# 2016
# KPI-Team

## Sustainability Measures
## for Logistical Activities

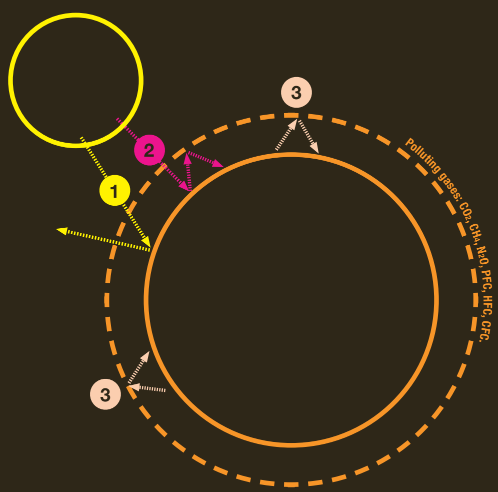
## $CO_2$ (GHG) and Energy Reduction

The Consumer Goods
FORUM
The Global Network Serving
Shopper&ConsumerNeeds

Version 1.0 - March 2012

**What is climate change?**
It is one of the most serious environmental problem we face.

When we speak of climate change, we refer to an alteration in climate due to global warming from burning fossil fuels (coal, oil and gas) by human activity. The gases that we emit causes retention of solar radiation (greenhouse), and an increase in temperature.




1

Solar radiation penetrates Earth's atmosphere, the earth absorbs and then emits energy into space

2

Some gases prevent that energy escape, causing the temperature rise of the land: it is the greenhouse effect

3

The burning of fossil fuels increases the greenhouse effect and cause climate change

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## 2016 Vision

Serving consumers in a sustainable way is the vision of the **Consumer Goods Forum's 2016 Future Supply Chain Platform**. A group of manufacturers and retailers is working to realise one specific element of this vision: a common language for sustainability-related key performance indicators (KPI) in logistics. The main focus of this work is $CO_2$ reduction.

## About this document

The goal of decision-makers in logistics has always been to optimize costs, subject to service level constraints. The $CO_2$ KPIs defined in this document will help decision-makers to see the impact of their logistics decisions on $CO_2$ emissions.

The 2016 KPI Team has developed a comprehensive and practical set of KPIs for $CO_2$ emission and energy consumption reduction, ready for use by consumer goods companies. There are also linked measures for transportation and warehousing activities in different parts of the supply chain.

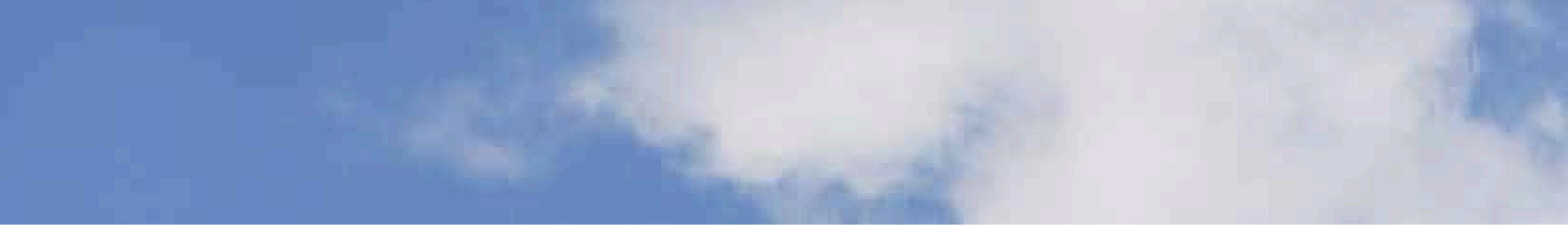
It is certainly not meant that all companies have to align to the emission factors proposed in this guideline; rather, they will provide a shared language to enable dialogue about carbon emissions between business partners.

This document does not claim to be exhaustive, but dynamic in nature. Many aspects have deliberately been left out in order to keep the content as simple as possible while trying to achieve the envisioned goal: create a usable first approach on a common definition to improve decision-making.

We appreciate your feedback!

Please send your suggestions and comments to:
r.hagedorn@theconsumergoodsforum.com

**Note: Topics not covered**
This document is a **building block** for a cradle-to-cradle analysis and focuses on a companies own distribution activities. The Cradle-to-cradle approach requires a full LCA and is a complex exercise. This is out of scope of this project.
This guideline includes separate emission factors for **biofuel** but not guidance on it's application, which is a different topic. **Manufacturing** and **Dust Emission** are not covered yet, but might be in future versions.



## Introduction

Reporting on $CO_2$-emissions along a supply chain helps a company to understand its environmental footprint over time. Keeping track of the year-on-year evolution in this way demonstrates the progress of any improvement measures taken.

## Scope

To ensure the completeness of the reporting, the reporting boundaries of a company need to be defined across the four following scopes:

1. **Scope of Reporting**
2. **Scope of Emissions**
3. **Scope of Activities**
4. **Scope of Supply Chain**

## 1/ Scope of Reporting

From the outset, a company needs to decide on the scope of its reporting, which can be:

- Geographical level: global, regional, country,
- Product level: company wide, brand level, SKU level

**Guidance:**
The recommendation is to report geographically at country level and company-wide at selected brand levels.

## 2/ Scope of Emissions

The Greenhouse Gas Protocol (GHGP) classifies emissions according to three scopes. Reporting on emissions should cover scopes 1, 2 and 3 as follows:

| Scope 1 | Scope 2 | Scope 3 |
|---|---|---|
| Direct Emissions | Indirect Emissions (purchased electricity, heat or steam) | Emissions from Outsourced Activities (not owned or controlled by reporting entity) |

figure 1 GHGP scopes

**GHGP Scope 1: direct emissions**
Refers to all direct $CO_2$ emissions from fossil fuels incurred during transportation or warehousing activities, moving or handling the goods with wholly-owned or controlled assets.

Transportation includes $CO_2$ emissions from the combustion of fuels in engines, known as "tank-to-wheel".

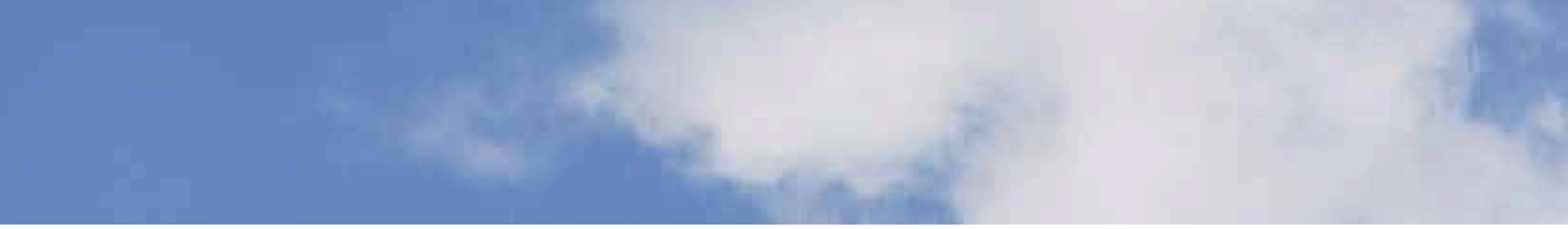
**GHGP Scope 2: indirect emissions**
Refers to all indirect $CO_2$ emissions from the consumption of purchased electricity, heat or steam.

