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Shortening Global Supply Chains as a Key to Decarbonising Transport



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Key findings



The historical development of global supply chains: past drivers

- In the past 50 years, the length and fragmentation of supply chains have exploded due to new manufacturing, transport and logistics, and communication technologies, as well as international economic regulations related to trade liberalisation.
- Today, international production is highly organised within global value chains, where the different stages of the production process are located across different countries. As of 2021, an estimated 70% of international trade involved global value chains.
- These drivers enabled an internationalization of supply chains in offering new business opportunities to increase profits, access new markets and reduce costs due to international trade competition.

Recent disruptions to global supply chains revealed vulnerabilities

- The global financial crisis of 2007-08 and the multiple recent events of 2020-22 such as the COVID-19 pandemic, the Russian Federation's invasion of Ukraine, and the blockage of the Suez Canal caused supply shortages, raising awareness of the fragility of global supply and logistics chains and their international dependencies. These disruptions resulted in the Global Supply Chain Pressure Index recording an all-time high value of 4.3 above the historical average of 1997 to 2022.
- These past drivers and system organisation led supply chains to become more vulnerable to external disruptions.

The future of global supply chains: a changing context

- In the future, an ongoing changing context could lead to more regional value chains that are closer to customers, corresponding to a shortening of global supply chains.
- Key structural changing drivers include a shift in economic policies towards protectionism of employment and industries; changes in the international security context to reinforce security of supply and value chain independence; rising pressures to reduce carbon emissions; and the continuous evolution of manufacturing technologies.

Perspectives for the international climate co-operation agenda

- A review of the long-term strategies of the five leading economies – China, India, Japan, the United States and the EU – published between 2020 and 2022 found that none of them mention phrases related to shortening supply chain distances, reducing freight movements or reducing long-distance freight, shifting supply chains closer and developing local production-consumption ecosystems. This reveals an important gap between science and policy.
- These changes are overlooked in existing international climate discussions and are not taken enough into account by companies in their long-term climate strategies.
- The possibility of a reduction of movements and distances should be considered as a core component of any realistic freight decarbonisation strategy to reach zero emissions by 2050. This demand-side component of the strategy should be articulated with necessary technological changes in a coherent systemic change.

- In the perspective of the first Global Stocktake (2022-23) and future revisions of countries' Nationally Determined Contributions and Long-Term Strategies under the Paris Agreement, an international climate policy agenda on identifying barriers and enablers for strengthening international co-operation towards shorter and more resilient supply chains should be opened. Critical international co-operation activities should help to discuss opportunities and issues related to the changing context, and co-ordinate collective action to avoid unilateral and unfair decisions.



Introduction

Global freight transport activity, measured in tonne-kilometres, grew 68% between 2000 and 2015 and is projected to further increase 2.0 times from 2019 to 2050.¹ If unchecked, this growth poses a critical challenge to efforts to decarbonise freight transport.² Key to addressing this challenge is to consider the role of structural and systemic factors, and their interaction with technology factors, in the effort to reach net zero emissions.³ International trade and the geographically long global supply chains of many industries have contributed greatly to the rapid increase in emissions from freight transport.⁴

This spotlight complements *Spotlight 4 - The Role of Companies in Decarbonising Global Freight and Logistics*. While Spotlight 4 delves into decarbonisation trends pertaining to global supply chains across different transport modes, this spotlight focuses on the historical evolution of global supply chains, recent disruptions and future outlooks.

In the wake of the global financial crisis of 2007-2008, the factors that have traditionally determined the geographical organisation of supply chains (see Box 1) have changed.⁵ More recently, supply crises related to the COVID-19 pandemic and the Russian Federation's invasion of Ukraine have raised awareness about the interdependencies and resiliency challenges related to global supply chains. At the same time, ongoing shifts could accelerate reductions in the lengths of supply chains.

Given that technological solutions for reducing freight transport emissions – such as zero-emission vessels, aircraft and long-distance trucks – are still far from maturity, it will be necessary to give greater attention to the systemic reorganisation of global supply chains in the effort to reach net zero emissions, and to minimise risks to industry during the energy transition.⁶

BOX 1. Five key determinants of the geographical organisation of supply chains

Traditionally, five key factors have determined the structure of supply chains, although these factors vary depending on the value chain as well as on the step of the value chain being considered. They are:

- | | | | | |
|---|---|---|--|---|
| 1 | 2 | 3 | 4 | 5 |
| Labour costs and other non-economic labour-related regulations | Sunk investment costs and public investment incentives | Trade and transaction costs and non-economic transaction-related regulations | Access to know-how/talents, technologies, infrastructure and supply sources | Access to distribution markets, transport and logistics costs and lead time. |

These five determinants also can depend on the relative cost structure and final price of the products, on the degree of reliance on extractive industries, and on the modularity of the production process, among others. Understanding these five determinants makes it possible to better analyse the underlying changes that are affecting global supply chains.

