CIRCLE2
VET and SMEs on the road to CE

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# How to use the “Freight Calculator”

The Freight Calculator is an interactive tool designed for students which can be used individually or in groups. It allows students to learn more about freight transportation's economic and environmental impact. Students are invited to research freight transport using the tool, including product choice, route, transport used, and related environmental costs.

Once the data has been selected and entered, the calculator returns the economic and environmental values of the individual routes and the total. It also allows you to extrapolate the data for later use. In economic terms, the calculator estimates the total price of the freight. For more details, see below.

The “Freight Calculator” encourages students to develop critical thinking. By analyzing data, students can reflect on the complex mechanisms behind the seemingly simple act of having a product on store shelves. This fosters a deeper understanding of global supply chains and the hidden costs associated with everyday items in both environmental and economic terms.

Access options:

- Use the tool directly on the website (online).
- Download a ZIP file in HTML format for offline use.
- Download a ZIP file in Excel format for offline use.

Step 1: **Choose your product**

The tool suggests starting with a familiar item, like a food product (e.g., bananas). This makes the initial exploration more relatable for students.

How to prepare bananas for the world - an Ecuadorian story

Step 2: **Define the shipment weight**

Step 3: **Define the shipping route**

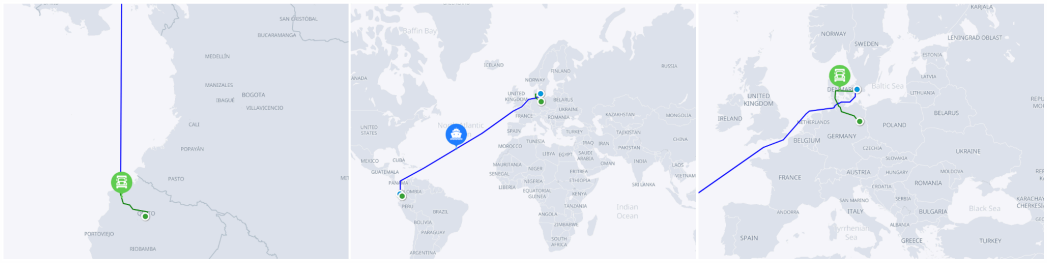
For example, you could choose Quito (Ecuador) to Berlin (Germany).

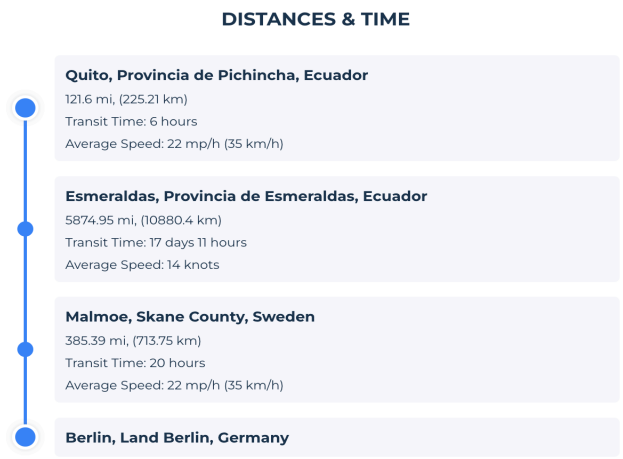
Step 4: **Select the mode of transport (or combination)**

The Freight Calculator allows you to consider different options like trucks, cargo ships, airplanes, or trains. Depending on your chosen route, you might need to combine multiple modes of transport.

For reference on distances and potential transport options, you can visit Cargo Calculator. For example, it might suggest a combination of truck, cargo ship, and truck again to transport bananas from Quito to

Berlin. You will need to factor in the total distances for each leg of the journey (truck + ship + truck) to calculate the complete distance.






Step 5: **Research and input transport emissions**

Emissions data can vary based on specific transport types and specific vehicle features. Consult online resources to find estimated emission values and manually enter them into the Freight Calculator. Nevertheless, the tool suggests values based on an average taken from different resources among those suggested.

We suggest:

- CO2 emissions from trucks in the EU: An analysis of the heavy-duty CO2 standards baseline data - International Council on Clean Transportation (theicct.org)
- Emissions from train travel (carbonindependent.org)
- https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/innovfund/other/ghg-calculator-ccs_innovfund-lsc_v2.0_en.xlsx
- Transport Emission Factors | Climatiq

## Scenario 1:

| Bananas |
|---|

| Origin | Destination |
|---|---|
| Quito (Ecuador) | Berlin (Germany) |

| Weight |
|---|
| **1.5 tonne** |

| Start | Stop | Vehicle type | Distance |
|---|---|---|---|
| Quito (Ecuador) | Esmeraldas (Ecuador) | Truck | 225.21 Km |
| Esmeraldas (Ecuador) | Malmoe (Sweden) | Ship | 10880.4 Km |
| Malmoe (Sweden) | Berlin (Germany) | Truck | 713.75 Km |

| Vehicle | CO2e / tonne.km |
|---|---|
| Truck | 0.108 Kg |
| Train | 0.065 Kg |
| Airplane | 0.1116 Kg |
| Ship | 0.03 Kg |

## Scenario 2:

| Microchips |
|---|

| Origin | Destination |
|---|---|
| Beijing (China) | Berlin (Germany) |

| Weight |
|---|
| **1.5 tonne** |

| Start | Stop | Vehicle type | Distance |
|---|---|---|---|
| Beijing (China) | Beijing Airport (China) | Truck | 28.8 Km |
| Bijing Airport (China) | Frankfurt (Germany) | Airplane | 7780.85 Km |
| Frankfurt (Germany) | Berlin Station (Germany) | Train | 454 Km |
| Berlin Station (Germany) | Berlin Centre (Germany) | Truck | 3.6 km |

| Vehicle | CO2e / tonne.km |
|---|---|
| Truck | 0.246 Kg |
| Train | 0.065 Kg |
| Airplane | 0.1116 Kg |
| Ship | 0.03 Kg |

*Because every vehicle is different, the emission factors vary between circumstances. In the first scenario, the truck emission factor is based on an average of vehicles; in the other, the truck emission factor is based on data from a specifically selected truck.*

# Going one step further

## 1. Calculation economic value

Here, in-depth the used formula:

[(oneUnitFuelPrice/distanceOneFuelUnit)/(totalTeu*oneTeuTonnes)*distance*weight]/(percentage/100)

This formula calculates the estimated total transportation cost for a shipment.

