

**2016**

**KPI-Team**

Sustainability Measures  
for Logistical Activities

**CO<sub>2</sub> (GHG) and Energy Reduction**



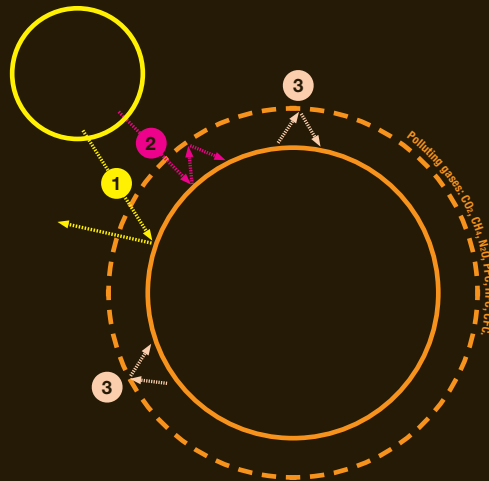
Version 1.0 - March 2012

**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<sub>2</sub> reduction.

## About this document

The goal of decision-makers in logistics has always been to optimize costs, subject to service level constraints. The CO<sub>2</sub> KPIs defined in this document will help decision-makers to see the impact of their logistics decisions on CO<sub>2</sub> emissions.

The 2016 KPI Team has developed a comprehensive and practical set of KPIs for CO<sub>2</sub> 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](mailto:r.hagedorn@theconsumergoodsforum.com)

### Note: Topics not covered

This document is a **building block** for a cradle-to-cradle analysis and focuses on a company's 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 its application, which is a different topic. **Manufacturing** and **Dust Emission** are not covered yet, but might be in future versions.

## Introduction

Reporting on CO<sub>2</sub>-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<sub>2</sub> emissions from fossil fuels incurred during transportation or warehousing activities, moving or handling the goods with wholly-owned or controlled assets.

Transportation includes CO<sub>2</sub> emissions from the combustion of fuels in engines, known as “tank-to-wheel”.

### GHGP Scope 2: indirect emissions

Refers to all indirect CO<sub>2</sub> 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<sub>2</sub> emissions are reported in “tonnes of carbon dioxide equivalent (CO<sub>2</sub>e)”. CO<sub>2</sub>e is the universal unit of measurement to indicate the global warming potential (GWP) of each of the six main greenhouse gases (NO<sub>x</sub>, SF<sub>6</sub>, CH<sub>4</sub>, N<sub>2</sub>O, HFCs and PFCs), expressed in terms of the GWP of one unit of carbon dioxide. For instance, CH<sub>4</sub> has a GWP of 25 CO<sub>2</sub>e, which means that emitting 1 kg of CH<sub>4</sub> has the same impact as emitting 25 kg of CO<sub>2</sub>. Therefore, from this point onwards, the term CO<sub>2</sub>e will be used.

#### Guidance:

The CO<sub>2</sub>e 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).

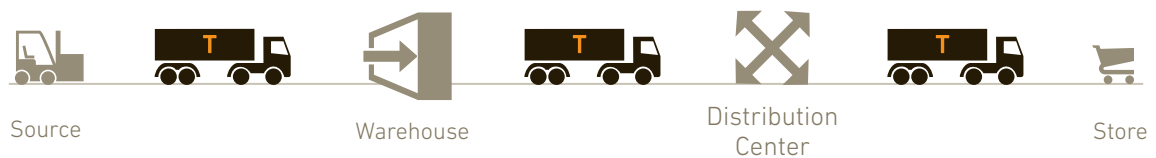


Figure 1 - Simple supply chain

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:

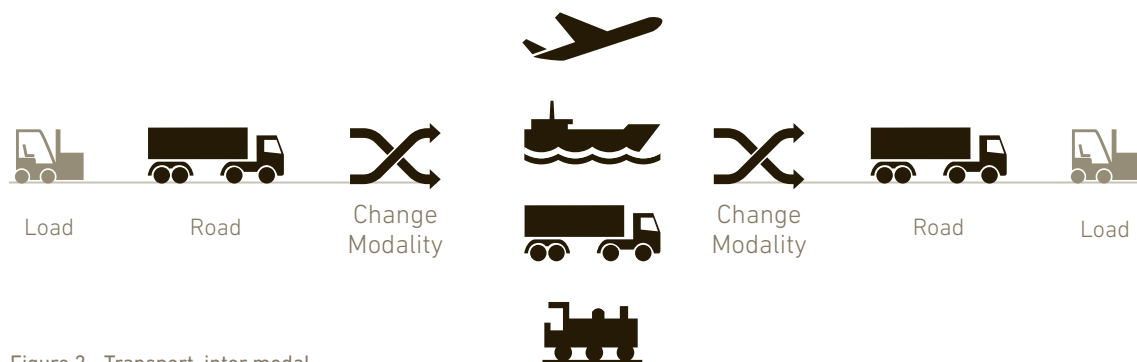


Figure 2 - Transport\_inter modal



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

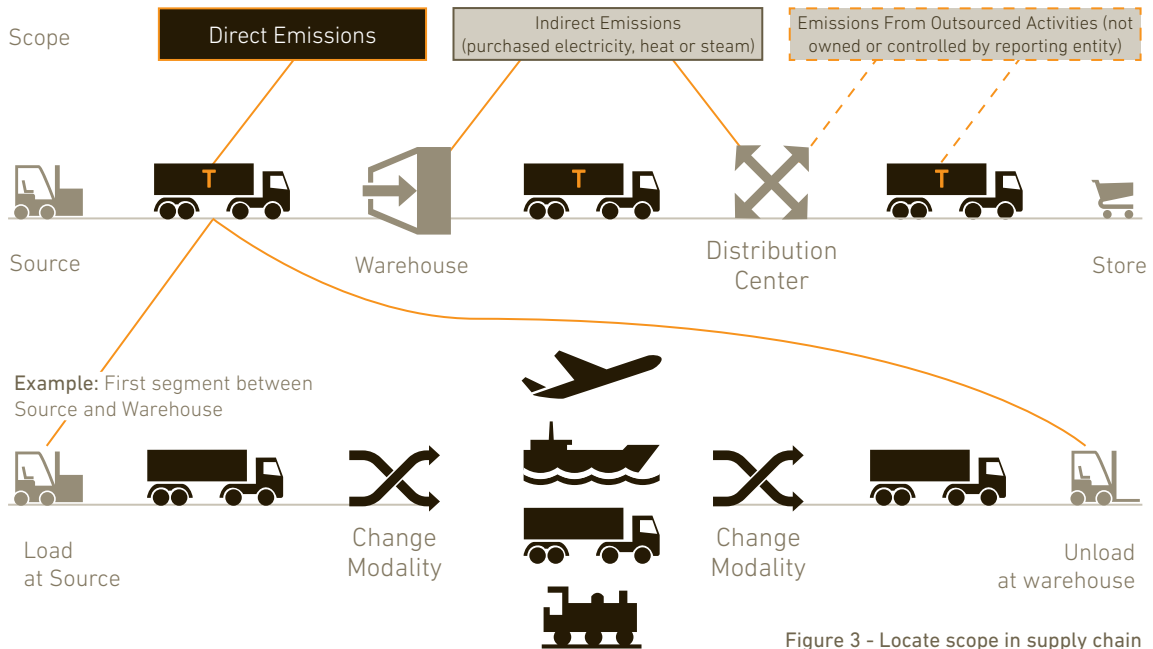


Figure 3 - Locate scope in supply chain

## 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, multi-modal 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<sub>2</sub>e emission reporting for manufacturing separate, as this allows for analysis and details focused on manufacturing specifics.

Eventually, the CO<sub>2</sub>e 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<sub>2</sub>e 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)



2

## Measuring CO<sub>2</sub>e & Energy Consumption

Total CO<sub>2</sub>e emissions of the reporting company year-on-year (your carbon footprint) are separated by GHG scope and by distribution activity. This allows the company to follow the evolution of its CO<sub>2</sub>e-emissions over time, including any impacts caused by fluctuations in the size of the company.

CO<sub>2</sub>e effectiveness standardizes the CO<sub>2</sub>e-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<sub>2</sub>e effectiveness depends on the CO<sub>2</sub>e efficiency of the transport network, the distance travelled and warehousing infrastructure.

