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Choosing a transport mode: sea, air, road and rail compared

The five transport modes, selection criteria, a criteria × mode decision table, the cost of inventory in transit, emissions and typical corridors from Türkiye

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Online interactive version: **https://ozgurkonakci.com/en/guide/transport-mode-selection/**

SHORT ANSWER

A transport mode is chosen by weighing the value, weight and volume of the cargo, how tightly you are tied to a delivery date, the route and the budget together. Sea freight offers the lowest variable cost over long distances and for large volumes, but it is the slowest. Air is the fastest, and also the most expensive and highest-emitting per tonne-km. Road gives door-to-door flexibility over short and medium distances; rail is strong on land for heavy, regular flows. A sound comparison looks beyond the freight rate to the cost of inventory in transit, safety stock and emissions.

The freight rate is not the only criterion

A company making its first export usually starts with the same question: "Which one is cheaper?" Yet the freight line on two quotations is only part of the total cost. Every day the goods spend on the road or at sea ties up capital; when delivery dates slip you need to hold more safety stock; and customers now ask about the carbon footprint of the shipment too.

Türkiye's foreign trade data shows clearly why the modes carry different kinds of cargo:

Mode	Share of exports by value (2025)	Share of exports by weight (2025)	Average value per kg exported
Sea	56.2%	79.71%	≈ USD 1.12
Road	31.9%	18.42%	≈ USD 2.76
Air	10.3%	0.93%	≈ USD 17.63
Rail	0.6%	0.84%	≈ USD 1.31

Source: Ministry of Trade of Türkiye, *Dış Ticaret Lojistiği 2026* (May 2026), data for 2025. The last column is our own calculation: export value by mode (USD million) ÷ export weight (thousand tonnes). For air, for example: 28,276 ÷ 1,604 ≈ USD 17.63/kg. The "other" category, which covers pipelines, post and electricity transmission, is left out of the table.

Air carries less than 1% of Türkiye's export tonnage but a tenth of its value. The global picture is similar: according to IATA's sample of 42 countries, air cargo carried less than 1% of world trade by weight in 2025 but close to a third by value. According to UNCTAD, around 80% of the volume of international trade in goods is carried by sea.

The five transport modes

Mode	Strengths	Weaknesses	More in this guide
Road	Door-to-door flexibility; the fewest physical constraints of any mode; competitive over short distances	Limited capacity per vehicle; energy-intensive; exposed to traffic and border crossings	**Road vehicle types and loading metres**
Rail	The highest capacity of the land modes; suits heavy, regular flows	Tied to the network; usually needs road for the first and last leg; track gauges can differ between countries	**Intermodal and combined transport**
Sea and inland waterway	Moves large volumes over long distances at the lowest variable cost	Slow; ports and ships are capital-intensive; another mode is needed to and from the port	**FCL, LCL and freight calculation**, **Shipping container types and dimensions**
Air	The fastest mode; flexible network	Highest cost and emissions; aircraft and unit load device (ULD) dimensions limit capacity	**Air cargo: the AWB and chargeable weight**
Pipeline	Moves liquids and gas continuously over long distances at low cost	Only certain products; the route is fixed once built	—

The characteristics of the modes are based on Rodrigue's open-access textbook *The Geography of Transport Systems* (6th edition, 2024).

Two notes. Inland waterways compete with rail in regions with large river and canal systems; in the Ministry of Trade's foreign trade tables, however, they do not appear as a separate category. Pipelines are not a mode most exporters can choose either; they are built for fluids such as crude oil, natural gas and refined products.

Selection criteria

Ask the same eight questions for every shipment:

1. **Cost:** Is the freight rate the whole quotation? Have surcharges, local charges and pre- and on-carriage been added? See **Freight quotations and surcharges** for how to read a quotation.
2. **Transit time:** Not port-to-port or airport-to-airport, but **door-to-door**. Cut-off, transshipment, customs and delivery days are all included; for the sea leg, see **The container shipment timeline**.
3. **Reliability:** How often the promised time holds. The spread matters more than the average: the more the transit time varies, the more safety stock you need.
4. **Capacity:** Does the cargo fit in a vehicle, a container or an aircraft unit load device? Heavy, long or out-of-gauge cargo narrows the choice by itself (**Project cargo and out-of-gauge loads**).
5. **Cargo type:** Dangerous goods follow separate rules in each mode: IMDG at sea, ADR on the road, RID on rail and the IATA DGR in the air (**Dangerous goods transport: IMDG and ADR**). For cold chain products, equipment and transit time are considered together (**Reefer containers and the cold chain**).
6. **Value density:** Value per kilogram. When it is high, freight is a small share of the goods' value and a faster mode pays for itself more easily.
7. **Inventory cost:** The cost of stock in transit and of safety stock held at destination. We work through it below.
8. **Emissions:** The carbon footprint of the transport, for your customer or your own targets. The modes differ by multiples.