**GHGP Scope 3: third-party emissions**
Refers to all other indirect emissions from outsourced activities in transport and warehousing, such as transport or warehousing related activities in assets not owned or controlled by the reporting entity. The recommendation is to cover all transactions directly received or paid for by the company.

In accordance with the GHG protocol, $CO_2$ emissions are reported in "tonnes of carbon dioxide equivalent ($CO_2e$)". $CO_2e$ is the universal unit of measurement to indicate the global warming potential (GWP) of each of the six main greenhouse gases (NOx, $SF_6$, $CH_4$, $N_2O$, HFCs and PFCs), expressed in terms of the GWP of one unit of carbon dioxide. For instance, $CH_4$ has a GWP of 25 $CO_2e$, which means that emitting 1 kg of $CH_4$ has the same impact as emitting 25 kg of $CO_2$. Therefore, from this point onwards, the term $CO_2e$ will be used.

**Guidance**:
The $CO_2e$ emissions have to be reported separately by scope 1, 2 and 3.

**GHGP Scope Reference**
- Greenhouse Gas Protocol
- GRI EN16/EN29 Logistics and transportation sector supplement



## 3/ Scope of Activities

We will differentiate between the following activities:
- Warehousing
- Transport
- “Plug-ins”, for manufacturing activities

In order to visualize the three emissions scopes as they apply to the supply chain, we will use the following simplified supply chain model (Figure 1), looking at the end-to-end supply chain.

**Example:** Raw materials are moved to a warehouse (standalone or part of a production site). From there, components/finished goods are moved to the corresponding distribution center (DC) and from there to a facility near the consumer (store).

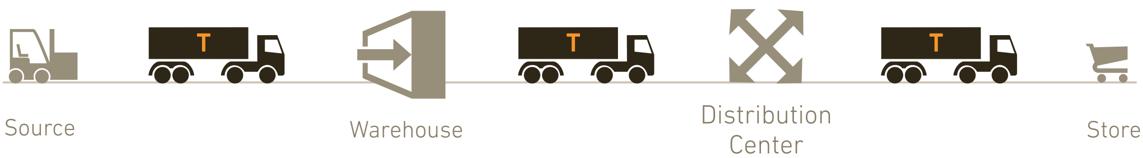



Figure 1 - Simple supply chain

For the transport (“ T ”) component we will use the following simplified model including a zoom into the intermodal transport (Figure 2) to help allocate and visualize the scopes. Of course, additional combinations such as train-only or road-only are possible, but were not visualized in this example, to keep the graph simple.

**Example:** Goods are loaded onto a truck. This truck can move the pallets or container to an inter-modal centre, where a crane lifts it on rail. Upon arrival near its destination, the container is again loaded onto a truck, which takes it to the DC. There, they are unloaded again and loaded into the storage area:

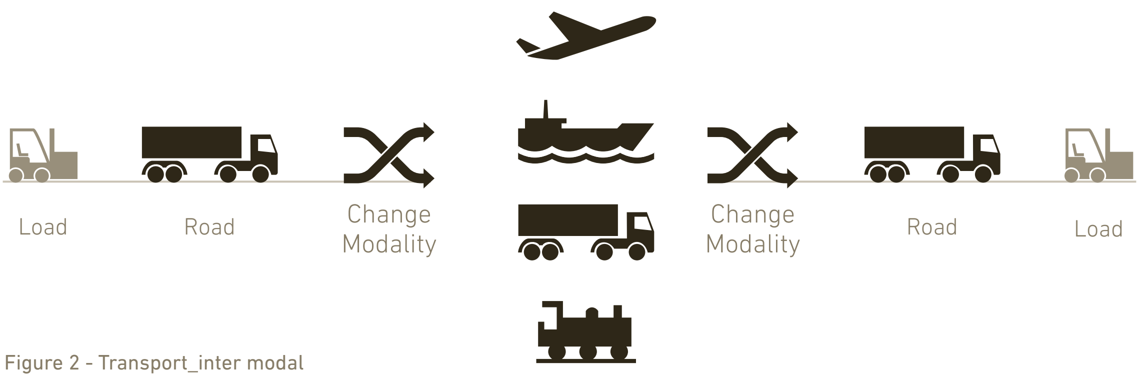



Figure 2 - Transport_inter modal

**Example:** In summary, the overall model we will use throughout this document looks like this: (with random assignment of scopes for illustrative purposes only)

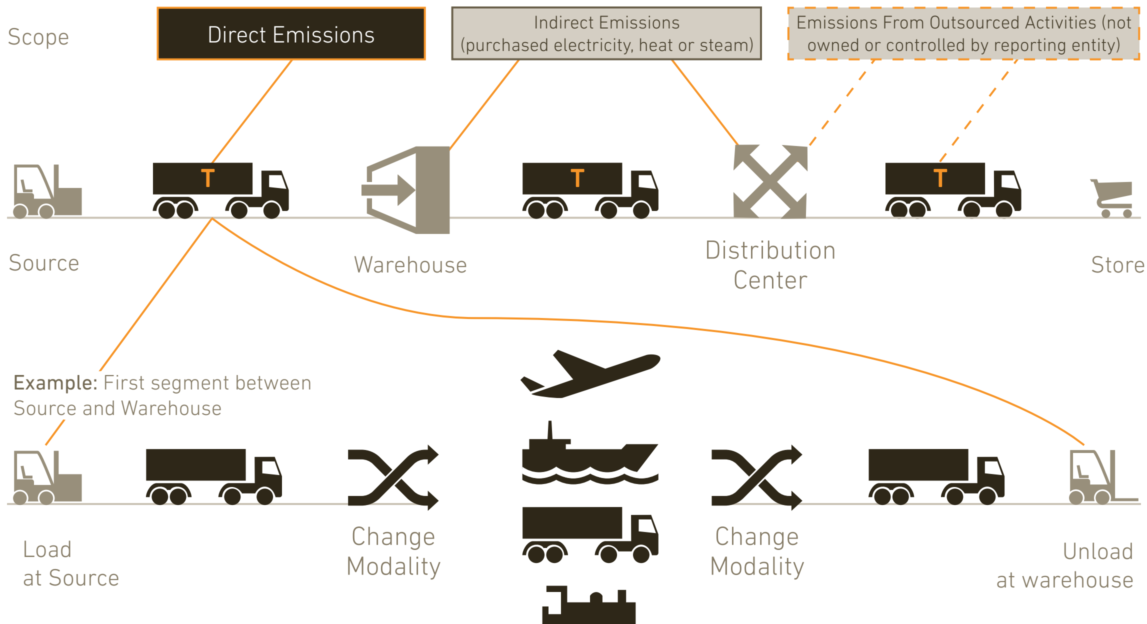



Figure 3 - Locate scope in supply chain

**Warehousing**

**The term "warehousing" includes:**

- Warehousing activities related to the storage and handling of raw and packaging material at source or semi-finished or finished goods at the regional or local destination markets
- Warehousing executed in-house, as well as outsourced to logistics service providers

