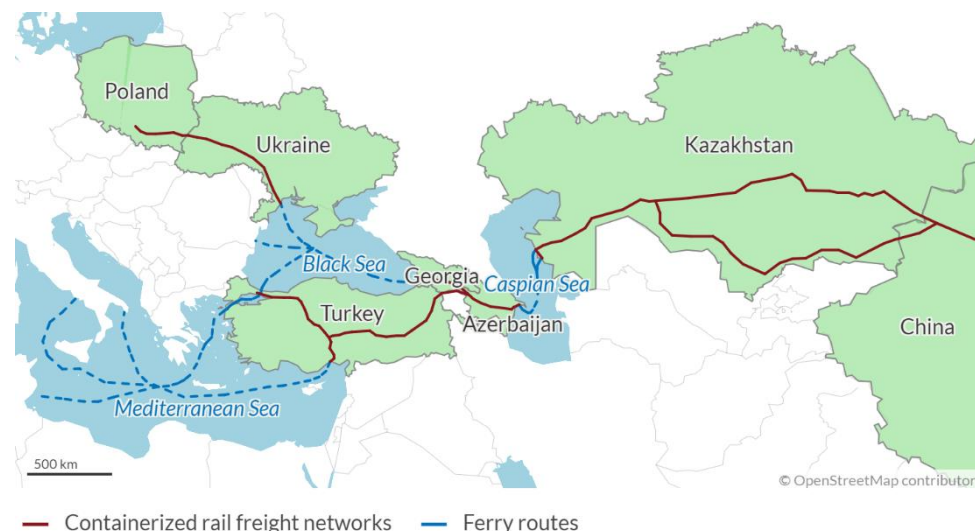


Figure 7 - Middle Corridor Multimodal Routes (railfreight.com, 2022)

Peripheral issues contributing to the emergence of the Middle Corridor as an immediate option for transit trade to Europe is the stranding of 150,000 wagons remaining inactive on the Russian railway network due to the Russian invasion of Ukraine and sanctions. This shows that in the short and medium terms war may affect PRC’s land-based connectivity with the EU negatively.

3.5.1 Middle Corridor Capacity

Rail networks and terminal infrastructure capacity are one such constraint on the overall trade volume capability of a network. In the case of the Middle Corridor this hinterland capacity is coupled with port and shipping capacities. Unbundling these capacity upper limits will require in-depth studies of supply chain facilitation testing to understand the reconfiguration or developments required to expand the capacity of the end-to-end performance.

Initial desktop research has provided insights of node capacity and some route capacity limits. It has been consistently cited that the Middle Corridor route's capacity is 3-5% of the volume passing through the northern routes of approximately 1,5 million TEU (Railfreight.com, 2022). This equates to a route capacity of 45,000-75,000 TEU annualised.

The shipping network via the Middle Corridor is cited at a capacity of three feeder vessels operating regularly in the Caspian, with a capacity of 350 TEU, 125 TEU and 125 TEU, totaling 600 TEU. In theory, a transit time of three to four days per roundtrip, the three vessels can provide five departures per week. This translates to a maximum total capacity of 3,000 TEUs per week, which is equivalent to 30-40 trains (ERAI, 2022). There are plans to add three new ships in September 2022, which would in theory, double capacity to 60-80 trains per week. The scheduled frequency of the shipping network has been cited as being 'irregular' and subject to weather delays and inconsistent scheduling.

In the Black Sea the shipping needs are met by regular shipping services that provide point-to-point operations and by vessels of between 3,000 TEU and 8,000-9,000 TEU capacity. Restrictions imposed across the Bosphorus Strait limit ship sizes up to 8,000-9,000 TEU for transit to/from Mediterranean ports into the Black Sea. This is likely to reflect on freight capacity and freight rates charged.

Nominal annual port capacity of Black Sea ports is cited at Batumi 200,000 TEU, Poti 550,000 TEU and Caspian Sea ports at Aktau 25,000TEU, Kuryk 100,000TEU, Baku-Alat 500,000TEU and Turkmenbashi 400,000TEU (Ragas, Sammons, & Khodjaev, 2021). It should be noted that throughput is much lower than the nominal capacity with exception of Poti which is nearing its nominal capacity limit.

3.5.2 Middle Corridor Transit

Researchers cite the Middle Corridor is physically the shortest path between PRC and Europe, travel time on the route compares unfavourably with the Northern Corridor. Cargos reach their destination via the northern route in approx. 5-6 days, the Middle Corridor requires about 20-25 days' transit (Utlc.com, November 12, 2020; Adycontainer.com, accessed April 19, 2022) (Sharifli Y. , 2022).

TRANS-CASPIAN ROUTE - Lianyungang (PRC) - Aktau / Kuryk (Kazakhstan) - Azerbaijan - Georgia - Turkey / Ukraine / Poland / Romania / Italy / other European countries 9 400 – 11 000 km 13-21 days (TITR, 2020).