Decision table: criteria × mode

The table shows general tendencies; for a specific cargo and route, current quotations and schedules decide.

Criterion	Road	Rail	Sea (and inland waterway)	Air	Pipeline
Cost per tonne (long distance)	Medium to high	Low to medium	Lowest	Highest	Low (suitable fluids only)
Short distances and small shipments	Most competitive	Weak: terminal costs dominate	Weak	Urgent and valuable cargo only	—
Transit time	Fast, depends on the route	Medium; schedule-bound	Slowest	Fastest	Continuous flow
Watch points for reliability	Traffic, waiting at border crossings, driving-time rules	Schedules, changes of track and wagons at borders	Schedule deviation, transshipment ports, port congestion	Capacity and transfers; if the cargo misses the aircraft, the next flight	Cannot leave the line
Capacity	Limited per vehicle (a standard trailer takes about 24 tonnes, 33 Euro pallets)	Highest of the land modes	Highest	Limited by aircraft and ULD dimensions	Continuous and high, single product
Door-to-door	Yes	No; usually needs a road leg	No; needs port legs	No; needs airport legs	No
Typical cargo	Part and full loads, regional distribution	Bulk, containers, heavy industrial cargo	Bulk and containers, large volumes	Valuable, urgent, perishable, small volumes	Oil, gas, fluids
Value per kg of Türkiye's exports (2025)	≈ USD 2.76	≈ USD 1.31	≈ USD 1.12	≈ USD 17.63	—
Cost of inventory in transit	Low to medium	Medium	High (long transit)	Lowest	—
Emissions (g CO2e/tonne-km, EU-27, 2018)	137 (heavy goods vehicles)	24	6.6 (sea); 33 (inland waterway)	834*	Not in the source
Charging unit	Full truck or loading metre	Check with the carrier	FCL: per container; LCL: W/M	Volumetric weight (÷ 6,000)	—
Transport document	CMR consignment note	CIM (CIM/SMGS)	Bill of lading, sea waybill	AWB	—

The emission values are well-to-wheel EU-27 averages (Fraunhofer ISI and CE Delft for the EEA, December 2020). *The air value includes non-CO2 effects. 834 is the value as first published. Under the report's corrigendum the non-CO2 multiplier should apply to all flights, which raises the air value (the corrected figure appears only as a chart in EEA Briefing 01/2021). See below. The capacity figures come from **Road vehicle types and loading metres**.

How each charging unit is calculated is covered in separate topics: the 1 m^3 = 1,000 kg rule (W/M) for LCL in **FCL, LCL and freight calculation**, volumetric weight for air in **Air cargo: the AWB and chargeable weight**, and loading metres for part loads by road in **Road vehicle types and loading metres**. For the legal differences between the documents and liability limits by mode, see **Transport documents compared** and **Carrier liability and cargo insurance**.

Total cost: inventory in transit and safety stock

While the goods are on a ship they still belong to you, or have already been paid for. Capital is tied up for that whole time, and insurance, depreciation and opportunity cost keep running. For a single shipment, the cost can be estimated like this:

> **Cost of inventory in transit ≈ goods value × annual carrying cost rate × door-to-door days ÷ 365**

(An approximation we derived from the annual carrying cost of average inventory.)

The annual carrying cost rate is the yearly cost of holding stock as a percentage of its value: cost of capital, insurance, depreciation. Get it from your finance team; it varies by industry and interest-rate environment.

Example (the numbers are assumptions, not typical transit times or rates): You have two quotations for a shipment worth USD 500,000. Quotation 1 takes 30 days door to door, quotation 2 takes 5 days. Your annual carrying cost rate is 15%.

	Quotation 1 (30 days)	Quotation 2 (5 days)
Cost of inventory in transit	500,000 × 0.15 × 30 ÷ 365 ≈ **USD 6,164**	500,000 × 0.15 × 5 ÷ 365 ≈ **USD 1,027**

The difference is about **USD 5,137**. If quotation 2's freight is less than this amount above quotation 1's, the faster mode wins on in-transit inventory alone. If the freight gap is larger, the decision rests on the other items.

Safety stock: The warehouse at destination holds safety stock against variation both in demand and in the replenishment lead time itself. A long and variable transit time increases safety stock, and that stock has its own annual carrying cost. The method is explained in **Warehousing and inventory management**.