**Transport**

- Inbound and outbound transportation activities across all transportation modes (e.g. road, rail, sea, inland waterways, multimodal transportation)
- Transportation planned, controlled and executed in-house, as well as outsourced to logistics service providers

**"Plug-ins", for production**

Manufacturing activities occur at different steps along the supply chain and can be easily mapped to the above supply chain model. For practical reasons, it is normally recommended to keep $CO_2e$ emission reporting for manufacturing separate, as this allows for analysis and details focused on manufacturing specifics.

Eventually, the $CO_2e$ reporting of manufacturing components can be easily combined with supply chain reporting in order to get the complete picture of the company's environmental impact.

To ensure coherence, the $CO_2e$ emission reporting for manufacturing needs to follow identical scope definitions to those applied to warehousing and transport activities, as well as reporting units.

**Guidance**:
It is the recommendation to report emissions from both warehousing and transportation for those products you put on the market.

## 4/ Scope of Supply Chain

The scope of the supply chain will define which part of the chain a company has to report on. The key here is who owns the product at any given stage.

The recommendation is to report on all activities which deal with products you own, from the moment you gain ownership until the moment ownership is transferred. You should split the distribution emissions by scope: Scope 1 and 2 for own transport and warehousing, scope 3 third party or outsourced transport and warehousing.

**Guidance**:
If you own the product, you report on the activities and assets involved in getting the product to the market (excl. manufacturing activities)

# Measuring $CO_2e$ & Energy Consumption

Total $CO_2e$ emissions of the reporting company year-on-year (your carbon footprint) are separeted by GHG scope and by distribution activity. This allows the company to follow the evolution of its $CO_2e$-emissions over time, including any impacts caused by fluctuations in the size of the company.

$CO_2e$ effectiveness standardizes the $CO_2e$-emissions per reporting unit of the company. This shows the overall performance of the supply chain on a comparable basis year-on-year. The $CO_2e$ effectiveness depends on the $CO_2e$ efficiency of the transport network, the distance travelled and warehousing infrastructure.

$CO_2e$ efficiency measures how efficiently the products are transported and stored. Lower figures stand for higher efficiency. The transport $CO_2e$-efficiency depends mostly on the mode of transport and the loading factor of the transportation vehicles.

The transport mode breakdown shows the mix of modes used and the evolution year-on-year. The breakdown is based on tonne.km per transport mode.

## $CO_2e$ emissions KPIs (See page 15 graph)

In order to offer guidance on the choices to be made, we will differentiate between "types" of KPI and split those by activity (transportation and warehousing).

| KPI type | Transportation | Warehousing [2] |
|---|---|---|
| Total $CO_2e$ - emissions | Tonnes of $CO_2e$ emitted per year | Tonnes of $CO_2e$ emitted per year |
| $CO_2e$ - effectiveness | Kg $CO_2e$ /Unit of Business [1] | Kg $CO_2e$ /Unit of business [1] |
| $CO_2e$ - efficiency | kg $CO_2e$ / tonne.km | kg $CO_2e$ / pallet-stored<br>Kg $CO_2e$/ $m^2$ |

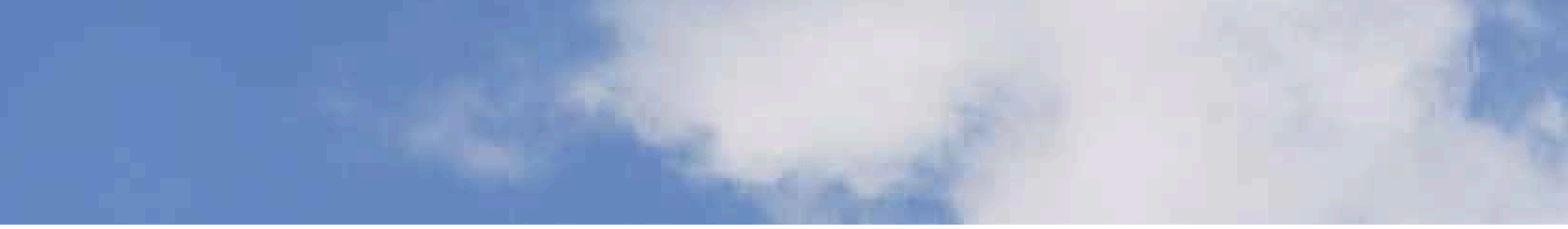
1) Unit of Business is the one used by each company for reporting and managing operations (e.g. m3 sold, HL sold, tons sold, euro)

2) Breakdown of indicator according to warehouse classification (ambient, temperature controlled, chilled +2°C to +4°C, negative temperature -25°C to -28°C)

## Total $CO_2e$ emissions (See page 15 graph)

The total $CO_2e$ emissions figure indicates the overall GHG impact of the company covering the scope as defined earlier.

The total $CO_2e$ emissions figure depends not only upon the figures for $CO_2e$ effectiveness and $CO_2e$ efficiency but also on the overall volume of the reporting company.



It is therefore important to map the trend of the total $CO_2$e emissions against that of company growth.