SEA ROUTE - Shanghai port to Hamburg port 37 days (HapagLloyd, 2022).

SEA ROUTE - Lianyungang (PRC) - Suez (Egypt) - Istanbul (Turkey) 16,400km 30-40 days (TITR, 2020).

3.5.3 Middle Corridor Pricing

Northern Corridor (through PRC, Kazakhstan, Russia and Belarus) is approximately 2,467 euros (\$2,662) per twenty-foot equivalent unit (TEU), the cost of cargo delivery via the Middle Corridor (PRC-Kazakhstan-Caspian Sea-Azerbaijan-Georgia-Turkey or the Black Sea-Europe) starts at 5,000 euros (almost \$5,400) per TEU (Sharifli Y. , 2022).

PRC Rail terminal Lianyungang via KAZ, Caspian Sea, AZE, GEO to Duisburg terminal USD8,200/40' low - USD12,000/40' high (ADYContainers, 2022).

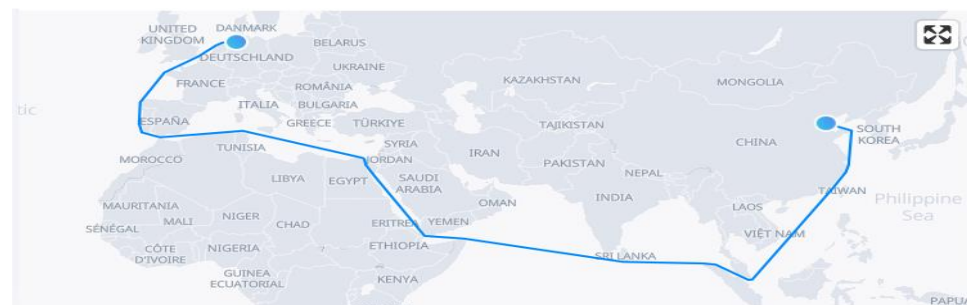


Figure 8 - Shanghai port to Hamburg port 37 days (Hapag Lloyd, 2022).

3.5.4 Middle Corridor Constraints

Neither Poti nor Batumi ports have efficient rail connection down to the dockside container terminal (see sections on Poti and Batumi ports in Volume II). In the case of Batumi, it is space-constrained and needs complex shunting. In the case of Poti rail connection for breakbulk is available at the dockside but the rail container terminal is located about 3 Km away so that a truck shuttle is necessary. Research (KPMG, 2019) has concluded that the combination of the Middle Corridor and Black Sea ferries may be an attractive option for cargoes between Central Asia and the coastal nations around the Black Sea (Turkey, Bulgaria, Romania, and Ukraine), plus Greece; but hardly beyond, where the UTLC northern corridor is more competitive. Other studies also mention that this route is unlikely to compete with other routes to link with Northern and Central Europe's industrial heartlands (Kenderdine & Bucsky, 2021).

However, it is to be noted that the Middle Corridor is an essential lifeline for some major industrial complexes located far inland in Central Asia such as fertilizers plant in Mary (Turkmenistan) and TALCO aluminium plant in Tursunzade (Tajikistan). Excessive and uncertain waiting times at Caspian Ports is a repeated concern of private sector stakeholders.

Waiting times seem not to be such an issue on the Kazakhstan side of the Caspian. Caspian ferries are designed for rail wagons but can also accommodate trucks though apparently rail wagons take priority. In addition, the Caspian is prone to strong winds and bad weather that restricts shipping operations. During the site visit, consultants could observe about 100 trucks waiting within Alat port premises. (Ragas, Sammons, & Khodjaev, 2021).

CR Express, and Belt and Road policies, provide a clear picture of the future trade potential of the transcontinental PRC–Europe rail freight system. For example, a PRC policy from a central ministry to a subnational government to increase freight throughput via Istanbul will likely lead to institutional deployment on the PRC side, and yet meet a physical geographic bottleneck on the shores of the Bosphorus and a freight-forwarding industry in Poland, with little incentive to ship containers back to the PRC via rail. The PRC's CR Express policy is thus caught between multiple policy frictions (Kenderdine & Bucsky, 2021). The Caspian Sea depth in sections

is shallow and constrains the ship sizes that can operate upon it. The vessel class that are operating today are designed to handle rail wagons, road trucks-trailers and motor vehicles. The typical rail-ferry operated by Azerbaijan Shipping Co has a draft of 4.5-5.6m and deadweight of 5000-7000 tonne.

A future predicted constraint for the Middle Corridor is the Caspian Sea is losing depth of water. The Caspian Sea depth of water is dropping by 7cm every year, a trend likely to increase. In five years it might be about 40cm lower than today and in ten years almost one metre lower. By the end of the century the Caspian Sea will be nine metres to 18 metres lower. (Wesselingh, F., 2020).