One-time investment: Miller and Peters (2024) stress that switching to a slower mode requires a one-time inventory investment to fill a longer pipeline of stock in transit and in the warehouse. If the annual savings do not pay this back within a reasonable time, a cheap freight rate can be misleading. As a middle path, the authors also assess a strategy that combines **planned sea shipments with air freight for emergencies**.

For the full comparison, put four items side by side: freight and surcharges, inventory in transit, safety stock, and the cost of delays or stock-outs.

The emissions gap

Transport emissions are calculated by multiplying transport activity (tonne-km) by the emission intensity of the mode. The method and standards (ISO 14083, the GLEC Framework) are explained in **CBAM and sustainable logistics**; here we look at the differences between modes.

Mode	EU-27, 2018 (g CO2e/tonne-km)	Relative to heavy goods vehicles
Sea (average)	6.57	≈ 5%
Rail (average)	23.99	≈ 18%
Inland waterway	33.44	≈ 24%
Road (heavy goods vehicles)	137	—
Air (including non-CO2 effects; value as first published)	834	≥ 6 times

Source: Fraunhofer ISI and CE Delft, *Methodology for GHG Efficiency of Transport Modes* (for the EEA, 08.12.2020), well-to-wheel values. The ratios in the last column match the report's own comparison (sea about 5%, rail 18%, inland waterway 24%); the air ratio is our own calculation (834 ÷ 137 ≈ 6.1). Because the corrected air value is higher, this ratio is a lower bound.

How to read the air value: The report's air value includes a multiplier for non-CO2 effects, and according to the report's corrigendum this multiplier should apply to all flights; the corrected value appears only as a chart in the EEA's 2021 briefing. As a different source, the UK government's 2026 conversion factors give **0.49 kg CO2e** per tonne-km for long-haul air freight; this value does **not** include non-CO2 effects (radiative forcing) or the distance uplift. Because the methods and scope differ, do not compare the two figures directly; state in your report which factor you used.

Example: A 10-tonne load travels 1,000 km: 10 × 1,000 = 10,000 tonne-km. On EU averages, that is about 10,000 × 137 = 1,370 kg CO2e by road and about 10,000 × 23.99 ≈ 240 kg CO2e by rail. In practice the routes and distances differ by mode, and the load factor changes the result too, so compare each mode over its own distance.

According to the EEA, emissions per tonne-km fell by 12% for air cargo, 11% for rail and only 3% for heavy goods vehicles between 2014 and 2018. Averages change over time; use the current factor (last checked: November 2026).

Mode combinations and typical corridors from Türkiye

Most international shipments use more than one mode. Three combinations come up often:

- **Intermodal and combined transport:** The cargo changes mode while staying in the same unit (container, semi-trailer, swap body). Definitions and the Türkiye–Trieste Ro-Ro and Middle Corridor examples are in **Intermodal and combined transport**.
- **Ro-Ro:** The trailer or truck is driven onto the ship on its own wheels, so part of the road journey moves to sea. According to the Ministry of Trade, 724,726 Ro-Ro movements were made in 2025, 72.12% of them on European lines.
- **Sea-air:** The cargo travels by sea to a transshipment hub and then by air to its destination. Time and cost fall between the two modes; because the cargo is handled again at the hub, it is not intermodal.

When freight on a route moves from one mode to another, this is called a **modal shift**. According to Rodrigue, road and air are more energy-intensive than the other modes, so rising energy prices can push freight towards water and rail.

The table below is a **general, qualitative assessment** of the main directions out of Türkiye; the figures in the data column are 2025 data from the Ministry of Trade's *Dış Ticaret Lojistiği 2026*.

Direction	Commonly used modes (our assessment)	Data (2025)
Western and Central Europe	Road (Kapıkule), Ro-Ro + rail, sea containers, rail	Germany is first for exports by road (12.85%) and first for exports by rail (19.94%); 2.891 million vehicle crossings at Kapıkule
Iraq and the neighbouring Middle East	Road	Iraq is second for exports by road (11.90%); 879,343 export trips by vehicle through Habur
Black Sea, Russia and the Caucasus	Road, Ro-Ro, rail (Baku–Tbilisi–Kars)	12.63% of Ro-Ro movements on Black Sea lines; about 60,000 tonnes of freight on Baku–Tbilisi–Kars in 2024
China and the Far East	Sea containers; air for urgent and valuable cargo; the Middle Corridor by rail	A total China–Türkiye transit of 10 days is the Middle Corridor target (a target, not achieved performance)
North Africa and the Eastern Mediterranean	Sea, Ro-Ro	14.28% of Ro-Ro movements on Mediterranean lines

Lines open and close: according to the Ministry, the Karasu–Constanța Ro-Ro line restarted on 14 May 2025 and was then halted again because of technical problems. Before planning a corridor, check the sailing frequency and the current status of the line with the carrier.

