4

# Category 4: Upstream Transportation and Distribution

## Category description

Category 4 includes emissions from:

- Transportation and distribution of products purchased in the reporting year, between a company's tier 1 suppliers[3] and its own operations in vehicles not owned or operated by the reporting company (including multi-modal shipping where multiple carriers are involved in the delivery of a product, but excluding fuel and energy products)
- Third-party transportation and distribution services purchased by the reporting company in the reporting year (either directly or through an intermediary), including inbound logistics, outbound logistics (e.g., of sold products), and third-party transportation and distribution between a company's own facilities.

Emissions may arise from the following transportation and distribution activities throughout the value chain:

- Air transport
- Rail transport
- Road transport
- Marine transport
- Storage of purchased products in warehouses, distribution centers, and retail facilities.

Outbound logistics services purchased by the reporting company are categorized as upstream because they are a purchased service. Emissions from transportation and distribution of purchased products upstream of the reporting company's tier 1 suppliers (e.g., transportation between a company's tier 2 and tier 1 suppliers) are accounted for in scope 3, category 1 (Purchased goods and services). Table 4.1 shows the scope and category of emissions where each type of transportation and distribution activity should be accounted for.

3 Tier 1 suppliers are companies with which the reporting company has a purchase order for goods or services (e.g., materials, parts, components, etc.). Tier 2 suppliers are companies with which tier 1 suppliers have a purchase order for goods and services (see figure 7.3 in the Scope 3 Standard).

A reporting company's scope 3 emissions from upstream transportation and distribution include the scope 1 and scope 2 emissions of third-party transportation companies (allocated to the reporting company).

**Table [4.1] Accounting for emissions from transportation and distribution activities in the value chain**

| *Transportation and distribution activity in the value chain* | *Scope and category of emissions* |
|---|---|
| Transportation and distribution in vehicles and facilities owned or controlled by the reporting company | Scope 1 (for fuel use) or scope 2 (for electricity use) |
| Transportation and distribution in vehicles and facilities leased by and operated by the reporting company (and not already included in scope 1 or scope 2) | Scope 3, category 8 (Upstream leased assets) |
| Transportation and distribution of purchased products, upstream of the reporting company's tier 1 suppliers (e.g., transportation between a company's tier 2 and tier 1 suppliers) | Scope 3, category 1 (Purchased goods and services), since emissions from transportation are already included in the cradle-to-gate emissions of purchased products. These emissions are not required to be reported separately from category 1. |
| Production of vehicles (e.g., ships, trucks, planes) purchased or acquired by the reporting company | Account for the upstream (i.e., cradle-to-gate) emissions associated with manufacturing vehicles in Scope 3, category 2 (Capital goods) |
| Transportation of fuels and energy consumed by the reporting company | Scope 3, category 3 (Fuel- and energy-related emissions not included in scope 1 or scope 2) |
| Transportation and distribution of products purchased by the reporting company, between a company's tier 1 suppliers and its own operations (in vehicles and facilities not owned or controlled by the reporting company) | Scope 3, category 4 (Upstream transportation and distribution) |
| Transportation and distribution services purchased by the reporting company in the reporting year (either directly or through an intermediary), including inbound logistics, outbound logistics (e.g., of sold products), and transportation and distribution between a company's own facilities (in vehicles and facilities not owned or controlled by the reporting company) | Scope 3, category 4, (Upstream transportation and distribution) |
| Transportation and distribution of products sold by the reporting company between the reporting company's operations and the end consumer (if not paid for by the reporting company), including retail and storage (in vehicles and facilities not owned or controlled by the reporting company) | Scope 3, category 9 (Downstream transportation and distribution) |

Source: Table 5.7 from the *Scope 3 Standard.*

This section provides calculation guidance first from transportation and then from distribution (e.g., warehouses, distribution centers).

## *Calculating emissions from transportation*

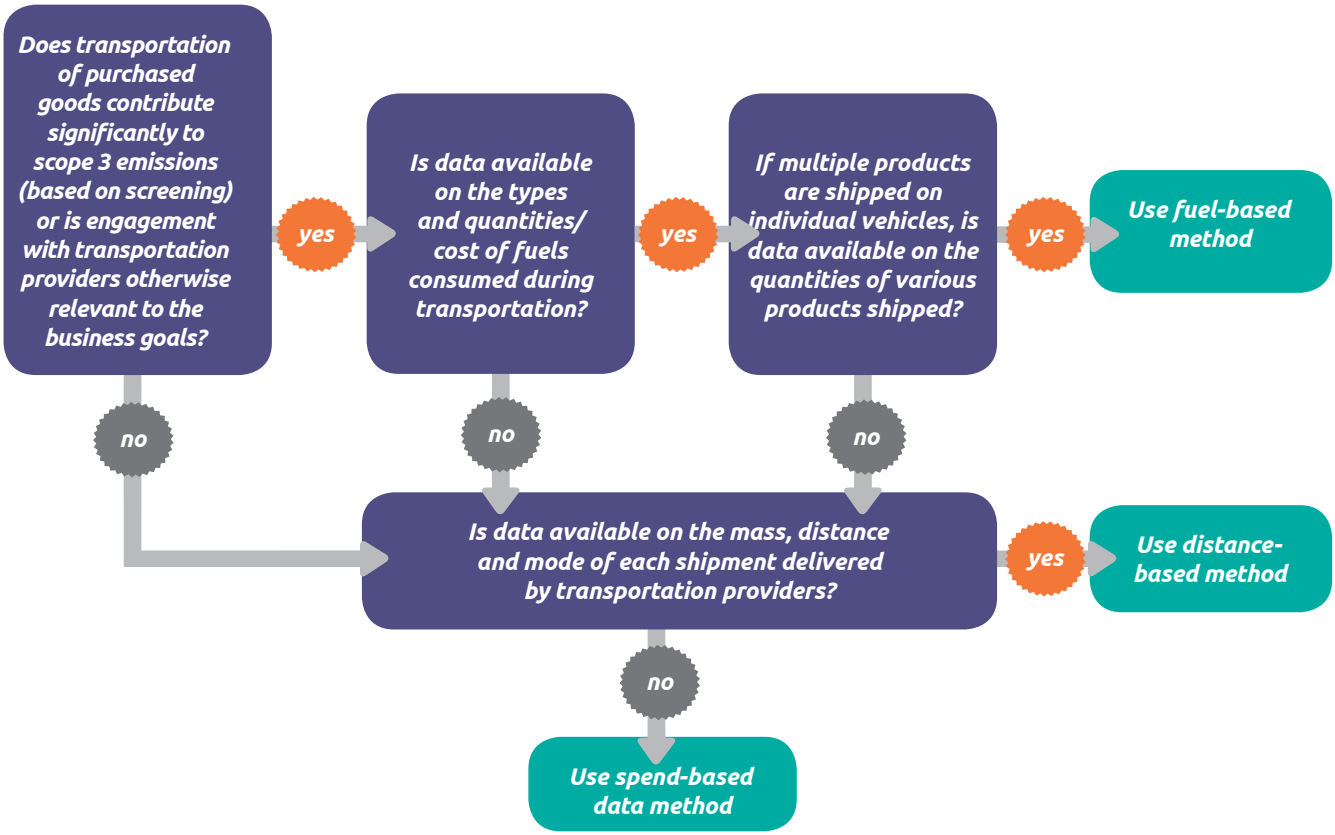
Companies may use the following methods to calculate scope 3 emissions from transportation:

- **Fuel-based method**, which involves determining the amount of fuel consumed (i.e., scope 1 and scope 2 emissions of transport providers) and applying the appropriate emission factor for that fuel
- **Distance-based method,** which involves determining the mass, distance, and mode of each shipment, then applying the appropriate mass-distance emission factor for the vehicle used
- **Spend-based method,** which involves determining the amount of money spent on each mode of business travel transport and applying secondary (EEIO) emission factors.

The GHG Protocol has a calculation tool for transportation that uses a combination of the fuel-based and distance-based methods. This combination is used because $CO_2$ is better estimated from fuel use, and $CH_4$ and $N_2O$ are better estimated from distance travelled. The tool uses fuel-efficiency ratios to convert either type of activity data (fuel or distance) supplied by the user into either fuel or distance depending on the GHG being calculated. The calculation tool ("GHG emissions from transport or mobile sources") is available at the GHG Protocol website: http://www.ghgprotocol.org/calculation-tools/all-tools).

It is important to note that the calculation tool was originally developed to calculate an organization's scope 1 emissions (i.e., emissions from vehicles that the organization owns and operates). Therefore, the emission factors that pre-populate the calculation tool are combustion emission factors. When calculating emissions from transportation in scope 3, companies should use life cycle emission factors (see "Energy emission factors in scope 3 accounting" in the Introduction for more information on which emission factors to use). If using the GHG Protocol transport calculation tool to calculate scope 3 emissions, companies should customize the tool by entering life cycle emission factors.

**Figure [4.1] Decision tree for selecting a calculation method for emissions from upstream transportation**



### *Fuel-based method (transportation)*

The fuel-based method should be used when companies can obtain data for fuel use from transport providers (and, if applicable, refrigerant leakage due to refrigeration of products) from vehicle fleets (e.g., trucks, trains, planes, vessels). Companies should also take into account any additional energy used and account for fugitive emissions (e.g., refrigerant loss or air-conditioning). Companies may optionally calculate any emissions from unladen backhaul (i.e., the return journey of the empty vehicle).

Where fuel use data is unavailable, the company may derive fuel use by using the:

- Amount spent on fuels and the average price of fuels
- Distance travelled and the vehicle's fuel efficiency
- Amount spent on transportation services, fuel cost share (as percent of total cost of transportation services) and the average price of fuels.

For calculating $CO_2$, the fuel-based method is more accurate than the distance-based method because fuel consumption is directly related to emissions.

The fuel-based method is best applied if the vehicle exclusively ships the reporting company's purchased goods (i.e., exclusive use or truckload shipping, rather than less-than-truckload (LTL) shipping). Otherwise, emissions should be allocated between goods shipped for the reporting company and goods shipped for other companies. See chapter 8 of the *Scope 3 Standard* for further guidance on allocating emissions.

Companies should allocate emissions based on the following default limiting factors for each transportation mode, unless more accurate data is available to show that another factor is the limiting factor:

- **Road transport:** Truck capacity is typically limited by mass, so mass-based allocation should be used
- **Marine transport**: Vessel capacity is typically limited by volume, so volume-based allocation should be used
- **Air transport**: Aircraft capacity is typically limited by mass, so mass-based allocation should be used
- **Rail transport**: Rail capacity is typically limited by mass, so mass-based allocation should be used.

If there are multiple shipments on a transport leg, distance should also be used as a means for allocation. (For more information, see the Deutsche Post DHL example in this section.)

If data required for allocation is not available or reliable due to the variety of goods transported in one vehicle at the same time, the distance-based method should be used to calculate scope 3 emissions.

### *Activity data needed*

Companies should collect data on:

- Quantities of fuel (e.g., diesel, gasoline, jet fuel, biofuels) consumed
- Amount spent on fuels
- Quantities of fugitive emissions (e.g., from air conditioning and refrigeration).

If applicable:

- Distance travelled
- Average fuel efficiency of the vehicle, expressed in units of liters of fuel consumed per tonne per kilometer transported
- Cost of fuels
- Volume and/or mass of purchased goods in the vehicle
- Information on whether the products are refrigerated in transport.