## $CO_2$e effectiveness (See page 15 graph)

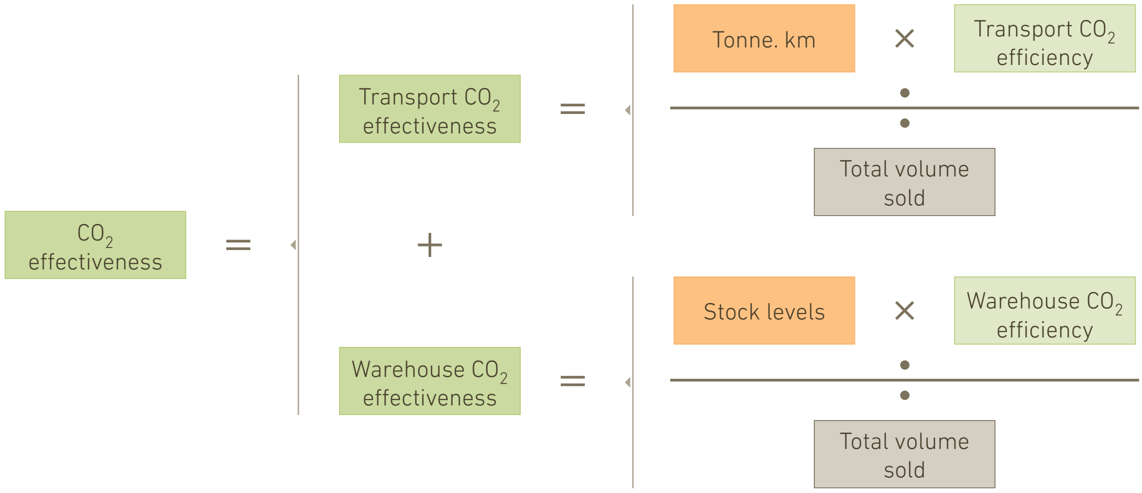



Figure 4 - $CO_2$ Effectiveness

The **$CO_2$e effectiveness** measures the overall performance of the supply chain as a ratio of the total tonnes of $CO_2$e emitted against the overall volume of products sold. The lower the reported figure the more effective the operations are. The $CO_2$e effectiveness is linked to the distribution strategy, the warehousing strategy, the network design and the route planning, thus being a strategic performance measure. This measure allows you to keep track of the performance independently of any volume change / growth of the reporting company.

## $CO_2$e efficiency (See page 15 graph)

**$CO_2$e efficiency** measures the efficiency of a specific activity (e.g. transport or warehousing).

The transport $CO_2$e efficiency is showing how much $CO_2$e is emitted for every tonne of product transported over 1 km. The transport $CO_2$e efficiency is impacted by:

- The mode of transport (road, rail, ship),
- Vehicles size and weight
- The published fuel efficiency factor for the mode of transport
- The driver's behavior impacting fuel performance.

It is therefore typically an operational performance measure.

**Example 1:**
Supply chain A and supply chain B both sell 100'000 tonnes of product a year. They have the same operational performance, as they use

the same mode of transport and report an identical transport $CO_2$e efficiency of 70 g $CO_2$e per tonne.km.

The sourcing strategy of the two supply chains is however very different. Supply chain A has a strategy of local production and local sourcing with short transport distances (on average 100 km). Supply chain B has a centralized production strategy resulting in long transport distances (in average 500 km).

Therefore : Supply Chain B reports  higher figures for total $CO_2$e-emissions than supply chain A because they use more fuel travailing greater distances:

Supply chain A:
100'000 tonnes * 100 km * 70 g $CO_2$e/tonne.km = 700'000 kg $CO_2$e

Supply chain B:
100'000 tonnes * 500 km * 70 g $CO_2$e/tonne.km = 3'500'000 kg $CO_2$e

The KPI "transport $CO_2$e-effectiveness" of supply chain A is 7 kg $CO_2$e per tonne of product and for supply chain B it is 35 kg $CO_2$e per tonne of product. Supply chain B is therefore less effective.

Improvement opportunities in example 1 could be:
- Network review
- Route planning review
- Further improve the transport efficiency

**Example 2:**
Supply chain A and supply chain B sell both 100'000 tonnes of product a year. They both report  the same $CO_2$e-effectivness of 30 kg $CO_2$e per tonne of product.

As  in example 1, the sourcing strategy is different for the two supply chains, with 100 km average transport distance for supply chain A and 500 km average transport distance for supply chain B.

The total $CO_2$e-emissions (effectiveness) are identical for both supply chains:

Supply chain A and B :
100'000 tonnes * 30 kg $CO_2$e/tonne of product = 3'000'000 kg  $CO_2$e
However the transport  $CO_2$e -efficiency is different

Supply chain A:
3'000'000 kg $CO_2$e /(100'000 tonnes * 100km) = 300 gr $CO_2$e / tonne.km

Supply chain B:
3'000'000 kg $CO_2$e /(100'000 tonnes * 500km) = 60 gr $CO_2$e / tonne.km

The supply chain B reports therefore a better $CO_2$e-transport efficiency.

Improvement opportunities in example 2 could be

- Better load fill
- Improving fuel performance
- Different modes of transport
- Larger vehicles

## Calculation of total $CO_2$e emissions for transport

(See page 15 graph)

The approach for the calculation of $CO_2$e emissions depends on the available transport data.

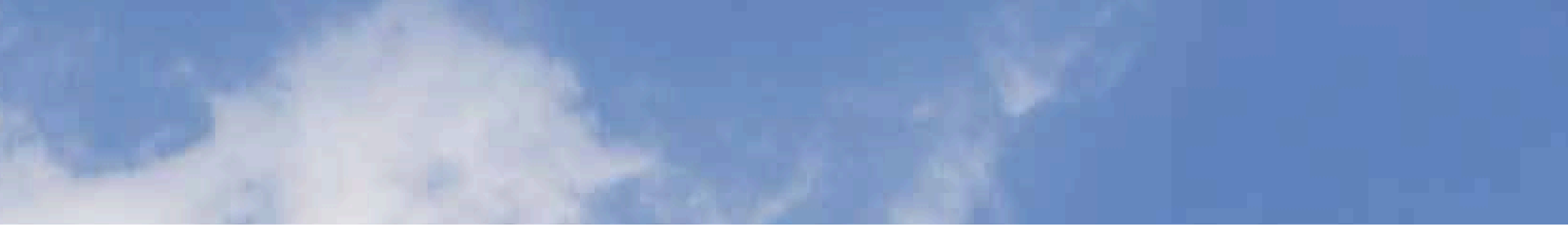
The most accurate reporting can be made when the exact fuel consumption for transport is known. The fuel consumption can then be converted into $CO_2$e emissions by using the specific $CO_2$e aconversion factor by fuel type.

Since the fuel consumption data is normally only available for owned vehicles, different approaches are needed in order to obtain the best possible estimate of fuel consumption and eventual $CO_2$e emissions for outsourced transport.

For *road transport*, the four following approaches can be taken:

| | Available data | Intermediate steps | Final result |
|---|---|---|---|
| 1 | Data on amount of fuel is available by fuel type | | $CO_2$e emissions = litre of fuel used x emission factor of fuel type (g $CO_2$e per lt) |
| 2 | Data on distance travelled and vehicle's efficiency is available (lt/100km or mpg) | Fuel used = distance x vehicle's efficiency | $CO_2$e emissions = litre of fuel used x emission factor of fuel type (g $CO_2$e per lt) |
| 3 | Data on distance travelled by vehicle type is available | Fuel used = distance x standard vehicle's efficiency | $CO_2$e emissions = litre of fuel used x emission factor of fuel type (g $CO_2$e per lt) |
| 4 | Data on distance travelled by transport, tonnage and vehicle type available | Calculate tonne.km = distance travelled x tonnage | $CO_2$e emissions = tonne.km x emissions factor for vehicle type (g $CO_2$e per tonne.km) |

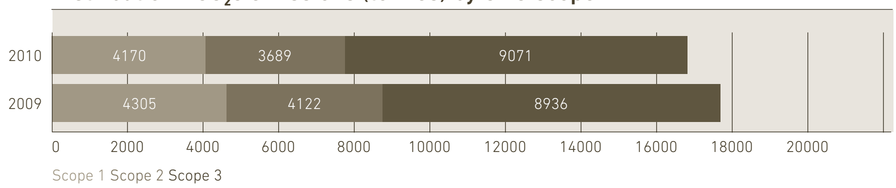
For *rail, intermodal, ship and air freight*, normally no detailed fuel or energy consumption data is available. The approach, therefore, is to use the available $CO_2$e efficiency factors of the different transport modes – indicated in "g $CO_2$e e per tonne.km" – and multiply these with the transport volume, expressed in "tonne.km", as shown in the calculation approach 4.