Should this loss of depth occur in the Caspian Sea there would be significant impact on navigation of cargo vessels and ports infrastructure to service the fleet of shipping. Large scale rebuilds and possible port relocations would likely be required. See Figure 8.



Figure 9 - Prediction of the land that will be exposed after a water-level drop in the 9-metre scenario (in red) and the 18-metre scenario (in dark red). Prange et al. 2020.

3.7 GHG Emissions

This study would not be complete without mention of the Green House Gas (GHG) emissions created by different modes of transportation.

In this context it is clear that transcontinental sea transport handling large volumes of freight such as the case between PRC and Europe, produces the most efficient rates of GHG for freight transportation. Figure 10 shows the tonne-km, means transporting the freight payload of one tonne over one kilometre (EEA, 2022).

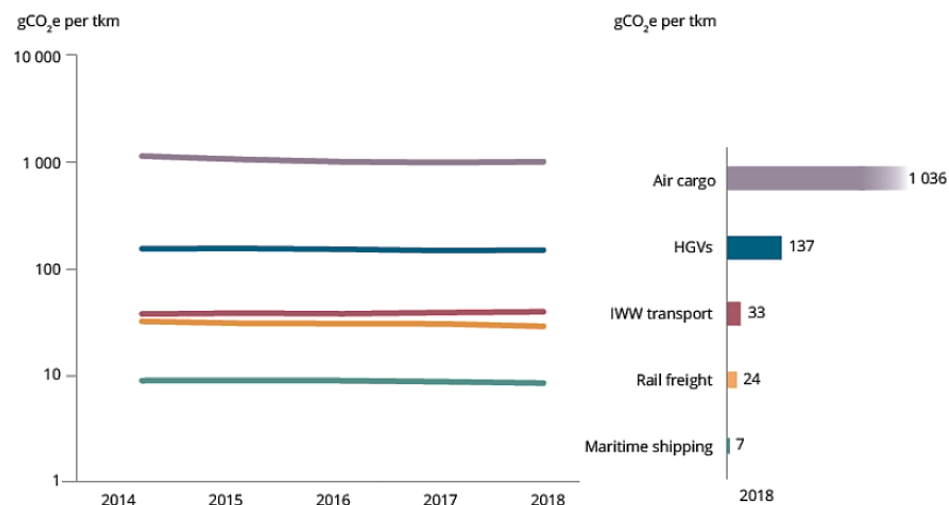


Figure 10 - Average GHG emissions by mode of freight transport, EU-27, 2014-2018

The shipping industry is a small contributor to the total volume of atmospheric emissions compared to road vehicles and air transport (see graph below) as well as public utilities such as power stations, and atmospheric pollution from ships has reduced in the last decade. There have been significant improvements in engine efficiency and hull design, and the use of ships with larger cargo carrying capacities have led to a reduction in emissions and an increase in fuel efficiency.

In terms of CO2 emissions per tonne of cargo transported one mile, shipping is recognised as the most efficient form of commercial transport. However, the enormous scale of the industry means that it is nevertheless a significant

contributor to the world's total greenhouse gas emissions (around 3% of total global CO2 emissions).

The industry is therefore closely involved in global discussions on ships' CO2 emissions now being firmly led by IMO. More information about what the shipping industry and IMO are doing to deliver a significant reduction in shipping's CO2 emissions can be found here (ICS, 2022).

3.7.1 Electrification of Railways

Electrification of railway networks is aimed at reducing costs of diesel consumption, lowering operating costs, and reducing GHG.

Electrification schemes necessitate costly fixed installations for power supply (sub-stations) and power transmission (contact wire systems) as well as cabling of telecommunication lines alongside the railway line and reconstruction of some existing buildings. The capital requirements of electrification are thus high. It follows that routes to be electrified must have a traffic density high enough to justify the initial costs of the scheme (Lashine & Abdelkader., 2012).

Recent studies of PRC's national strategy identify railway electrification as one of the principal means of reducing carbon emissions and optimising the energy structure of transportation in the country. The latest modelling demonstrates that railway electrification using the current energy generation mix can reduce carbon emissions by 8.9% (Xu, Kent, & Schmid, 2021).

Electrification of industrial scale freight railways comes with a dilemma in many country locations. The ambitions of reducing carbon emissions by replacing diesel locomotives with electric locomotives that to meet performance levels requires continuous base loads of electric power. The carbon emissions of electric locomotives engaged in freight transport may increase overall as in some major north Asian countries they required high coal-based electricity generation.

As railway transport demand keeps increasing new technology has been implemented to help reduce the power demand and carbon emissions from power stations. These recent solutions include electric multiple units or EMU's which are multiple-unit trains consisting of self-propelled carriages using electricity as the motive power.