### *Emission factors needed*

Companies should collect:

- Fuel emission factors, expressed in units of emissions per unit of energy consumed (e.g., kg $CO_2e$/liters, $CO_2e$/Btu)
- For electric vehicles (if applicable), electricity emission factors, expressed in units of emissions per unit of electricity consumed (e.g., kg $CO_2e$/kWh)
- Fugitive emission factors, expressed in units of emissions per unit (e.g., kg $CO_2e$/kg refrigerant leakage)

Emission factors should at a minimum include emissions from fuel combustion, and should, where possible, include cradle-to-gate emissions of the fuel (i.e., from extraction, processing, and transportation to the point of use).

Note: For air travel emission factors, multipliers or other corrections to account for radiative forcing may be applied to the GWP of emissions arising from aircraft transport. If applied, companies should disclose the specific factor used.

### *Data collection guidance*

Data sources for activity data include:

- Aggregated fuel receipts
- Purchase records (provided by transportation providers)
- Internal transport management systems.

Data sources for emission factors include:

- Transportation carriers
- Government agencies (e.g., Defra provides emission factors for the United Kingdom)
- The GHG Protocol website (http://www.ghgprotocol.org/calculation-tools/all-tools and http://www.ghgprotocol.org/standards/scope-3-standard)
- Industry associations
- Additional sources in table 4.2.

Transportation emissions are calculated by multiplying each fuel/refrigerant type used by a corresponding emission factor and summing the results as shown in the formula below:

### Calculation formula [4.1] Fuel-based method (transportation)

***$CO_2e$ emissions from transportation =***

**sum across fuel types:**

∑ (quantity of fuel consumed (liters) × emission factor for the fuel (e.g., kg $CO_2e$/liter))

+

**sum across grid regions:**

∑ (quantity of electricity consumed (kWh) × emission factor for electricity grid (e.g., kg $CO_2e$/kWh))

+

**sum across refrigerant and air-conditioning types:**

∑ (quantity of refrigerant leakage × global warming potential for the refrigerant (e.g., kg $CO_2e$))

If fuel consumption data is unavailable, companies may use formula 4.2 and/or formula 4.3 to calculate quantities of fuel consumed.

### Calculation formula [4.2] Calculating fuel use from fuel spend

***Quantities of fuel consumed (liters) =***

**sum across fuel types:**

$$\sum \left( \frac{\text{total fuel spend (e.g., \$)}}{\text{average fuel price (e.g., \$/liter)}} \right)$$

Companies should first apportion annual amount spent on fuel to each relevant fuel type. Where the mix of fuels is unknown, companies may refer to average fuel mix statistics from industry bodies and/or government statistical publications.

### Calculation formula [4.3] Calculating fuel use from distance travelled

***Quantities of fuel consumed (liters) =***

**sum across transport steps:**

∑ (total distance travelled (e.g., km) × fuel efficiency of vehicle (e.g., liters/km))

If allocation is needed, companies should calculate the allocated fuel use (for the goods shipped by the reporting company) using the formula below, then apply formula 4.1 above.

### Calculation formula [4.4] Allocating fuel use

***Allocated fuel use =***

$$= \text{total fuel consumed (liters)} \times \left( \frac{\text{mass/volume of company's goods}}{\text{mass/volume of goods transported}} \right)$$

Companies may optionally substitute mass of goods by volume with dimensional mass or chargeable mass where data is available to prove that the alternative method is more suitable.

Dimensional mass is a calculated mass that takes into account packaging volume as well as the actual mass of the goods.

Chargeable mass is the higher value of either the actual or the dimensional mass of the goods.

Companies may optionally calculate emissions from unladen backhaul (i.e., the return journey of the empty vehicle) using the following formula:

### Calculation formula [4.5] Calculating emissions from unladen backhaul

***$CO_2e$ emissions from unladen backhaul =***

**for each fuel type:**

∑ (quantity of fuel consumed from backhaul × emission factor for the fuel (e.g., kg $CO_2e$/liter))

**where:**

quantity of fuel consumed from backhaul
= average efficiency of vehicles unladed (l/km) × total distance travelled unladen.

### Example [4.1] Calculating emissions from upstream transportation using the fuel-based method

Company A makes bread in Italy. Suppliers B, C, and D supply refrigerated raw materials for Company A's operations. Company A collects activity data from its suppliers on the amount of fuel used and refrigerant leakage incurred by the transport of raw materials to Company A's facility. All trucks transport goods exclusively for Company A. Company A collects emission factors for the fuel type used by suppliers and for refrigerant leakage.

The situation is summarized in the table below:

| *Supplier* | *Fuel consumed (liters) or refrigerant leakage (kg)* | *Fuel/refrigerant type* | *Emission factor (kg CO2e/ liter for fuels; Global warming potential for refrigerants)* |
|---|---|---|---|
| B | 50,000 | Diesel | 3 |
| C | 80,000 | Diesel | 3 |
| D | 90,000 | Diesel | 3 |
| D | 50 | Refrigerant R410a | 2,000 |

Note: The activity data and emissions factors are illustrative only, and do not represent actual data.

**emissions from diesel is calculated as:**

∑ (quantity of fuel consumed (liters) × emission factor for the fuel (kg $CO_2e$/liter))

= (50,000 × 3) + (80,000 × 3) + (90,000 × 3) = 660,000 kg CO2e

**emissions from refrigerant leakage is calculated as:**

∑ (quantity of refrigerant leakage (kg) × emission factor for refrigerant (kg $CO_2e$/kg))

= 50 × 2,000 = 100,000 kg $CO_2e$

**total emissions is calculated as follows:**

emissions from fuels + emissions from refrigerant leakage

= 660,000 + 100,000 = 760,000 kg $CO_2e$

### *Distance-based method (transportation)*

In this method, distance is multiplied by mass or volume of goods transported and relevant emission factors that incorporate average fuel consumption, average utilization, average size and mass or volume of the goods and the vehicles, and their associated GHG emissions.