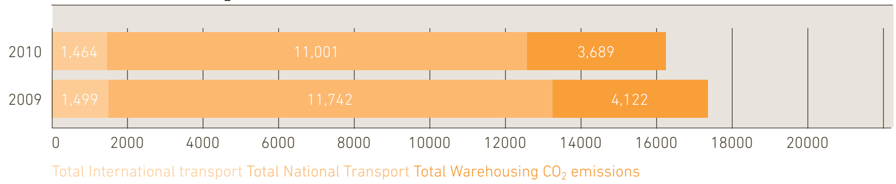
## Example of a company's $CO_2$e-reporting

The $CO_2$e-reporting should include at least the KPIs defined in this document. A graphical representation makes the year-on-year evolution more visible.

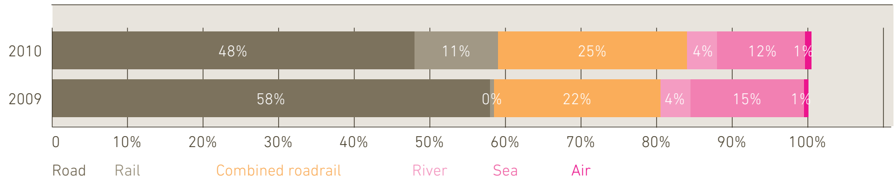
### Distribution - $CO_2$e emissions (tonnes) by GHG scope



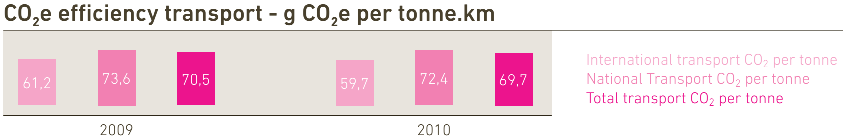

### Distribution - $CO_2$e emissions (tonnes) by activity



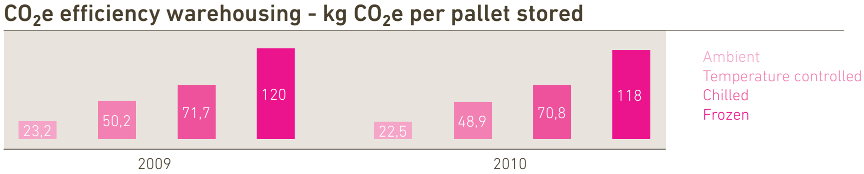

### Transport modes



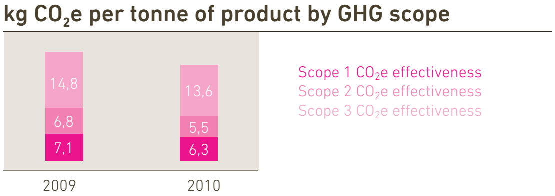

### $CO_2$e efficiency transport - g $CO_2$e per tonne.km



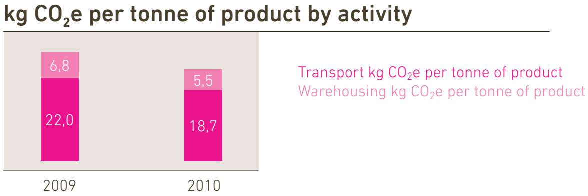

### $CO_2$e efficiency warehousing - kg $CO_2$e per pallet stored




### $CO_2$e effectiveness kg $CO_2$e per tonne of product by GHG scope




### $CO_2$e effectiveness kg $CO_2$e per tonne of product by activity



## Where to get the data

Emission factors for fuel and by transport mode are published by different governmental or industry organizations. The below shown factors can be used by companies starting the CO2-reporting, when no other emission factors are available from local governmental organizations. Once the CO2-reporting has started, it is recommended to remain consistent in applying the factors over time, in order to ensure a coherent reporting.

### Emission factor for fuel

| Converting fuel types by unit volume | | $CO_2$ | $CH_4$ | $N_2O$ | Total Direct GHG |
|---|---|---|---|---|---|
| Fuel Type | Units | kg $CO_2$ per unit | kg $CO_2e$ per unit | kg $CO_2e$ per unit | kg $CO_2e$ per unit |
| Aviation Spirit | Litres | 2.2121 | 0.0227 | 0.0219 | 2.2568 |
| Aviation Turbine Fuel | Litres | 2.5218 | 0.0012 | 0.0248 | 2.5478 |
| Burning Oil | Litres | 2.5299 | 0.0054 | 0.0069 | 2.5421 |
| CNG | Litres | 0.4728 | 0.0007 | 0.0003 | 0.4738 |
| Diesel (retail station biofuel blend) | Litres | 2.5530 | 0.0012 | 0.0183 | 2.5725 |
| Diesel (100% mineral diesel) | Litres | 2.6480 | 0.0012 | 0.0184 | 2.6676 |
| Gas Oil | Litres | 2.7667 | 0.0030 | 0.2898 | 3.0595 |
| LNG | Litres | 1.2226 | 0.0018 | 0.0007 | 1.2251 |
| LPG | Litres | 1.4884 | 0.0010 | 0.0023 | 1.4918 |
| Natural Gas | Cubic metre | 2.0154 | 0.0030 | 0.0012 | 2.0196 |
| Petrol (retail station biofuel blend) | Litres | 2.2352 | 0.0034 | 0.0064 | 2.2450 |
| Petrol (100% mineral petrol) | Litres | 2.3018 | 0.0034 | 0.0065 | 2.3117 |

Source: August 2011 Guidelines to Defra/
DECC's Greenhouse Gas Conversion Factors for Company Reporting,
http://www.defra.gov.uk/environment/economy/business-efficiency/reporting/

### CO2e emission factors by weight distance (tonne.km) for freight

| Transport mode | Kg $CO_2e$ per tonne.km |
|---|---|
| Air - Domestic (<463 km) | 1,96073 |
| Air - Short Haul (463 to 1108 km) | 1,47389 |
| Air - Long Haul (>1108 km) | 0,61324 |
| Rail | 0,0285 |
| Road Vehicle - Heavy Goods Vehicle - Rigid - Engine Size Unknown | 0,25115 |
| Road Vehicle - Heavy Goods Vehicle - Articulated - Engine Size Unknown | 0,08869 |
| Road Vehicle - Light Goods Vehicle - Fuel and Engine size unknown | 0,58651 |
| Watercraft - Shipping - Very Large Tanker (100000 tonnes deadweight) | 0,0059 |
| **Watercraft - Shipping - Very Large Bulk Carrier (70000 tonnes deadweight)** | **0,0041** |
| **Watercraft - Shipping - Large Container Vessel (20000 tonnes deadweight)** | **0,0125** |