EMUs have reduced by almost half (to 0.719 kg per kWh) the power required from conventional electric powered train units (Xu, Kent, & Schmid, 2021). The targets



Conclusions

4 Summary

PRC is now the EU's biggest trading partner, overtaking the USA in 2020.

PRC maintained its trade dominance against the trend, as trade with most of Europe's major partners dipped due to the Covid-19 pandemic.

Trade between PRC and the EU was worth USD709 billion in 2020, compared with USD671 billion worth of imports and exports from the USA. The real value of global trade is set to rise by 7.6% after an estimated contraction of 13.5% in 2020 to \$16.4tn, according to research firm IHS Markit (BBC, 2021).

Sea transport from PRC to Europe is frequent and under normalized conditions offers the lowest price of containerized freight, particularly over transcontinental distances. Sea transport is agile and can adapt quickly to changing circumstances by increasing ship numbers and capacity and adding ports of call.

There are few regulatory barriers to sea trade, unlike air freight that requires landing access and flyover rights or railways that require permanent rail line infrastructure (shipping only relies on 3rd party owned ports and terminals).

Sea Transport Capacity

Single ship capacity of PRC-EU route is 18,000 TEU (UNCTAD, 2021). These giant vessels combined multi-consortia fleets to provide capacity of 35.15 million TEU per annum from PRC to EU destination ports. Shipping lines can quickly change/add ports of call and add extra tonnage (ships) to trade routes as demand increases. This last point is explained in Section 3.1 and witnessed the rapid pace at which shipping lines removed ships from the PRC to Europe trade and created 'blank sailings' which exacerbated the supply chain stress when freight volumes subsequently increased only a few months later.

Rail Transport Capacity

The capacity of the Middle Corridor is about 0.21% of sea trade annualised capacity and the Northern Corridor capacity is about 4.7% of sea trade annualised capacity. The capacity of railway is limited by the linear rail line infrastructure, such as the numbers and length of the so-called rail sidings (passing lines), where trains can avoid single-track lines and also limited by the loading, unloading and reloading capacity of terminals servicing trains on the route. The other limitation

inherent to transcontinental rail is individual countries' regulations through which the routes run (Neumann, 2021). These constraints limit the rail services to a maximum number of containers that can be transported end to end. Single train set capacity on PRC-EU is between 85-100 TEU (authors calculations from CR Express stats). Capacity estimates shown in Figure 11.

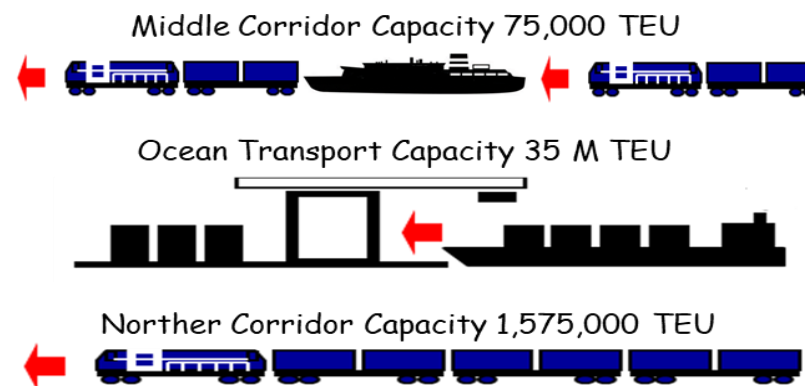


Figure 11 - Different Mode Capacity Estimates

Cost of Rail Transport

In the case of rail transport, the transport cost depends largely on the fees charged by the owner of the line and point infrastructure on which the train moves and which it uses.

This condition also depends on the mode of transport on which it is operated. In this case, the locomotive and its efficiency are taken into account, i.e., fuel or electricity consumption. The technical condition of the platform carriages and their maximum permissible speed when fully loaded is also important. The estimated cost of USD2,000 /TEU for PRC to Poland route (Neumann, 2021).

Cost of Sea Transport

In sea transport, the cost depends largely on the current fuel costs and the geopolitical situation. As in rail transport, the level of quality of the means of transport, i.e., a ship, is important. The engine room's efficiency plays a key role in the amount of fuel used and thus translates into transport costs. The estimated cost for sea transport at the level of USD850 /TEU based on 18,000 TEU ships (Neumann, 2021).

For high value electronic goods, for example, a 40 ft container can hold up to 22,000 kg of goods. In normalised supply chain conditions, by train the cost would be about USD8,000/40' and the cost by sea would be around USD4,000/40'. By air, as a final comparison the cost would rise to USD32,000 (Dayal, 2021). The time value of goods via overland rail from PRC to EU with a saving of approx. 20 days would therefore lend itself to consider accepting the higher freight cost.