Emission factors for this method are typically represented in grams or kilograms of carbon dioxide equivalent per tonne-kilometer or TEU-kilometer. Tonne-kilometer is a unit of measure representing one tonne of goods transported over 1 kilometer. TEU-kilometer is a unit of measure representing one twenty-foot container equivalent of goods transported over 1 kilometer.

The distance-based method is especially useful for an organization that does not have access to fuel or mileage records from the transport vehicles, or has shipments smaller than those that would consume an entire vehicle or vessel.

If sub-contractor fuel data cannot be easily obtained in order to use the fuel-based method, then the distance-based method should be used. Distance can be tracked using internal management systems or, if these are unavailable, online maps. However, accuracy is generally lower than the fuel-based method as assumptions are made about the average fuel consumption, mass or volume of goods, and loading of vehicles.

### *Activity data needed*

Companies should collect data on the distance travelled by transportation suppliers. This data may be obtained by:

- Mass or volume of the products sold
- Actual distances provided by transportation supplier (if actual distance is unavailable, companies may use the shortest theoretical distance)
- Online maps or calculators
- Published port-to-port travel distances.

The actual distances should be used when available, and each leg of the transportation supply chain should be collected separately.

### *Emission factors needed*

Companies should collect:

- Emission factor by mode of transport (e.g., rail, air, road) or vehicle types (e.g., articulated lorry, container vessel), expressed in units of greenhouse gas ($CO_2$, $CH_4$, $N_2O$, or $CO_2e$) per unit of mass (e.g., tonne) or volume (e.g., TEU) travelled (e.g., kilometer).

Common forms of emission factors are kg $CO_2e$/tonne/km for road transport or kg $CO_2e$/TEU/km for sea transport.

Note: For air travel emission factors, multipliers or other corrections to account for radiative forcing may be applied to the GWP of emissions arising from aircraft transport. If applied, companies should disclose the specific factor used.

### *Data collection guidance*

Companies may obtain activity data from:

- Purchase orders
- Specific carrier or mode operator
- Internal management systems
- Industry associations
- Online maps and calculators.

Companies may obtain emission factors from:

- Transportation carriers
- Government agencies (e.g., Defra provides emission factors for the United Kingdom)
- The GHG Protocol website (http://www.ghgprotocol.org/calculation-tools/all-tools and http://www.ghgprotocol.org/standards/scope-3-standard)
- Industry associations
- Additional sources in table 4.2.

When collecting emission factors, it is important to note that they may be vehicle, regional, or country specific.

Calculation resources include:

- GHG Protocol Calculation Tool, "Mobile Combustion GHG Emissions Calculation Tool. Version 2.0. June 2009," developed by World Resources Institute, available at http://www.ghgprotocol.org/calculation-tools/all-tools.
- U.S. EPA Climate Leaders GHG Inventory Protocol, "Optional Emissions from Commuting, Business Travel and Product Transport," available at: http://www.epa.gov/stateply/documents/resources/commute_travel_product.pdf
- UK Defra, "Guidance on Measuring and Reporting GHG Emissions from Freight Transport Operations," available at http://www.defra.gov.uk/environment/economy/business-efficiency/reporting/
- UK Defra GHG Conversion Factors, developed by the United Kingdom Department of Environment, Food and Rural Affairs (Defra), available at http://www.defra.gov.uk/environment/economy/business-efficiency/reporting/

**Table [4.2] Data collection guidance for the distance-based method**

| Mode | Vehicle | Unit | Primary data sources | Secondary data sources | Comments | Assumptions |
|---|---|---|---|---|---|---|
| **air** | Freighter short-haul | kg $CO_2$e/t-km | Carrier | ICAO<br>UK Defra<br>Environmental reports of air carriers<br>LCA databases<br>EEIO databases | Carrier can provide<br>a) shipment specific emissions<br>b) trade-line emissions based on existing network design and historical plane consumption<br>c) emissions per type of plane | |
| | Freighter long- haul | kg $CO_2$e/t-km | | | | |
| | Belly-freight short-haul | kg $CO_2$e/t-km | | | | |
| | Belly-freight long-haul | kg $CO_2$e/t-km | | | | |
| | Passenger plane short-haul | kg $CO_2$e/t-km | | | | |
| | Passenger plane long-haul | kg $CO_2$e/t-km | | | | |
| **Ship** | Container vessel <2000 TEU | kg $CO_2$e/TEU-km | Carrier | IMO<br>CCWG<br>LCA databases<br>EEIO databases | Carrier can provide<br>a) shipment specific emissions<br>b) trade-line emissions based on existing network design and historical vessel consumption<br>c) emissions per type of vessel | Default 1 TEU = 10 t |
| | Container vessel 2000-5000 TEU | kg $CO_2$e/TEU-km | | | | |
| | Container vessel 5000-8000 TEU | kg $CO_2$e/TEU-km | | | | |
| | Container vessel >8000TEU | kg $CO_2$e/TEU-km | | | | |
| | Bulk vessel <20000 dwt | kg $CO_2$e/t-km | | | | |
| | Bulk vessel >20000 dwt | kg $CO_2$e/t-km | | | | |