Source: October 2011. GHG emissions from transport or mobile sources. Version 2.3
http://www.ghgprotocol.org/calculation-tools/all-tools
for more detailed CO2e emissions factors see also:
August 2011. Guidelines to Defra/DECC's Greenhouse Gas Conversion Factors for Company Reporting.
http://www.defra.gov.uk/environment/economy/business-efficiency/reporting/
Annex 7 Freight Transport - table 7e for road freight, table 7f for rail and air freight,
table 7g for maritime shipping freight

## Calculation examples for transport

### $CO_2$ emissions calculation for road freight

| Available Data | Intermediate steps | | | Final result | |
|---|---|---|---|---|---|
| **1 Data on amount of fuel is available by fuel type** | | | | | |
| Total fuel usage:<br>1'000'000 lt of Diesel<br>(100% mineral diesel)<br>500'000 lt of Petrol<br>(100% mineral petrol) | | | | 1'000'000 lt *<br>2.6676 kg $CO_2$e per lt<br>500'000 lt *<br>2.3117 kg $CO_2$e per lt | 2.667.600 kg of $CO_2$e<br>1.155.850 kg of $CO_2$e |
| | | | | | Total 3.823.450 kg of $CO_2$e |
| **2 Data on distance travelled and vehicle's efficiency is available** | | | | | |
| Truck A: 150'000 km,<br>33.4 lt / 100 km - Diesel | Diesel used =<br>150'000 km * 33.4 lt / 100km | | 50.100 lt<br>of Diesel | 50'100 lt *<br>2.6676 kg $CO_2$e per lt | 133.647 kg of $CO_2$e |
| Truck B: 90'000 km,<br>36.2 lt / 100 km - Diesel | Diesel used =<br>90'000 km * 36.2 lt / 100km | | 32.580 lt<br>of Diesel | 32'580 lt *<br>2.6676 kg $CO_2$e per lt | 86.910 kg of $CO_2$e |
| Truck C: 90'000 km,<br>28.4 lt / 100 km - Petrol | Petrol used =<br>90'000 km * 28.4 lt / 100 km | | 25.560 lt<br>of Diesel | 25'560 lt *<br>2.3117 kg $CO_2$e per lt | 59.087 kg of $CO_2$e |
| | | | | | Total 279.644 kg of $CO_2$e |
| **3 Data on distance travelled by vehicle type is available** | | | | | |
| 1'000'000 km<br>travelled with<br>40 tons truck | 40 tons truck<br>using in average<br>32.0 lt / 100 km | Fuel used =<br>1'000'000 km *<br>32.0 lt / 100 km | 320.000 lt<br>of Diesel | | |
| 2'500'000 km<br>travelled with<br>28 tons truck | 28 tons truck<br>using in average<br>27.2 lt / 100 km | Fuel used =<br>2'500'000 km *<br>27.2 lt / 100 km | 680.000 lt<br>of Diesel | | |
| | | Total | 1.000.000 lt<br>of Diesel | 1'000'000 lt *<br>2.6676 kg $CO_2$e per lt | Total 2.667.600 kg of $CO_2$e |
| **4 Data on distance travelled by transport, tonnage and vehicle type available** | | | | | |
| Shuttle from factory to<br>DC A, 150 km distance,<br>500'000 tonnes trans-<br>port in articulated HGV | standard<br>articulated HGV<br>efficiency =<br>0,0887 Kg $CO_2$e<br>per tonne.km | tonne.km =<br>500'000 tonnes<br>* 150 km | 75.000.000<br>tonne.km | 150'000'000 tonne.km<br>* 0,0887 Kg $CO_2$e per<br>tonne.km | 6.652.500 kg of $CO_2$e |
| Shuttle from factory to<br>DC B, 75 km distance,<br>500'000 tonnes trans-<br>port in articulated HGV | | tonne.km =<br>500'000 tonnes<br>* 75 km | 37.500.000<br>tonne.km | 37'500'000 tonne.km<br>* 0,0887 Kg $CO_2$e per<br>tonne.km | 3.326.250 kg of $CO_2$e |
| | | | | | Total 9.978.750 kg of $CO_2$e |

### $CO_2$ emissions calculation for rail, intermodal, ship and air freight

| Available Data | Intermediate steps | | | Final result | |
|---|---|---|---|---|---|
| **1 Rail freight** | | | | | |
| Rail factory 1 to DC A,<br>700 km, 500'000 tonnes<br>transported | tonne.km =<br>500'000 tonnes * 700 km | | 350.000.000<br>tonne.km | 350'000'000 tonne.km<br>* 0,0285 Kg $CO_2$e per<br>tonne.km | 9.975.000 kg of $CO_2$e |
| Rail factory 1 to DC<br>B, 1'500 km, 200'000<br>tonnes transported | tonne.km =<br>200'000 tonnes * 1'500 km | | 300.000.000<br>tonne.km | 300'000'000 tonne.km<br>* 0,0285 Kg $CO_2$e per<br>tonne.km | 8.550.000 kg of $CO_2$e |
| | | | | | Total 18.525.000 kg of $CO_2$e |
| **2 Air freight** | | | | | |
| Air from country A to<br>country B, 10'000 km,<br>500 tonnes transported | tonne.km =<br>500 tonnes * 10'000 km | | 5.000.000<br>tonne.km | 5'000'000 tonne.km *<br>0,6132 Kg $CO_2$e per<br>tonne.km | Total 3.066.000 kg of $CO_2$e |

## Calculation of total $CO_2$e-emissions warehousing

All energy consumption for warehousing needs to be collected by energy type (e.g. fuel, electricity).

The fuel consumption can then be converted into $CO_2$e by applying the specific $CO_2$e conversion factor by fuel type.

Electricity consumption is converted into $CO_2$e emissions by applying a country-specific conversion factor of indirect $CO_2$e emissions per kWh of electricity.

## Where to get the data

Similar to the calculation for transport, the below shown factors can be used by companies starting the CO2-reporting, when no other emission factors are available from local governmental organizations.