The historical development of global supply chains: past drivers

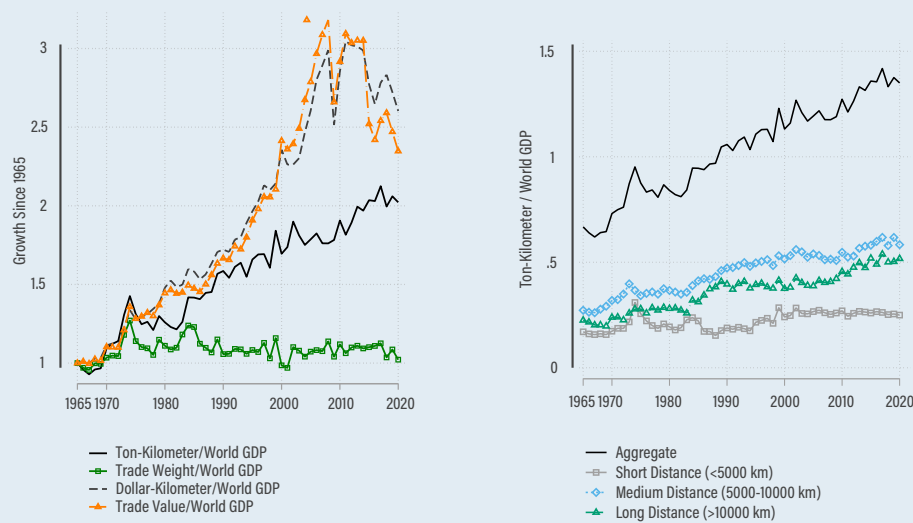
Historically, supply chains were shorter and simpler, typically located in a small geographic area and stretching only as far as a few kilometres. Longer-distance, international supply chains were needed only for specific processes that were not available in all countries, such as natural resource extraction or agricultural production. More recently, however, global supply chains have evolved dramatically (see Box 2)⁷.



BOX 2. Historical development of global supply chains

Starting in the mid-1980s, the development of global value chains with very long and scattered supply exploded. Companies started to offshore parts of their supply, production, operations and service processes, adding longer distances, more steps and additional time zones to the production process. From 1965 to 2020, the average distance of one internationally traded tonne almost doubled (see Figure 1). During this period, the number of international tonne-kilometres traded grew 120% for longer distances (more than 5,000 kilometres), but it grew only 45% for shorter distances (less than 5,000 kilometres).

FIGURE 1. The role of longer distance trade, 1965-2020



Source: See endnote 7 for this section.