There is another often another less-known cost benefit advantage of sea transport longer transit-times of 35-45 days (days depending upon the EU port destination). This advantage lies in importers of certain goods using the shipping transit are effective 'fixed period' warehousing – sometimes referred to as floating transit storage. This is especially the case for mass volume, low value consumer items which cannot bear additional cost of land-based transfer storage in warehousing.

Sea Transit Time and Frequency

It is without doubt that sea transport from Asia to Europe is longer than that of overland routes, including that of the Middle Corridor. However, the frequency of vessel sailings from PRC gateway ports to Europe, under normalised conditions is approx. 5.35 sailings daily. The levels of competition between meg-shipping carriers operating global consortia will continue to create competitive tensions as each strives to satisfy the market shares that such high-value assets demand.

The high degree of competition between mega-carriers drives the need for direct sailings between PRC gateway ports and European gateway ports. This results in dedicated routes that results in fast (by sea transport standards) transit times.

Examples of these are as follows;

- Shanghai – Rotterdam, Netherlands; 28 days
- Shanghai – Hamburg, Germany; 32 days
- Shanghai – Algeciras, Spain; 24 days

Rail Transit Time and Frequency

Overland rail operated from terminals and sidings in PRC requires strict coordination of block train sets to ensure frequency is maintained and thus overall capacity. As discussed in Section 3.5 there are constraints to rail operations that can impact the overall efficiency of the network. The data available from CR Express rail schedules indicates that approx. 41.6 block train sets depart from a PRC terminal daily. This is subject to variability of intensity of demand and

operational characteristics of each rail terminal. Given the numbers of terminal transfers, wagon siding and shunting needs rail often has inbuilt operational delays in the overall transit times of end-to-end overland transport.

Operational transit times using the Middle Corridor route from PRC rail terminals to European gateway rail terminals and gateway ports is shown as follows;

- Lianyungang-Altinkol-Poti-Constanta; 16 days
- Lianyungang-Altinkol-Baku-Istanbul; 14 days
- Lianyungang-Altinkol-Baku-Mersin-Trieste; 18 days
- Kashqar-Osh-Baku-Poti-Constanta; 12 days
- Kashqar-Osh-Baku-Mersin-Trieste; 16 days
- Lianyungang- Aktau / Kuryk-Baku/Alat-Poti/Batumi-Turkey / Romania / Poland / Romania / Italy / Austria; 13 – 21 days.

The mega-carrier shipping lines operating direct services from PRC to Europe's western gateway ports also provide through inter-modal services from the seaports to final destinations in the heartland of European distribution networks.

This competing multi-modal services are on the rise in capture of client base and in the sophistication of systems employed. Indeed, many of the mega-carrier global shipping lines have re-badged themselves at 'Logistics Providers' dropping their traditional nomenclature of linear maritime transport operators of ships.

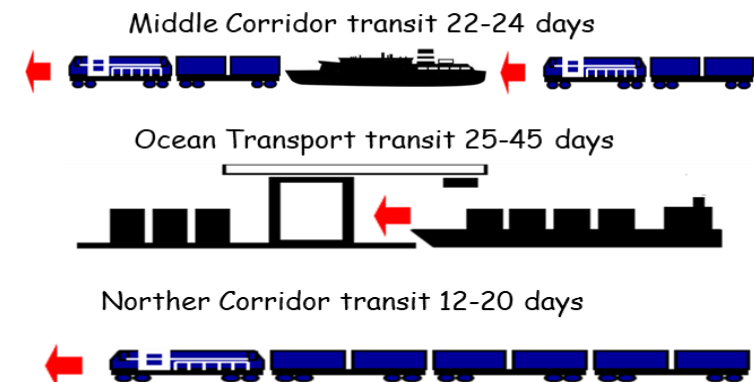


Figure 12 - Transit Times by Route Est.

4.1 Normalised PRC-EU Transport Scenario

It is without precedent that the conditions of the last three years have combined to create massive supply side delays and cost increases in the global value and supply chain networks. Center to the impacts was the manufacturing outputs of PRC and the markets it supplied. According to Euro-Stats rail handled 1.9% and sea routes handled 97.8% of merchandise freight from PRC to Europe in 2018.