**Table [4.2] Data collection guidance for the distance-based method (continued)**

| Mode | Vehicle | Unit | Primary data sources | Secondary data sources | Comments | Assumptions |
|---|---|---|---|---|---|---|
| **Rail** | Electric | kg $CO_2$e/t-km | Operator | EcoTransIT<br>LCA databases<br>EEIO databases | Operator can provide shipment specific emissions on trade-line historical emissions | |
| | Diesel | kg $CO_2$e/t-km | | | | |
| **Truck** | Van <3.5t | kg $CO_2$e/t-km | Operator | EcoTransIT<br>NTM<br>TREMOVE (EU)<br>EPA Smart Way (US)<br>Handbook Emission Factors for Road Transport (HBEFA)<br>LCA databases<br>EEIO databases | Trucker can provide<br>a) shipment specific emissions<br>b) trade-line emissions based on existing network design and historical fleet consumption<br>c) emissions per type of truck | Default 1 TEU = 10 t |
| | Truck 3.5-7.5t | kg $CO_2$e/t-km | | | | |
| | Truck 7.5t-16t | kg $CO_2$e/t-km | | | | |
| | Truck 16t-32t single axle | kg $CO_2$e/t-km<br>kg $CO_2$e/TEU-km | | | | |
| | Truck >32t tractor and trailer or flatbed | kg $CO_2$e/t-km<br>kg $CO_2$e/TEU-km | | | | |
| **Warehouse** | Dry warehouse | kg $CO_2$e/pallet-day<br>kg $CO_2$e/TEU-day<br>kg $CO_2$e/cbm-day<br>kg $CO_2$e/kg-day | Operator | LCA databases<br>EEIO databases | Operator may also have the emission factor based on the warehouse surface | 1 pallet = 1 square meter of floor space |
| | Refrigerated warehouse | kg $CO_2$e/pallet-day<br>kg $CO_2$e/TEU-day<br>kg $CO_2$e/cbm-day<br>kg $CO_2$e/kg-day | | | | |
| **Terminal** | Terminal | kg $CO_2$ e/t<br>kg $CO_2$e/TEU | Terminal owner | LCA databases<br>EEIO databases | | 1 TEU = 10 t |

Source: Carbon Trust

Notes:

ICAO = International Civil Aviation Organization

IMO = International Maritime Organization

CCWG = Clean Cargo Working Group

TEU = twenty-foot equivalent units, a measure of the size of shipping containers. One standard-size container is 1 TEU.

To calculate emissions, companies should multiply the quantity of goods purchased in mass (including packaging and pallets) or volume by the distance travelled in the transport leg and then multiply that by an emission factor specific to the transport leg (usually a transport mode- or vehicle type- specific emission factor).

Because each transport mode or vehicle type has a different emission factor, the transport legs should be calculated separately and total emissions aggregated.

The following formula can be applied to all modes of transport and/or vehicle types to calculate emissions from transportation:

**Calculation formula [4.6] Distance-based method (transportation)**

***$CO_2e$ emissions from transportation =***

**sum across transport modes and/or vehicle types:**

= ∑ (mass of goods purchased (tonnes or volume ) × distance travelled in transport leg (km)
× emission factor of transport mode or vehicle type (kg $CO_2e$/tonne or volume/km))

### Example [4.2] Calculating emissions from upstream transportation using the distance-based method

Company A makes chairs and sources basic materials from Suppliers B, C, and D. Company A calculates total distance from the transport of the basic goods and obtains information from suppliers on vehicle type used for transport. Company A obtains relevant emission factors from lifecycle databases. The information is summarized below:

| *Supplier* | *Mass of transported goods (tonnes)* | *Distance transported (km)* | *Transport mode or vehicle type* | *Emission factor (kg $CO_2e$/TEU-km)* |
|---|---|---|---|---|
| B | 2 | 2,000 | Truck (rigid, >3.5-7.5t) | 0.2 |
| C | 1 | 3,000 | Air (long haul) | 1.0 |
| D | 6 | 4,000 | Container 2,000–2,999 TEU | 0.05 |

Note: the activity data and emission factors in this example are for illustrative purposes only.

**Emissions from road transport:**

= ∑ (mass of goods purchased (tonnes) × distance travelled in transport leg × emission factor of transport mode or vehicle type (kg $CO_2e$/tonne-km))

= 2 × 2,000 × 0.2

= 800 kg $CO_2e$

**emissions from air transport:**

= ∑ (quantity of goods purchased (tonnes) x distance travelled in transport leg x emission factor of transport mode or vehicle type (kg $CO_2e$/tonne-km))

= 1 × 3,000 × 1

= 3,000 kg $CO_2e$

**emissions from sea transport:**

= ∑ (quantity of goods purchased (tonnes) x distance travelled in transport leg x emission factor of transport mode or vehicle type (kg $CO_2e$/tonne-km))

= 6 × 4,000 × 0.05

= 1,200 kg $CO_2e$

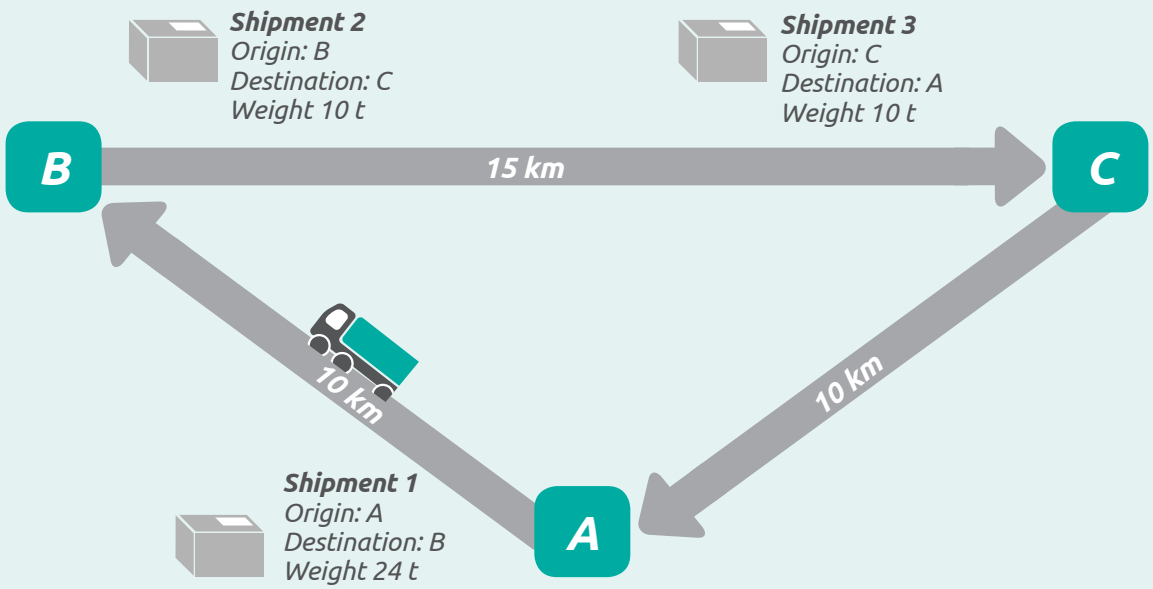
**total emissions form transport (upstream) is calculated as:**