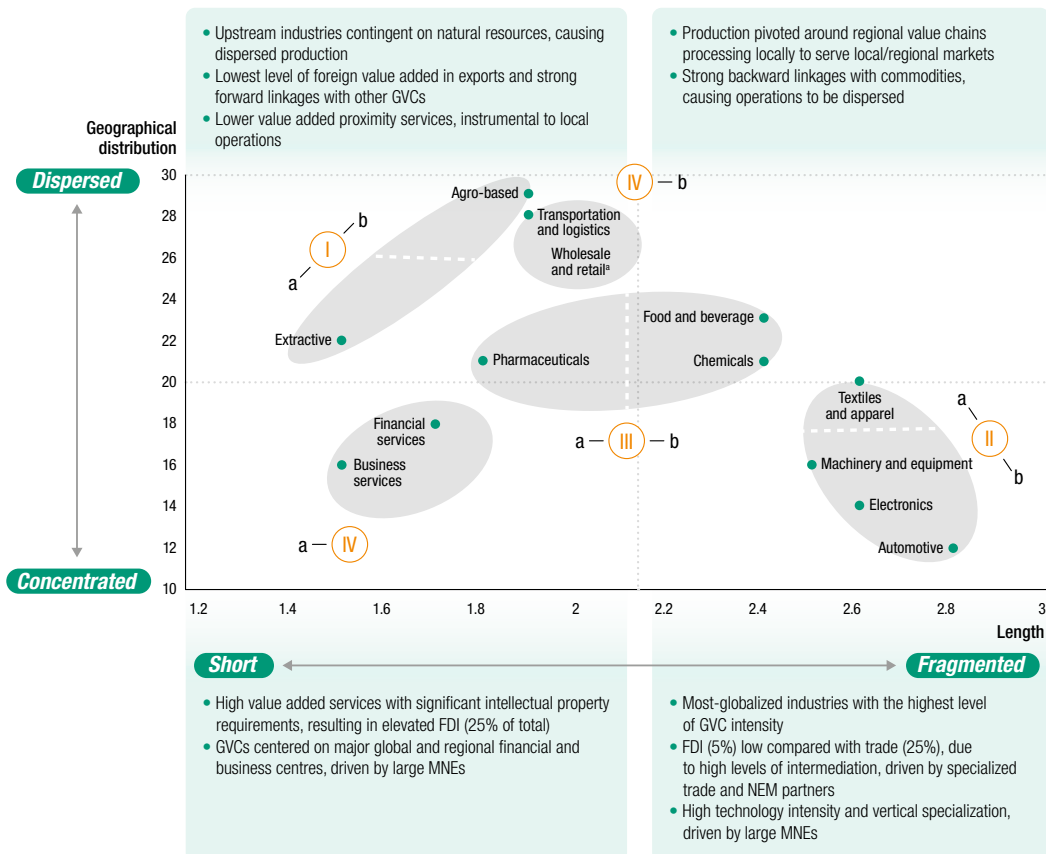
Today, international production is highly organised within global value chains, where the different stages of the production process are located across different countries.⁸ As of 2021, an estimated 70% of international trade involved global value chains.⁹ Figure 2 characterises the current organisation of value chains according to their geographical distribution and length. This helps to identify four main industry types (I to IV): primary industries (low or high capital intensive), global value chain-intensive industries (low or high tech), geographically distributed industries (global or regional hubs) and services industries (low or high value added).¹⁰ The industries with the longest and most fragmented global value chains are chemicals, electronics, automotive, machinery and equipment, textiles and apparel, and food and beverages.¹¹

Several important transformations have influenced the determinants of the geographical structure of supply chains (see Box 1). They include the development of new manufacturing, transport, and communication technologies, as well as international economic policies related to trade liberalisation.

- ▶ For example, advanced manufacturing technologies facilitated the scattering and offshoring of production processes; new communication technologies enabled complex cross-border co-ordination; and the containerisation of shipping contributed to lower transport costs.¹²
- ▶ On the policy side, economic liberalisation and the development of international and multilateral trade agreements after World War II contributed to the reduction or elimination of tariffs, quotas, preferences and other trade barriers.¹³ The General Agreement on Tariffs and Trade (GATT) grew to cover more countries, goods, and activities, leading in the 1990s to the creation of the World Trade Organization, involving more than 125 countries. Global competition among firms and economies led to dedicated national investment policies and export-oriented industrial policies.¹⁴

FIGURE 2. Length and geographical distribution of international production, by key industry type

Source: See endnote 13 for this section.



Recent disruptions to global supply chains: revealed vulnerabilities

Business decisions to increase profits, reduce product costs and access new markets created additional complexity in the scattering of value chains and increased their physical distance. Combined with manufacturing innovations such as just-in-time inventory management, global supply chains have become more vulnerable to external disruptions.

In recent years, multiple crises such as the COVID-19 pandemic, the Russian Federation's invasion of Ukraine, and the blockage of the Suez Canal caused supply shortages, raising awareness of the fragility of global supply and logistics chains and their international dependencies. These disruptions resulted in the Global Supply Chain Pressure Index recording an all-time high value of 4.3 above the historical average of 1997 to 2022 (see Figure 3).¹⁵