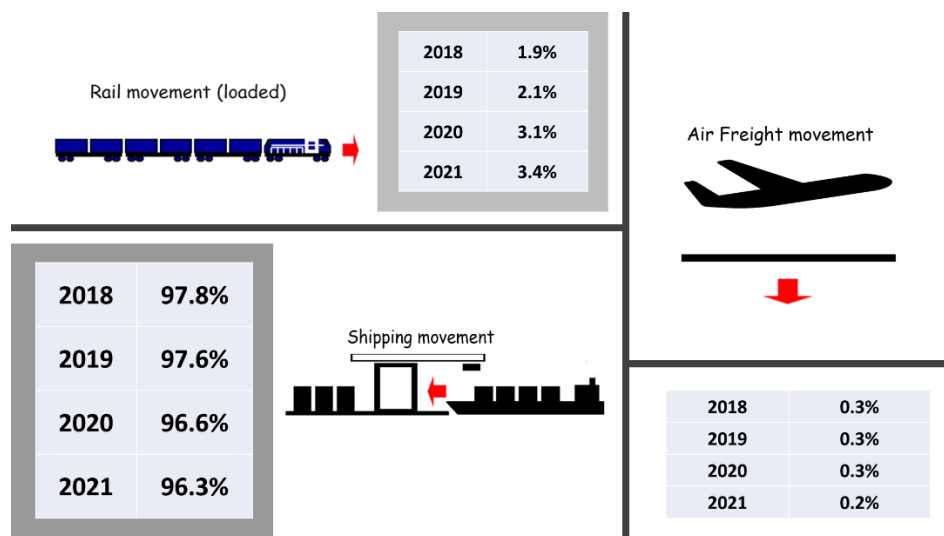


Figure 13 - Modal Market Share 2018-2021

As explained in previous sections of this report, the actions taken by the mega-carrier shipping lines created the conditions where demand outstripped supply of sea-freight space. This led to sea freight prices skyrocketing and month-long+ delays to access shipping space. Goods piled up at manufacturers and freight forwarders warehousing in PRC whilst the mega-carrier shipping lines maximised profits from 100% utilisation of their imposed reduced deployment of the number of container ships (temporarily) operated.

Against this background, importers and export companies and their agents scrambled for alternatives. For retailers and exporters in PRC and Europe, with

the option to take greater advantage of overland transport links. That has meant renewed interest in a transport mode that was mostly ignored before the pandemic but is now booming (Almendral, 2021).

The volume of goods carried on rail from PRC to Europe ballooned from 14 million metric tons in 2019, to 24 million metric tons in 2020. Demand for rail resulting from the limited capacity and spike in sea freight prices from \$2,000 per container in June 2020 to \$15,000 a year later, from data presented at the [European Silk Road Summit](#) held on Dec. 7-8 2021 (Almendral, 2021). "We have seen tremendous increase in demand for this mode (rail) of transport in the last two years," said Onno Boots, CEO for Asia-Pacific at global freight forwarder Geodis, which has seen a 176% increase between 2019 and 2021 in the volume of goods sent by train (Almendral, 2021).

Slowing Demand to Secure Freight Space via Overland Rail

From January to June 2022 a total of 7,473 freight trains were operated between PRC and Europe, carrying a total of 720,000 TEU. Compared with 2021, these figures were up 2% and 2.6% respectively (Preston R. , 2022). However, this compares with respective growth of 22% and 29% in the first half of 2021 and 50% and 56% in the first half of 2020 when rail freight services increased substantially at the start of the Covid-19 pandemic (F2F News, 2022).

The Ukraine conflict is cited for the growth slow down. To avoid routes through Russia, the Middle Corridor has had heightened interest with links across the Caspian Sea and Black Sea allowing entry to Europe via Romania although capacity on this slower route is limited enquiries are strong. Intermodal services using rail and ship in the Western Land-Sea corridor saw strong growth in the first half of 2022, carrying a total of 379,000 TEU, which was up 33.4% on the year before. Scheduled rail services has increased from 9 to 12 (Preston R. , 2022).

Beware the Return of Ship Capacity to the PRC-Europe Trade Routes

On 2 September 2022 it was reported that ship capacity shortage that underpinned skyrocketing ocean freight rates for the past two years has ended, and rates will continue to fall, according to Vespucci Maritime CEO Lars Jensen

(Wackett, 2022). “The available data shows that the fundamental support for very high freight rates has now fully disappeared and further weakening is to be anticipated,” he said (Wackett, 2022). The analyst added: “Even though small bumps in the road, in the form of a sudden short demand spike or unexpected bottlenecks, could cause temporary upward rate movements, the overall rate development will continue down towards more normal market levels.”

How Far will Ocean Freight Rates Fall?

Drewry’s World Container (freight) Index (WCI) in the last week of August 2022 week recorded a 5% fall in Asia-North Europe component, to USD7,583/40’, but the indices are having to play catch-up with a very fast-moving market as carriers start to discount heavily to fill ships that have been rapidly redeployed from layup.

Industry sources report rates offered the first week in September 2022 on sailings from PRC to Europe, valid through to November 2022, now below USD6,000/40’, with unlimited space availability. See Figure 12.