### Emission factor for fuel

| Converting fuel types by unit volume | | $CO_2$ | $CH_4$ | $N_2O$ | Total Direct GHG |
|---|---|---|---|---|---|
| Fuel Type | Units | kg $CO_2$ per unit | kg $CO_2$e per unit | kg $CO_2$e per unit | kg $CO_2$e per unit |
| Burning Oil | Litres | 2.5299 | 0.0054 | 0.0069 | 2.5421 |
| CNG | Litres | 0.4728 | 0.0007 | 0.0003 | 0.4738 |
| Diesel (retail station biofuel blend | Litres | 2.5530 | 0.0012 | 0.0183 | 2.5725 |
| Diesel (100% mineral diesel) | Litres | 2.6480 | 0.0012 | 0.0184 | 2.6676 |
| Gas Oil | Litres | 2.7667 | 0.0030 | 0.2898 | 3.0595 |
| LNG | Litres | 1.2226 | 0.0018 | 0.0007 | 1.2251 |
| LPG | Litres | 1.4884 | 0.0010 | 0.0023 | 1.4918 |
| Natural Gas | Cubic metre | 2.0154 | 0.0030 | 0.0012 | 2.0196 |
| Petrol (retail station biofuel blend) | Litres | 2.2352 | 0.0034 | 0.0064 | 2.2450 |
| Petrol (100% mineral petrol) | Litres | 2.3018 | 0.0034 | 0.0065 | 2.3117 |

Source: August 2011 Guidelines to Defra/DECC's Greenhouse Gas Conversion Factors for Company Reporting, http://www.defra.gov.uk/environment/economy/business-efficiency/reporting/

### Emission factor for electricity

The amount of $CO_2$e emissions related to purchased electricity depends on the way this electricity was generated. This conversion factor, in kg $CO_2$e per kWh, can be provided by the utility company. If this information is not available, a country-specific conversion factor should be used, as provided by GHGP in the tool "GHG emissions from purchased electricity". The tool can be found at this site: http://www.ghgprotocol.org/calculation-tools/all-tools

1

## Energy Consumption KPIs

The energy consumption should be tracked within the warehouse operations. All types of energy consumed need to be tracked. These will then be the basis on which to calculate the direct and indirect $CO_2e$ emissions of warehousing.

In order to offer guidance on the choices to be made, we will differentiate between types of KPIs:

| KPI type | Warehousing [1] |
|---|---|
| Total energy consumption | Total energy consumed in warehousing, reported in kWh or GJ per year |
| Energy effectiveness | yearly kWh / Unit of Business [2] |
| Energy efficiency | Yearly kWh / pallet-stored<br>Yearly kWh / $m^2$ surface in warehouse<br>Yearly kWh / $m^3$ volume in warehouse |

1) Breakdown of indicator according to warehouse classification (ambient, temperature controlled, chilled +2°C to +4°C, negative temperature -25°C to -28°C)

2) Unit of Business is the one used by each company for reporting and managing operations (e.g. m3 sold, HL sold, tons sold, euro)

For warehousing, it is recommended to track the energy performance indicators separately according to warehouse classification, as the energy consumption varies significantly according to the different warehouse classes. This classification allows better benchmarking across the industry:

- ambient
- temperature controlled
- chilled +2°C to +4°C
- negative temperature -25°C to -28°C

Additional recommendation: track separately the percentage of energy produced from renewable sources.

## Example: how to capture energy data

**Plant Identification**

| | | |
|---|---|---|
| DC | Plant id<br>Name<br>Country<br>Contact | 1111<br>Paris<br>Texas, USA<br>my-name@my company.com |

| ENVIROMENTAL REPORT: Warehousing |
|---|
| Reported period |
| 2010 - July to December |

**General info**

| DC type | Ambient | Temperature cotrolled | Chilled + 2° to + 4° | Negative temerature -25° to 28° | Total | square meter |
|---|---|---|---|---|---|---|
| Surface | 11,581 | 16756 | 0 | 0 | 28,337 | square meter |
| Storage places | 10,000 | 16,000 | 0 | 0 | 26,000 | pallets |
| Storage volume | 40,000 | 50,000 | 0 | 0 | 90,000 | cubic meter |
| | | | | | | |
| Products distributed (net weight) | 50,000 | 75,000 | 0 | 0 | 125,000 | tonne (metric ton) |

**Energy Consumption**

| | | | | | |
|---|---|---|---|---|---|
| Electricity | | | | 2010 - July to December | |
| | Electricity | for lighting, refrigeration, heating | | 1.000.000 | Kilowatt hour |
| | | from renewable sources | | 15 | % |
| | | | | | |
| Fuel | Natural gas | | | 0,0 | cubic metre |
| | Diesel | for groundwater pump | | 12,0 | cubic metre |
| | LPG | | | 0,0 | cubic metre |
| | Indicate other fuel | | | 0,0 | gigajoule |

Input field for measurements Input field for explanatory remarks (optional) Automatically calculated

## Example: Energy Consumption KPI reporting

**Warehouse energy analysis**

**Plant Identification**

| | |
|---|---|
| Plant id<br>Name<br>Country<br>Contact | 1111<br>Paris<br>Texas, USA<br>name@company.com |

**Energy Consumption**

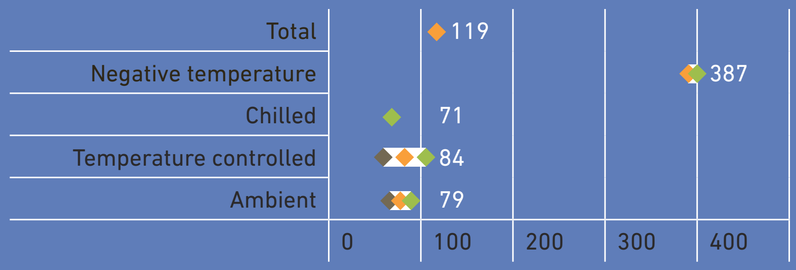
| | Energy in KWh | Energy in GJ |
|---|---|---|
| Electricity | 1.000.000 | 3.600 |
| From renewable sources | 15% | |
| | | |
| Natural gas | 0 | 0 |
| Diesel | 120,333 | 433 |
| LPG | 0 | 0 |
| Indicate other fuel | 0 | 0 |
| **Total energy consumption** | **1,120,333** | **4,033** |

**Energy Consumption analysis**

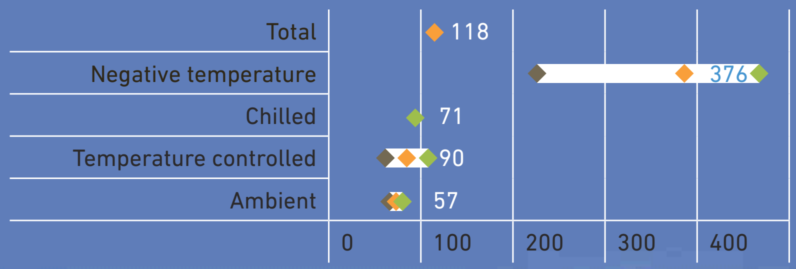
| | | | | |
|---|---|---|---|---|
| by surface | 40 | kWh / square meter | 142 | MJ / square meter |
| by storage place | 43 | kWh / pallets | 155 | MJ / pallets |
| by storage place | 12 | kWh / cubic meter | 45 | MJ / cubic meter |
| by products distributed | 9.0 | kWh / tonne (metric ton) | 32 | MJ / tonne (metric ton) |