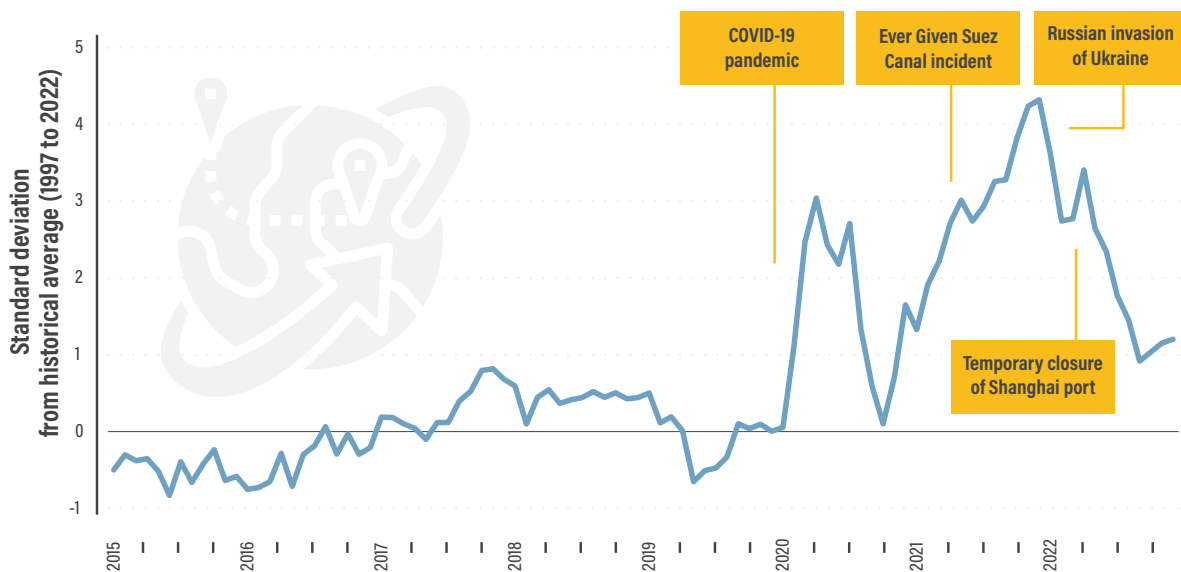
- ▶ The COVID-19 pandemic created supply shortages related to higher demand for medical and pharmaceutical goods such as face masks, protective gear, respirators, tests, medications and vaccines. The crisis led many to question the locations where critical safety- and health-related

products are made, and the commercial rules surrounding them, for national security reasons.¹⁶

- ▶ The pandemic also raised awareness about the huge role that China's economy and ports play in global supply, particularly after the entire port of Shanghai was shut down for two months in 2022 due to high COVID-19 incidence.¹⁷
- ▶ The Russian Federation's invasion of Ukraine led to a critical shortage in the global trade of cereals, revealing the strong dependency of grain markets on this region of the world.¹⁸
- ▶ The grounding of the *Ever Given* container ship, which blocked the Suez Canal for a week in March 2021, created delays in global supplies along the largest container route for Asia-Europe trade.¹⁹ This incident, caused by a sand storm and strong wind, provided a reminder of the vulnerability of international trade to extreme weather. As climate change increases the frequency and intensity of extreme weather events, closures of key trade chokepoints could increase.²⁰

FIGURE 3. Global supply chain pressure index (higher value means higher pressure), 2015 to 2022

Source: See endnote 16 for this section.



The future of global supply chains: a changing context

As both companies and policy makers express rising concerns about resiliency, many are considering associated strategies to relocate production facilities and suppliers closer to customers.²¹ A growing literature has emerged around reshoring (when manufacturing activities return to their initial country of origin) and nearshoring (when manufacturing is relocated to a country that is closer to “home”).²²

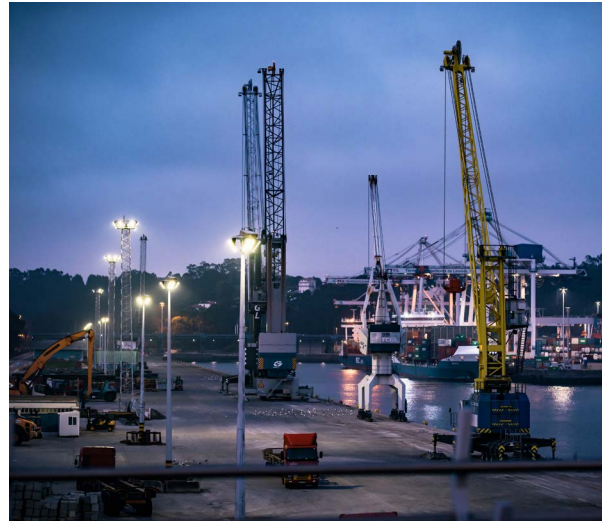
Increasingly, the key factors determining the geography of supply chains (see Box 1) are changing, which could lead to greater regionalisation of international trade and a shortening of supply chains. According to a 2019 analysis, a reduction in the average length of supply chains began in 2012.²³ Four structural changes are contributing to the reduced distances for value chains and international trade.