Route risk: chokepoints

Modes are usually compared on today's transit time. At sea, that time depends on the canals and straits the route passes through. When attacks in the Red Sea pushed ships round the Cape of Good Hope in 2024, a Shenzhen–Rotterdam voyage went from about 31 to about 41 days on UNCTAD's figures. In the same year, daily transits through the Panama Canal were cut because of drought.

In our view, two questions belong in any mode decision: does the route depend on a chokepoint, and what happens to transit time and freight if it closes? A longer transit feeds straight into the inventory in transit and safety stock calculation above. The chokepoints are compared in Shipping markets › Maritime chokepoints, and the effect on freight in War risk and canal surcharges.

Where to go next in the guide

- Charging and calculation: **FCL, LCL and freight calculation**, **Air cargo: the AWB and chargeable weight**, **Road vehicle types and loading metres**
- Reading a quotation: **Freight quotations and surcharges**
- Mode combinations: **Intermodal and combined transport**
- Stock and safety stock: **Warehousing and inventory management**
- Emissions calculation and EU rules: **CBAM and sustainable logistics**
- Documents and liability: **Transport documents compared: bill of lading, sea waybill, AWB, CMR and CIM**, **Carrier liability and cargo insurance**
- Delivery point and transfer of risk: **Incoterms® 2020**

Which courses cover this topic?

Comparing transport modes is taught as a course or part of a course in logistics and international trade programmes in Türkiye and abroad. Besides degree programmes, it also appears in professional certifications. A few examples:

- **Anadolu University** — International Trade and Logistics (English-medium), bachelor's: Transportation Systems (UTL205)
- **Bandırma Onyedi Eylül University** — International Trade and Logistics, bachelor's: Taşımacılık Yönetimi (UTL2108) (Transportation Management)
- **Copenhagen Business School** — Minor in Maritime Business, master's: Global Transportation and Maritime Logistics (KAN-CCMVV1723U)
- **United Arab Emirates University** — Supply Chain Management and Logistics, bachelor's: Transportation Management (SCML400)
- **ASCM** — CLTD (Certified in Logistics, Transportation and Distribution): Module 6: Transportation Management

Test yourself

1. In 2025, air carried less than 1% of Türkiye's export tonnage but about 10% of its value. Which criterion explains this? *(Answer: Value density. Cargo sent by air has a high value per kilogram; according to the Ministry's data about USD 17.63/kg, compared with about USD 1.12/kg by sea.)*
2. You have two quotations for a shipment worth USD 200,000: 40 days and 6 days door to door. If your annual carrying cost rate is 20%, what is the approximate difference in the cost of inventory in transit? *(Answer: 200,000 × 0.20 × (40 − 6) ÷ 365 ≈ USD 3,726.)*
3. A 10-tonne load travels 1,000 km. On EU-27 averages for 2018, roughly what are the emissions by road and by rail? *(Answer: 10,000 tonne-km; about 10,000 × 137 ≈ 1,370 kg CO2e by road and 10,000 × 23.99 ≈ 240 kg CO2e by rail.)*
4. Why is sea-air freight not considered intermodal? *(Answer: At the hub, the cargo is unloaded from the ship and rebuilt onto aircraft unit load devices, so it does not stay in the same loading unit and is handled.)*

Frequently asked questions

Which transport mode is the cheapest?

There is no single answer. Over long distances and for large volumes, sea freight has the lowest variable cost per tonne; for short distances and small shipments, road is usually more competitive because fixed terminal costs such as loading and unloading weigh heavily. Freight rates change over time and by lane, so compare current quotations for each shipment.

When does air freight make more sense than sea freight?

When the goods are valuable and light, when delays are expensive, or when the long sea transit would require a lot of inventory. Compare the freight difference together with the cost of inventory in transit (goods value × annual carrying cost rate × days ÷ 365), safety stock and possible lost sales.

Which modes carry Türkiye's foreign trade?

According to the Ministry of Trade's data for 2025, 56.2% of exports by value went by sea, 31.9% by road, 10.3% by air and 0.6% by rail. By weight, sea accounted for 79.71% and air for 0.93%.

Which transport mode has the lowest emissions?

On EU averages, sea freight has the lowest emissions per tonne-km, followed by rail and inland waterways. Road is several times higher than these, and air is several times higher than road. Actual values depend on the vehicle, load factor, fuel and distance.

What is sea-air freight?

A combination in which the cargo travels by sea to a transshipment hub and then by air to its destination. The aim is a lower cost than all-air and a shorter transit than all-sea; the cargo is handled again at the hub.

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