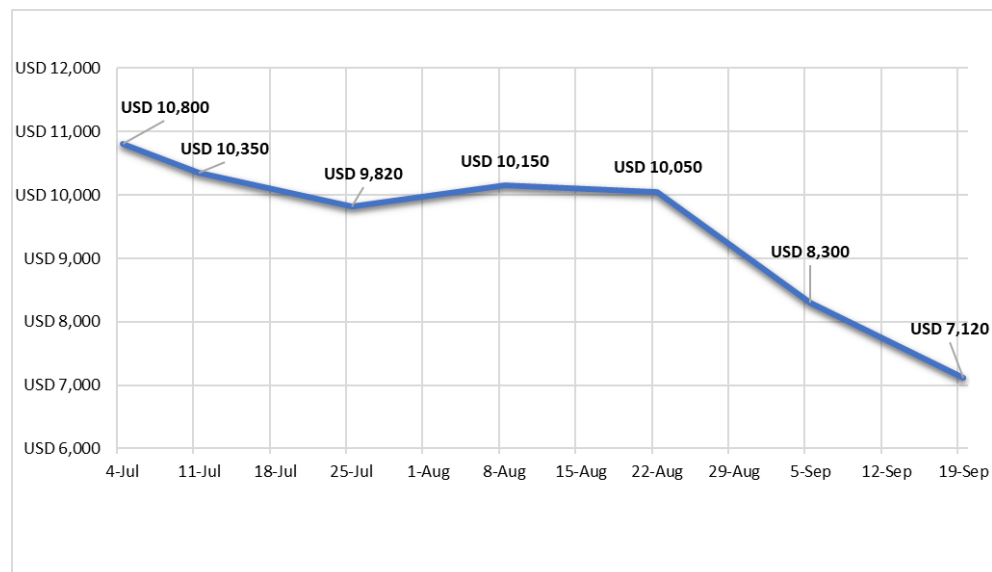


Figure 14 - FBX Baltic Index PRC to EU Container Rates Jul-Sept 2022

One year ago, rates from PRC to North Europe were around USD14,000 for Antwerp and Rotterdam and USD16,000 for the UK, with cargo being rolled from week to week. This is in stark contrast to September 2020, when spot rates were readily available at USD2000/40’ Shanghai to Rotterdam (Wackett, 2022).

Mega-carriers have a track record of attempting to control and arrest sliding sea freight rates, but in the scramble to secure market share history has shown that price wars are often inevitable.

Middle Corridor Dilemma or Business as Usual?

The surge to switch to overland rail during 2020-21 saw renewed use of rail from PRC to Europe for all Corridors. The Ukraine conflict in early 2022 resulted in the closure of Ukraine seaports and many shippers avoid using the northern rail corridor through the Russian Federation. This left the Middle Corridor as a remaining alternative to satisfy the surge in freight volume.

Key nodes and freight service providers that make up the Middle Corridor are contemplating renewed investments in their rail networks, rolling stock, terminals, seaports and trans-Caspian shipping assets so as to increase network capacity.

These investment opportunities are plausible ambitions as set against the assumptions that demand will be maintained at its present levels. As described above the sea-freight world is coming back into a balance of supply to demand and perhaps even oversupply as shipping lines again use pricing to capture market share.

It would be wise for the Middle Corridor freight actors to ‘pause and reflect on what has occurred over the last two years. It would be advisable to analyse what volumes have been delivered by their service networks and what new mixture of freight types not seen previously have been carried end to end.

The planning towards phased development of the Middle Corridor is probably the best course of action – and in fact this was the existing condition pre-covid and pre-UKR conflict. There is no doubt that the Middle Corridor will increase in its importance as freight corridor and a return to a strategic well thought out expansion investment plans.

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APPENDICES

Appendix A – Other Routes

Although the northern route is the most popular, volumes are also increasing on other routes between Europe and PRC. The volume of containerised freight shipments along the Trans-Siberian railway through Russia [grew](#) by 22 per cent in the first eight months of 2018. Between January and August 2018, 590 thousand containers were shipped on the Trans-Siberian connection. This is already more than the total volumes in 2017, which counted 262 thousand containers, according to Oleg Belozarov, CEO and Chairman of the Board of Russian Railways (ULTC, 2018).

This lesser-known multimodal route transfers cargo from PRC through Azerbaijan and Georgia to Turkey, from where it enters Europe. According to joint organisation the Middle Corridor, traffic along this corridor amounted to 15 thousand TEUs this year, a massive rise considering the 200 TEUs in 2017 (ULTC, 2018).

The volume of containerised freight shipments along the Trans-Siberian railway through Russia increased by 77% in 2018, reported Russian Railways. More than 262,000 containers were shipped on the route connecting PRC and Europe. With normalisation of conditions post the Russian Federation-Ukraine conflict resolution, this route could also attract greater volumes

PRC also has launched several new freight routes from Chongqing and Chengdu provinces, empowering Vietnam and ASEAN exporters to establish new trade prospects with Western China. These routes will reduce the transportation time from an average of 20 days to between five and seven days (F2F News, 2022).