= emissions from road transport + emissions from air transport + emissions from sea transport

= 800 + 3,000 + 1,200

= 5,000 kg $CO_2e$

## Example [4.3] Allocating emissions from transportation (Deutsche Post DHL)




Deutsche Post DHL, a global mail and logistics company, set a $CO_2$ efficiency target. The choice of appropriate allocation factors is a critical decision point to ensure fair allocation of emissions. The following example demonstrates a typical situation, in which different allocation factors may lead to completely different results.

This example is about a typical delivery run where a truck needs to stop at different locations to pick up or drop off shipments. In this example, 24-tonne shipment 1 needs to be transported from a home station (A) to a customer (B). At customer (B), shipment 1 is unloaded and shipments 2 and 3 are picked up. Shipment 2 is addressed to customer (C) and shipment 3 needs to be transported back to the home station (A).

Data were not available on the type and quantity of fuel consumed during transportation, but data on the mass, distance, and mode of shipment was available. Therefore the distance-based method was used. It was calculated that 31.5 kg $CO_2$ was emitted during this delivery run. How can we allocate these emissions to the shipments?

**I. Allocation using driven-tonne kilometers**

One option for allocation is to use driven-tonne kilometers (tkm) as an allocation factor. For calculating the tonne-kilometers, the weight of each shipment is multiplied by the distance driven. Then the total amount of $CO_2$ emissions is allocated to the shipments on the basis of their share in the driven tonne- kilometers.

| | Shipment 1 | Shipment 2 | Shipment 3 | Total |
|---|---|---|---|---|
| Driven tkm | 240 tkm | 150 tkm | 250 tkm | 640 tkm |
| Total emissions | | | | 31.5 kg $CO_2$ |
| Allocation factor | | | | 0.049 kg $CO_2$ per tkm |
| Shipment emissions | 11.8 kg $CO_2$ | 7.4 kg $CO_2$ | 12.3 kg $CO_2$ | 31.5 kg $CO_2$ |

### Example [4.3] Allocating emissions from transportation (Deutsche Post DHL) (continued)

Surprisingly, shipment 2, which causes the longest transportation leg (15 km), receives minimum emissions and shipment 3 is "punished" for being transported jointly with shipment 2 via customer (C). The next option shows how such downsides can be mitigated.

**II. Allocation using shortest theoretical distance**

The second option aims at allocating $CO_2$ emissions using the shortest theoretical distance between the origin and destination of each shipment (also known as the Great Circle Distance) as an allocation factor. The shipments' $CO_2$ allocation is independent from the actual driven distance because that is of no relevance to the customer. As in the example above, tonne-kilometers are calculated – this time using the shortest theoretical distance between a shipment's origin and destination – before performing the allocation.

| | *Shipment 1* | *Shipment 2* | *Shipment 3* | *Total* |
|---|---|---|---|---|
| Tkm based on GCD | 240 tkm | 150 tkm | 100 tkm | 490 tkm |
| Total emissions | | | | 31.5 kg $CO_2$ |
| Allocation factor | | | | 0.064 kg $CO_2$ per tkm |
| Shipment emissions | 15.43 kg $CO_2$ | 9.64 kg $CO_2$ | 6.43 kg $CO_2$ | 31.5 kg $CO_2$ |

Because the allocation of emissions for individual items is based only on the characteristics of the individual shipments, this option provides a fair allocation method.

Although there are many more options to perform the allocation to shipments in freight transport, this example illustrates pitfalls a user can encounter by picking an allocation factor.

### *Spend-based method*

If the fuel-based method and distance method cannot be applied (e.g., due to data limitations), companies should apply the spend-based method to calculate the emissions from transportation. In this method, the amount spent on transportation by type is multiplied by the relevant EEIO emission factors. Refer to "Environmentally-extended input output (EEIO) data" in the Introduction for guidance on EEIO data. Companies may determine the amount spent on transportation through bills, invoice payments, or financial accounting systems. The spend-based method is effective for screening purposes; however it has high levels of uncertainty and the fuel-based and distance-based methods are recommended for accounting for transportation emissions.

### *Activity data needed*

- Amount spent on transportation by type (e.g. road, rail, air, barge), using market values (e.g., dollars).

### *Emission factors needed*

- Cradle-to-gate emission factors of the transportation type per unit of economic value (e.g., kg $CO_2e$/$)
- Where applicable, inflation data to convert market values between the year of the EEIO emissions factors and the year of the activity data.

### *Data collection guidance*

Data sources for activity data include:

- Internal data systems (e.g., financial accounting systems)
- Bills
- Invoices.

Data sources for emission factors include:

- Environmentally-extended input-output (EEIO) databases. A list of EEIO databases is provided on the GHG Protocol website (http://www.ghgprotocol.org/Third-Party-Databases). Additional databases may be added periodically, so continue to check the website.