It factors in the fuel cost based on fuel price, fuel efficiency, distance travelled, and the total cargo weight (both from the twenty-foot equivalent units (TEU)[1] and the specific cargo weight).

However, the true total cost for a freight company involves additional expenses that can vary depending on the specific shipment. These expenses might include:

- Labor costs: salaries and benefits for drivers, loaders, and other personnel involved in transportation.
- Vehicle maintenance and repairs: keeping the vehicles in good running condition.
- Administrative costs: insurance, permits, and other operational expenses.

To account for these variable costs, the formula uses a percentage representing the estimated fuel cost portion of the final price. This allows us to calculate a hypothetical final price considering fuel costs and a buffer for the additional expenses. While it is not the exact final cost, it gives us an idea of the potential profit margin based on the chosen percentage.

[1] "The TEU represents the global standard for measuring container ships and cargo and is pivotal in harmonizing shipping practices worldwide." - Sino Ships. A single Twenty-foot Equivalent Unit (TEU) has dimensions of 2.39 by 2.35 by 5.9 meters. It has the capacity to transport a maximum of 21.6 tonnes. When not loaded, the average weight of a TEU is approximately 2.3 tonnes.

## 2. Modifying the code

The script.js file within the tool allows for customization. Students can analyze the environmental and economic impact of specific vehicles by modifying the formulas to include their chosen vehicle's values instead of averages.

```
if (transport === 'truck') {
  //costPerKg = parseFloat(document.getElementById('truck-cost').value) || 0;
  emisPerKg = parseFloat(document.getElementById('co2-truck').value) || 0;
  const percentage = 10;                // Fuel cost of total cost in percentage
  const totalTeu = 1;                   // Maximum payload expressed in TEU
  const oneTeuTonnes = 21.4;            // Capability of 1 TEU expressed in tonnes (in case of 1 TEU provide the max payload expressed in tonnes)
  const distanceOneFuelUnit = 2;        // Kilometers with 1 unit of fuel (truck: 1 liter)
  const oneUnitFuelPrice = 1.29;        // Price of 1 unit of fuel (truck: 1 liter)
  calculatedCostPerVehicle = (((oneUnitFuelPrice/distanceOneFuelUnit)/(totalTeu*oneTeuTonnes)*distance)*weight)/(percentage/100)
} else if (transport === 'train') {
  //costPerKg = parseFloat(document.getElementById('train-cost').value) || 0;
  emisPerKg = parseFloat(document.getElementById('co2-train').value) || 0;
  const percentage = 5;                 // Fuel cost of total cost in percentage
  const totalTeu = 63;                  // Maximum payload expressed in TEU
  const oneTeuTonnes = 21.4;            // Capability of 1 TEU expressed in tonnes (in case of 1 TEU provide the max payload expressed in tonnes)
  const distanceOneFuelUnit = 0.25;     // Kilometers with 1 unit of fuel (train: 1 liter)
  const oneUnitFuelPrice = 1.29;        // Price of 1 unit of fuel (train: 1 liter)
  calculatedCostPerVehicle = (((oneUnitFuelPrice/distanceOneFuelUnit)/(totalTeu*oneTeuTonnes)*distance)*weight)/(percentage/100)
} else if (transport === 'plane') {
  //costPerKg = parseFloat(document.getElementById('plane-cost').value) || 0;
  emisPerKg = parseFloat(document.getElementById('co2-plane').value) || 0;
  const percentage = 25;                // Fuel cost of total cost in percentage
  const totalTeu = 1;                   // Maximum payload expressed in TEU
  const oneTeuTonnes = 115;             // Capability of 1 TEU expressed in tonnes (in case of 1 TEU provide the max payload expressed in tonnes)
  const distanceOneFuelUnit = 0.0833;   // Kilometers with 1 unit of fuel (plane: 1 liter)
  const oneUnitFuelPrice = 1.29;        // Price of 1 unit of fuel (plane: 1 liter)
  calculatedCostPerVehicle = (((oneUnitFuelPrice/distanceOneFuelUnit)/(totalTeu*oneTeuTonnes)*distance)*weight)/(percentage/100)
} else if (transport === 'ship') {
  //costPerKg = parseFloat(document.getElementById('ship-cost').value) || 0;
  emisPerKg = parseFloat(document.getElementById('co2-ship').value) || 0;
  const percentage = 5;                 // Fuel cost of total cost in percentage
  const totalTeu = 4000;                // Maximum payload expressed in TEU
  const oneTeuTonnes = 21.4;            // Capability of 1 TEU expressed in tonnes (in case of 1 TEU provide the max payload expressed in tonnes)
  const distanceOneFuelUnit = 5;        // Kilometers with 1 unit of fuel (ship: 1 tonne)
  const oneUnitFuelPrice = 560;         // Price of 1 unit of fuel (ship: 1 tonne)
  calculatedCostPerVehicle = (((oneUnitFuelPrice/distanceOneFuelUnit)/(totalTeu*oneTeuTonnes)*distance)*weight)/(percentage/100)
```