1

The shift in economic policies from market liberalisation towards protectionism

Since the global financial crisis of 2007-2008, the international economic policy agenda has shifted towards the development of protectionist measures among the G20 economies, contributing to the recent trade wars between the United States and China.²⁴ Between 2010 and 2020, at least 110 countries increased the adoption of both formal industrial policies and individual policy measures related to protectionism. These policies were aimed at job creation and economic development but also reflected efforts to support achievement of the Sustainable Development Goals.²⁵

- ▶ In 2022, the US Inflation Reduction Act created tax credits for the domestic production of specific goods and for building and maintaining new factories in the United States.²⁶
- ▶ Recent trade policies reflect the rapid proliferation of regional trade agreements that use local content requirements to require manufacturers in the region to source goods and services produced in member countries.²⁷



2

Changes in the international security context to reinforce security of supply and ensure the independence of critical value chains

New investment restrictions or regulations in recent years have reflected concerns about national security and foreign ownership of technology firms, strategic assets, and land and natural resources.

- ▶ In the European Union (EU), the adoption of the Directive on Cross-Border Mobility expanded the screening of foreign investments in European companies and takeovers.²⁸
- ▶ In 2017, the EU launched a USD 7 billion plan for German and French firms to jointly produce batteries based on the model of Airbus, including through USD 1.5 billion in public subsidies targeting this strategically important industry.²⁹
- ▶ In the wake of the COVID-19 pandemic, governments re-launched national subsidies for specific pharmaceutical goods.³⁰

3

Rising pressures to reduce emissions

Since the Paris Agreement in 2015, environmental concerns related to the impact of human activities on climate change and biodiversity loss have grown in importance. As of 2022, more than 58 countries and one-fifth of the world’s largest companies had committed to reaching carbon neutrality.³¹ Governments have been pushed to act by adopting more and better sustainability policies.

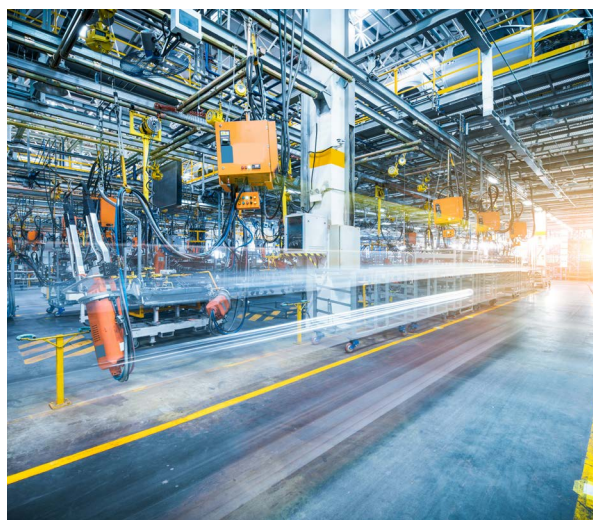
- ▶ In 2022, the European Commission adopted the European Carbon Border Adjustment Mechanism, the first climate-oriented border tariff on imports of carbon-intensive industrial products.³²
- ▶ The EU regulation on deforestation-free supply chains, adopted in 2022, reinforces control and transparency in the value chains of specific agricultural products to ensure that they do not contribute to additional deforestation.³³

Businesses are turning to life-cycle assessments to measure the environmental impacts along the value chain for each step of a product’s life cycle, from production to transport, distribution and disposal. The Smart Freight Centre’s Global Logistics Emission Council (GLEC) Framework is the only globally recognised methodology to help companies harmonise the calculation and reporting of the logistics greenhouse gas footprint across the multi-modal supply chain.³⁴

4

New manufacturing technologies

Finally, new manufacturing technologies such as automation and additive manufacturing have impacted industrial production costs by favouring reshoring and nearshoring. However, innovations in communication technologies such as 5G, cloud computing and artificial intelligence could have the opposite effect on the length of value chains.³⁵



Perspectives for the international climate co-operation agenda

The international scientific community has noted that “systemic changes” related to transformations in structural demand could play a large role in keeping global temperature rise below 1.5 degrees Celsius (°C). A key recommendation is for the transport sector to better articulate the needed transformations related to supply chain management, which include reducing movements and distances, alongside technological changes.³⁶ However, a review of the long-term strategies of the five leading economies – China, India, Japan, the United States and the EU – published between 2020 and 2022 found that none of them mention phrases related to shortening supply chain distances, reducing freight movements or reducing long-distance freight, shifting supply chains closer and

developing local production-consumption ecosystems. This reveals an important gap between science and policy.