### Calculation formula [4.7] Spend-based method (transportation)

***$CO_2e$ emissions from transportation =***

**sum across transport modes and/or vehicle types:**

∑ (amount spent on transportation by type ($)

× relevant EEIO emission factors per unit of economic value (kg $CO_2e$/$))

### Example [4.4] Calculating emissions from transportation by using the spend-based method

Company A makes televisions and sources basic materials from suppliers B, C, and D. Company A calculates total amount spent from the transport of the basic goods and obtains information from suppliers on vehicle type used for transport. Company A obtains relevant emission factors from EEIO databases. The information is summarized in the table below:

| *Supplier* | *Amount spent ($)* | *Transport mode or vehicle type* | *EEIO emission factor (kg $CO_2e$/$)* |
|---|---|---|---|
| B | 20,000 | Truck (rigid, >3.5-7.5t) | 0.04 |
| C | 30,000 | Air (long haul) | 0.15 |
| D | 40,000 | Container 2,000–2,999 TEU | 0.05 |

Note: the activity data and emission factors in this example are for illustrative purposes only.

**emissions from road transport:**
= ∑ (amount spent on transportation leg
× EEIO emission factor of transport mode or vehicle type (kg $CO_2e$/$))
= 20,000 × 0.04 = 800 kg $CO_2e$/$

**emissions from air transport:**
= ∑ (amount spent on transportation leg × EEIO emission factor of
transport mode or vehicle type (kg $CO_2e$/$))
= 30,000 × 0.15 = 4,500 kg $CO_2e$/$

**emissions from sea transport:**
= ∑ (amount spent on transport leg
× EEIO emission factor of transport mode or vehicle type (kg $CO_2e$/$))
= 40,000 × 0.05 = 2,000 kg $CO_2e$/$

**total emissions from transport (upstream) is calculated as:**
= emissions from road transport + emissions from air transport + emissions from sea transport
= 800 + 4,500 + 2,000 = 7,300 kg $CO_2e$/$

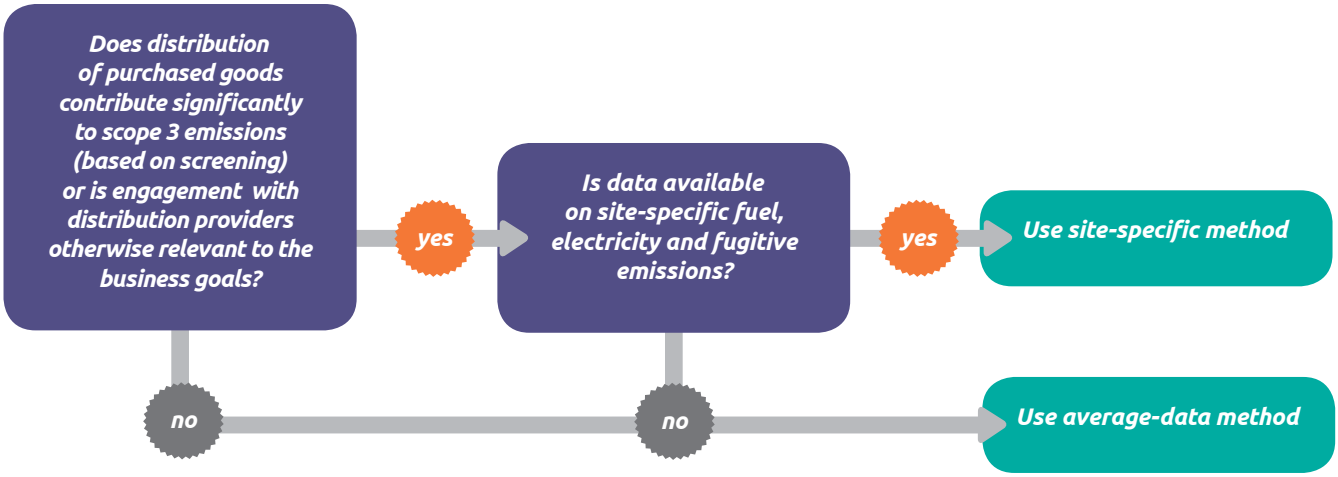
### *Calculating emissions from distribution (upstream)*

Companies may use either of two methods to calculate scope 3 emissions from upstream distribution (e.g. storage facilities):

- **Site-specific method,** which involves site-specific fuel, electricity, and fugitive emissions data and applying the appropriate emission factors
- **Average-data method**, which involves estimating emissions for each distribution activity, based on average data (such as average emissions per pallet or cubic meter stored per day).

Figure 4.2 gives a decision tree for selecting a calculation method for emissions from upstream distribution.

**Figure [4.2] Decision tree for selecting a calculation method for emissions from upstream distribution**




### *Site-specific method*

This method involves collecting site-specific fuel and energy data from the storage facility (e.g., warehouses, distribution centres) of individual distribution activities, and multiplying them by appropriate emission factors.

If the storage facility stores goods for companies other than the reporting company, emissions should be allocated to the reporting company. For more information on allocation, see chapter 8 of the *Scope 3 Standard*.

### *Activity data needed*

Companies should collect data on:

- Site-specific fuel and electricity use
- Site-specific fugitive emissions (e.g., air conditioning or refrigerant leakage)
- The average occupancy rate of the storage facility (i.e., average total volume of goods stored).

### *Emission factors needed*

Companies should collect:

- Site or regionally specific emission factors for energy sources (e.g., electricity and fuels) per unit of consumption (e.g., kg CO2e/kWh for electricity, kg CO2e/liter for diesel)
- Emission factors of fugitive and process emissions (kg $CO_2e$/kg).

***Data collection guidance***

Data sources for activity data include:

- Utility bills
- Purchase records
- Meter readings
- Internal IT systems.

Data sources for emission factors include:

- Life cycle databases
- Company-developed emission factors
- Industry associations.