Chengdu has also opened a road-rail transport link through Myanmar – and provides trade routes to the Indian Ocean. The route is the most convenient land and sea channel linking Southwest China and the Indian Ocean and provides an alternative to PRC's fear of maritime blockage at the Straits of Malacca (a narrow stretch of water, 580 miles in length, between the Malay Peninsula and the Indonesian island of Sumatra).

Appendix B -New Developments

New developments in transportation that are related to CAREC region are occurring at a fast pace. There are new rail connections implemented and under planning that will add capacity to the westbound PRC-EU overland route. In addition there are seaport developments within the Black Sea region which will add capacity to the sea routes between Georgia and eastern Europe gateway ports.

On May 10 2021, Finnish company Nurminen Logistics started running a container train from PRC to Central Europe using the Trans-Caspian route (Carafano, 2022).

Georgia is working with businesses from Azerbaijan and Kazakhstan to develop a new shipping route employing feeder vessels between Georgia's Poti and Romania's Constanta ports. The TITR currently has only about 5% of the Russian route's capacity, but Central Asian countries have been spending heavily to develop modern infrastructure (Mammadli, 2022).

Georgia is modernizing its freight train network, expanding the capacity of the Batumi and Poti ports with support from the U.S., and plans to construct a new deep sea port in Anaklia, mainly for bulk vessels (Calabrese, 2019).

The Asia Development Bank (ADB) support program, the average time of freight traffic between the border of Azerbaijan and Georgia's Batumi Port will be reduced by 4 hours (Sharifli Y. , 2022).

For example, Kazakhstan invested approximately \$35 billion over the last 15 years to build more than 2,000 kilometers of railways, 19,500 kilometers of roads, 15 airports and port capacities along the Caspian Sea (Carafano, 2022).

In 2022, Kazakhstan announced a \$20 billion investment for diversifying transit and freight transport routes and integrating logistic solutions (Carafano, 2022).

Kyrgyzstan's president, announced that construction would start on a line connecting PRC, Kyrgyzstan and Uzbekistan (see map) in 2023. The new line would open a route from PRC to Europe through Turkmenistan, Iran and Turkey, shortening the journey by some 900km and eight days. More important, it would skirt Russia, which has become tricky to move goods across because of sanctions imposed as a result of Vladimir Putin's invasion of Ukraine. Mr Osoyev says PRC, Kyrgyzstan and Uzbekistan have finally agreed on a 280km route. It will cost \$4.1bn and be financed either through direct investment or public-private partnership. The route runs from the Torugart pass on PRC's border to Jalalabad in western Kyrgyzstan, which is already connected to Uzbekistan by a railway built by the Russians in 1916. The gauge would change at Makmal, site of a gold mine in which Chinese investors have an interest. The new line would provide an alternative, non-Russian, rail-only route between PRC and Europe. (The Economist, 2022).

DP World has already broken ground on a multimodal terminal in central Romania linked to its ocean terminal in the Black Sea port of Constanta that is one of the key European entry points on the PRC-Europe rail corridor (Container News, 2022). The APM Terminals facility at the Georgian port of Poti is another link in the middle corridor logistics chain that is in the middle of a \$250 million expansion, while European and Central Asian rail freight operators such as Metrans and Rail Freight Group are also expanding rail and sea services connecting Central Asia with North Europe and the Mediterranean (Knowler, 2022).

On top of the infrastructure development, several transport providers, including Maersk, have launched new services using the middle corridor or are trying to increase volume on their existing services.

Nippon Express (PRC), part of the Nippon Express Holdings group, has launched a new intermodal service from PRC to Europe using the middle corridor via the Caspian Sea, while CEVA Logistics started a weekly block train service from Xi'an to Duisburg earlier this month (Knowler, 2022).

Transpolar Sea Route that opened to commercial shipping passes through the middle of the Arctic, and which is projected to be safe all year navigation in late

2020's (Wishnick, 2017). The Arctic Corridor, connecting Scandinavia and western Europe deep-water ports via the Arctic Ocean and Baltic Sea. The Arctic Corridor, once fully open to commercial shipping, is envisaged to be the shortest, most direct route to transport goods between Asia and Europe. See Figure 15.



Figure 15 - Arctic Sea Route PRC-EU

While the journey takes 35 days from Asia to Europe through the Strait of Malacca and the Suez Canal, it takes only 22 days through the Arctic, saving time and cost. In 2015, COSCO's cargo ship Yong Sheng sailed from the port of Dalian to Rotterdam through the Northeast Passage, and back to the Chinese port of Tianjin in 55 days (Zoltai, 2021).