The international strategy for reducing maritime greenhouse gas emissions, which were responsible for 10% of all transport CO₂ emissions in 2019, is a good example of this disconnect.³⁷ The demand for international maritime transport has increased from around 4,000 million tonnes of goods transported in 1990 to more than 11,000 million tonnes in 2022, with an increasing average geographical distance of trips. Maritime transport emissions have increased proportionally and rapidly until 2010, and they now hover at around 1 gigatonne of CO₂ following a decade of energy efficiency gains; however, maritime emissions

have not yet begun to decrease in line with international targets to reduce them 50% between 2008 and 2050.³⁸ The International Maritime Organization is supposed to revise this target in 2023 with targets that are aligned to the Paris Agreement and can enable decarbonisation of the shipping sector.³⁹

Despite the need to accelerate efforts to curb maritime emissions, current strategies in the sector are focused on the technological fuel shift as a silver bullet, after having acknowledged that operational and technical energy efficiency measures on ships were insufficient. Consequently, national and international policy action in 2021 and 2022 to tackle emissions was focused on the fuel shift and related investments, including changes to vessel motors, fuel supply at ports, and energy production and supply (Green Shipping Challenge, Clydebank declaration, Global Maritime Forum's call⁴⁰).

However, as described in this spotlight, the context is changing and this may impact the future geographical configuration of supply chains. The possibility of a reduction of movements and distances should therefore be considered as a core component of any realistic freight decarbonisation strategy to reach zero emissions by 2050. This demand-side component of the strategy should be articulated with necessary technological changes in a coherent systemic change. Furthermore, failing to analyse and anticipate what will be the future of the international production organisation could be risky and raises questions for ports, ship owners and energy providers investing in the sector, including:

- ▶ What will be the future geographical structure of maritime routes? How will existing routes be affected?
- ▶ If the route lengths are changing, how will that affect the technological choices in ships and related energy supply?

If future routes are located elsewhere, how will that affect the estimation of traffics and investments in ports? There were very few explicit mentions of freight-related actions in both generations of the Nationally Determined Contributions (NDCs) towards reducing emissions that countries had submitted under the framework of the Paris Agreement as of 2022. Only 5% of all mitigation actions referred explicitly to freight transport⁴¹. The most popular freight actions in the second generation of NDCs included a shift from road transport to rail or inland waterways, freight efficiency improvements and freight vehicle improvements. An example on freight action in the United Arab Emirates' second NDC outlines plans to build the 1,200 kilometre Etihad Rail network, of which the first stage of 264 kilometres has been operational for freight since January 2016; it replaces around 300 trucks with a single train journey and reduces CO₂ emissions 70-80%.⁴²

An international policy agenda is needed to work on identifying barriers and enablers for strengthening international co-operation towards shorter and more resilient supply chains. Critical international co-operation activities should help to discuss opportunities and issues related to the changing context, and co-ordinate collective action to avoid unilateral and unfair decisions.

In the perspective of the first Global Stocktake (2022-23) and future revisions of countries' Nationally Determined Contributions and Long-Term Strategies under the Paris Agreement, the regionalisation of supply chains closer to customers should be better integrated.



Actions to Reduce Emissions and Boost the Resilience of Freight Transport and Global Supply Chains: SLOCAT Guidelines for NDCs⁴³

To secure their place in the future net zero economy, countries can use their Nationally Determined Contributions submitted under the Paris Agreement to set their freight transport and logistics systems on track to become net zero and resilient. Some key elements of a NDC that enables impactful action on decarbonisation and resilience of freight transport and global supply chains include:






Set robust freight transport targets seeking to:

- Reduce freight transport emissions
- Ensure that a certain share of goods is transported via rail or waterways
- Mandate a share of fuels for trucks supported by renewable energy
- Transform infrastructure



Include mitigation actions for freight transport structured by the Avoid-Shift-Improve framework:

-  Avoid and reduce the need for motorised travel
-  Shift to more sustainable modes
-  Improve transport modes



Adapt freight transport with measures that improve the resilience of infrastructure, including:

- All-weather roads and general flood protection
- Ports that account for sea-level rise and extreme weather events
- Early warning systems
- Multiple and shorter supply chains
- Plans for alternative freight transport



Feature actions to achieve more ambitious international maritime and aviation transport targets and measures.

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SPOTLIGHT 4 SHORTENING GLOBAL SUPPLY CHAINS AS A KEY TO DECARBONISING TRANSPORT

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