### Calculation formula [4.8] Site-specific method (distribution)

***$CO_2e$ emissions from distribution =***

**for each storage facility:**

emissions of storage facility (kg $CO_2e$)
= (fuel consumed (kWh) × fuel emission factor (kg $CO_2e$/kWh))
+ (electricity consumed (kWh) × electricity emission factor (kg $CO_2e$)/kWh)
+ (refrigerant leakage (kg) × refrigerant emission factor (kg $CO_2e$)/kg))

**then, allocate emissions based on volume that company's products take within storage facility:**

$$\text{allocated emissions of storage facility} = \left(\frac{\text{volume of reporting company's purchased goods } (m^3)}{\text{total volume of goods in storage facility } (m^3)}\right)$$

× emissions of storage facility (kg $CO_2e$)

**finally, sum across all storage facilities:**

∑ allocated emissions of storage facility

If data are available, companies may optionally allocate emissions based on different storage methods (e.g., temperature-controlled storage and ambient storage). This allocation step can be significant within shared storage. Companies may optionally allocate emissions based on length of time goods spend in storage.

If a company has a large number of distribution channels, sampling may be appropriate (see Appendix A for more information).

### Example [4.5] Calculating emissions from upstream distribution using the site-specific method

Company A's products are stored at two facilities throughout the reporting year. No chilling or freezing is needed during storage. Company A collects the data from operators on the amount of fuel and electricity consumed for the reporting year, as well as the volume of company A's purchased goods compared to total volume of goods. Company A collects corresponding emission factors from life cycle databases.

The information is summarized in the table below:

| *Storage facility* | *Electricity consumed (kWh)* | *Electricity emission factor (kg $CO_2$e/kWh)* | *Natural gas used (kWh)* | *Natural gas emission factor (kg $CO_2$e/kWh)* | *Volume of company A's goods ($m^3$)* | *Total volume of goods in storage facility ($m^3$)* |
|---|---|---|---|---|---|---|
| 1 | 10,000 | 0.8 | 1,000 | 0.25 | 100 | 400 |
| 2 | 15,000 | 0.8 | 2,000 | 0.25 | 200 | 800 |

Note: the activity data and emissions factors are illustrative only, and do not refer to actual data.

**emissions from storage facility 1 are calculated as:**

((fuel consumed (kWh) × fuel emission factor (kg $CO_2$e)/kWh))
+ (electricity consumed (kWh) × electricity emission factor (kg $CO_2$e)/kWh))

$$\times \left( \frac{\text{volume of reporting company's purchased goods } (m^3)}{(\text{total volume of goods in storage facility } (m^3)} \right)$$

= ((10,000×0.8)+(1,000×0.25))×(100/400)
= 2,062.5 kg $CO_2$e

**emissions from storage facility 2 are calculated as:**

((fuel consumed (kWh) × fuel emission factor (kg $CO_2$e)/kWh))
+ (electricity consumed (kWh) × electricity emission factor (kg $CO_2$e)/kWh))

$$\times \left( \frac{\text{volume of reporting company's purchased goods } (m^3)}{(\text{total volume of goods in storage facility } (m^3)} \right)$$

= (15,000 × 0.8) + (2,000 × 0.25)) × (200 / 800)
= 3,125 kg $CO_2$e

**total emissions from distribution (upstream) is calculated as follows:**

emissions from storage facility 1 + emissions from storage facilities 2
= 2,062.5 + 3,125 = 5,187.5 kg $CO_2$e

### *Average-data method*

Companies should use the average-data method where supply-chain specific data is unavailable. Companies should collect average emission factors for distribution activities.

### *Activity data needed*

Companies should collect data based on throughput:

- Volume of purchased goods that are stored (e.g., square meters, cubic meters, pallet, TEU) or number of pallets needed to store purchased goods
- Average number of days that goods are stored.

### *Emission factors needed*

Companies should collect data that allows the calculation of emissions per unit, per time period stored. This can be expressed in several different ways, including:

- Emission factor per pallet per day stored in facility
- Emission factor per square meter or cubic meter per day stored in facility
- Emission factor per TEU (twenty-foot equivalent unit) stored in facility.

### *Data collection guidance*

Data sources for activity data include:

- Supplier records
- Internal management systems.

Data sources for emission factors include:

- Life cycle databases
- Supplier- or company-developed emission factors
- Industry associations (for example the U.S. Energy information Administration has developed a dataset on average energy use by building type. Commercial Buildings Energy Consumption Survey, at http://www.eia.doe.gov/emeu/cbecs/)
- Academic publications.

### Calculation formula [4.9] Average-data method (distribution)

***$CO_2e$ emissions from distribution =***

**sum across storage facilities:**

∑ (volume of stored goods ($m^3$ or pallet or TEU) × average number of days stored (days) × emission factor for storage facility (kg $CO_2e/m^3$ or pallet or TEU/day))

### Example [4.6] Calculating emissions from upstream distribution using the average-data method

Company A is a producer of pasta. Its products are stored at distribution centers and then sent for retail sale in supermarkets. Company A collects data on the total volume needed to store its goods at storage facilities and the average number of days its goods are stored. Emission factors are collected from an academic publication. The information is summarized in the table:

| *Storage facility types* | *Total volume of stored goods ($m^3$)* | *Average days stored* | *Emission factor of storage (kg $CO_2e/m^3$/day)* |
|---|---|---|---|
| Distribution center | 4,000 | 2 | 0.01 |
| Supermarkets | 4,000 | 2 | 0.02 |

Note: the activity data and emission factors in this example are for illustrative purposes only.

**the emissions can be calculated as follows:**

$$\sum (\text{volume stored goods } (m^3) \times \text{number of days stored (days)} \times \text{emission factor for storage facility (kg } CO_2e/m^3/\text{day}))$$

$$= (4{,}000 \times 2 \times 0.01) + (4{,}000 \times 2 \times 0.02) = 80 + 160 = 240 \text{ kg } CO_2e$$