# Example: benchmarking reporting across your company

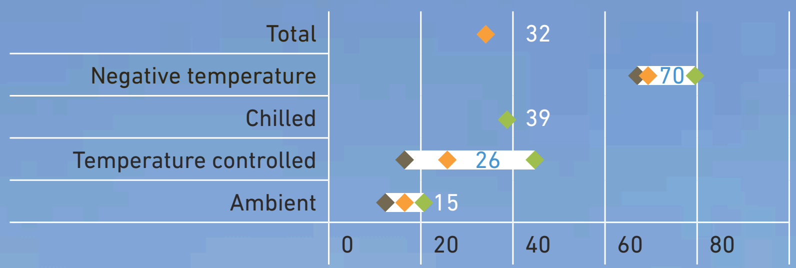
**Energy consumption kWh/square meter**

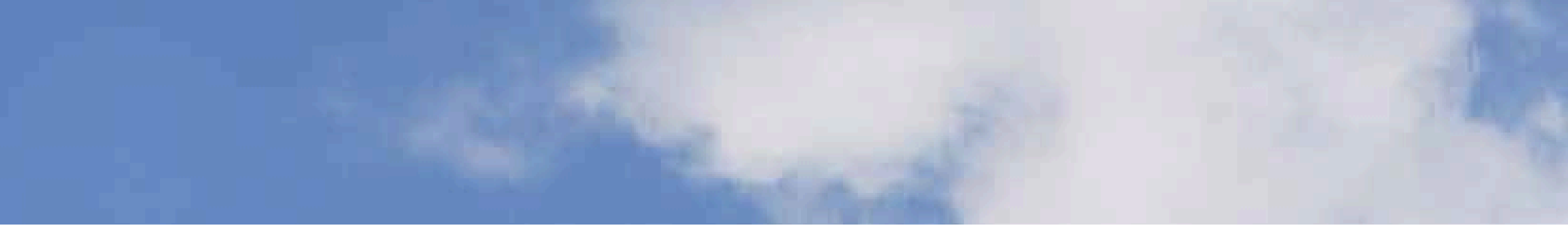



**Energy consumption kWh/storage place**




**Energy consumption kWh/tonne of product distributed**





## Improving $CO_2e$ & Energy Consumption

### 1/ Improving $CO_2e$

The end goal of decision-makers in logistics has always been to optimize costs, subject to service level constraints. The $CO_2e$ KPIs defined in this document help to see the impact of the different logistics decisions on $CO_2e$ emissions.

The following table captures the impact of logistics decisions at different levels – strategic, tactical and operational – on $CO_2e$ efficiency and $CO_2e$ effectiveness

**Strategic, Tactical and Operational Levels**

| Level | Area of Impact | Result |
|---|---|---|
| STRATEGIC | Supply Chain Design and Production Allocation (less km, less weight) | Affects $CO_2e$ **effectiveness** (via optimizing ton.km vs cost of supply) |
| | Product Design (less weight) | |
| | Distribution Network Design | Affects $CO_2e$ **effectiveness** and $CO_2e$ **efficiency** (via optimizing ton.km, transportation efficiency levels and storage requirements) |
| | Modal Shift / Transport Mode Selection | Affects $CO_2e$ **efficiency** (via shifting to more efficient transportation modes) |
| TACTICAL | LSP / Carrier selection | Affects $CO_2e$ **efficiency** (via selection of more efficient LSPs) |
| | Fleet Management | Affects $CO_2e$ **efficiency** (via improving efficiency of own fleet) |
| | Inventory Optimisation | Affects $CO_2e$ **effectiveness** (via reducing stock levels for same service level) |
| OPERATIONAL | Route Planning | Affects $CO_2e$ **effectiveness** (via reducing kilometers driven while meeting service constraints) |
| | Order Management & Fulfilment | Affects $CO_2e$ **efficiency** (via increasing utilization of vehicles and reducing empty kilometers) |

### 2/ Improving Energy Consumption

While it is not intended to be comprehensive, the following table captures some of the possible axes for energy consumption improvement.

| Level | Area of Impact | Result |
|---|---|---|
| STRATEGIC | Distribution Network Design<br>- right-sized warehouse | Affects **Energy efficiency**<br>- no energy waste through oversized operations |
| | Shared warehouses with other companies | Affects **Energy efficiency**, as warehouse space and operations can be optimized for larger operations. |
| TACTICAL | Warehouse design<br>- isolation<br>- heat reflection on roofs and walls<br>- natural lighting<br>- low energy bulbs<br>- movement sensors for lighting<br>- coupled electricity/heat generation<br>- etc. | Affects **Energy efficiency** |
| | Inventory Optimisation | Affects **Energy effectiveness** (via reducing stock levels for same service level) |
| OPERATIONAL | Best practices for warehouses<br>- avoidance of unnecessary movements in warehouse<br>- avoidance of energy loss in refrigerated/negative temperature warehouse (no open doors etc.)<br>- preventive maintenance of warehouse equipment | Affects **Energy effectiveness and efficiency** |

# Further Reading

Greenhouse Gas protocol – Standards -
http://www.ghgprotocol.org/standards/corporate-standard

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## About the Consumer Goods Forum

The Consumer Goods Forum is an independent global parity-based consumer goods network. It brings together the CEOs and senior management of over 650 retailers, manufacturers, service providers and other stakeholders across 70 countries.

The Forum was created in June 2009 by the merger of CIES - The Food Business Forum, the Global Commerce Initiative (GCI) and the Global CEO Forum. The Consumer Goods Forum is governed by its Board of Directors, which includes an equal number of manufacturer and retailer CEOs and Chairmen. Forum member companies have combined sales of € 2.1 trillion.

The Forum provides a unique global platform for thought leadership, knowledge exchange and networking between retailers, manufacturers and their partners on collaborative, non-competitive issues. Its strength lies in the privileged access it offers to the key players in the sector as well as in the development and implementation of best practices along the value chain.

It has a mandate from its members to develop common positions on key strategic and practical issues affecting the consumer goods business and to focus on non-competitive collaborative process improvement.

With its headquarters in Paris and its regional offices in Washington, D.C. and Tokyo, The Consumer Goods Forum serves its members throughout the world.

### Sustainability in the Consumer Goods Forum

The activities of the Consumer Goods Forum is organised into a series of strategic pillars. 'Sustainability' is one of the strategic pillars.

Sir Terry Leahy, CEO of Tesco, and Paul Polman, CEO of Unilever, sponsor the Sustainability pillar on behalf of the Board of the Consumer Goods Forum.

A Sustainability Steering Group consisting of twenty five business leaders from across the Forum companies lead the activities within the pillar on behalf of the sponsors.

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