CO<sub>2</sub>e efficiency measures how efficiently the products are transported and stored. Lower figures stand for higher efficiency. The transport CO<sub>2</sub>e-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<sub>2</sub>e 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 <sup>2</sup>
Total CO <sub>2</sub> e - emissions	Tonnes of CO <sub>2</sub> e emitted per year	Tonnes of CO <sub>2</sub> e emitted per year
CO <sub>2</sub> e - effectiveness	Kg CO <sub>2</sub> e /Unit of Business <sup>1</sup>	Kg CO <sub>2</sub> e /Unit of business <sup>1</sup>
CO <sub>2</sub> e - efficiency	kg CO <sub>2</sub> e / tonne.km	kg CO <sub>2</sub> e / pallet-stored Kg CO <sub>2</sub> e/ m <sup>2</sup>

<sup>1)</sup> Unit of Business is the one used by each company for reporting and managing operations (e.g. m<sup>3</sup> sold, HL sold, tons sold, euro)

<sup>2)</sup> 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<sub>2</sub>e emissions (See page 15 graph)

The total CO<sub>2</sub>e emissions figure indicates the overall GHG impact of the company covering the scope as defined earlier.

The total CO<sub>2</sub>e emissions figure depends not only upon the figures for CO<sub>2</sub>e effectiveness and CO<sub>2</sub>e efficiency but also on the overall volume of the reporting company.

It is therefore important to map the trend of the total CO<sub>2</sub>e emissions against that of company growth.

### CO<sub>2</sub>e effectiveness (See page 15 graph)

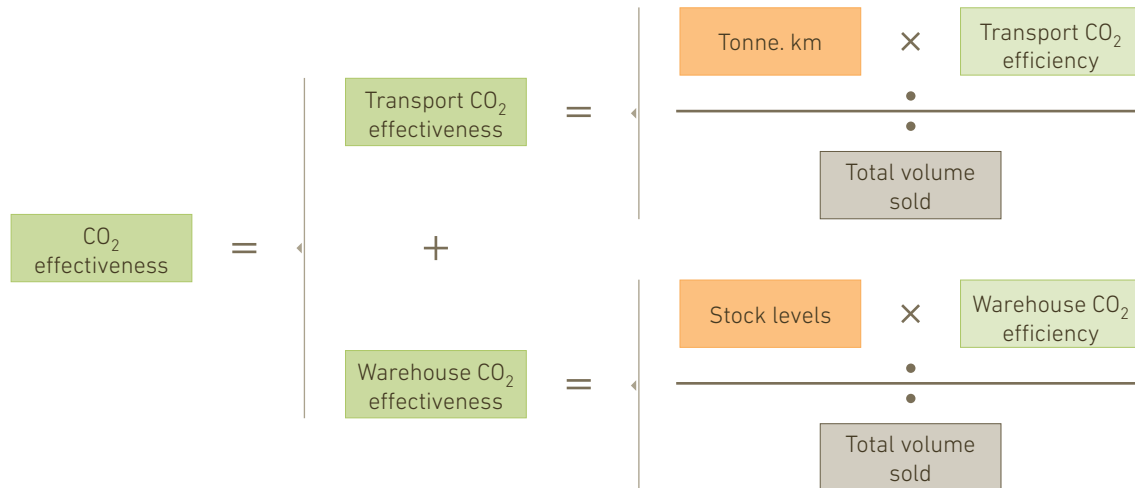


Figure 4 - CO<sub>2</sub> Effectiveness

The **CO<sub>2</sub>e effectiveness** measures the overall performance of the supply chain as a ratio of the total tonnes of CO<sub>2</sub>e emitted against the overall volume of products sold. The lower the reported figure the more effective the operations are. The CO<sub>2</sub>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<sub>2</sub>e efficiency (See page 15 graph)

**CO<sub>2</sub>e efficiency** measures the efficiency of a specific activity (e.g. transport or warehousing).

The transport CO<sub>2</sub>e efficiency is showing how much CO<sub>2</sub>e is emitted for every tonne of product transported over 1 km. The transport CO<sub>2</sub>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<sub>2</sub>e efficiency of 70 g CO<sub>2</sub>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<sub>2</sub>e-emissions than supply chain A because they use more fuel travelling greater distances:

Supply chain A:

$$100'000 \text{ tonnes} * 100 \text{ km} * 70 \text{ g CO}_2\text{e/tonne.km} = 700'000 \text{ kg CO}_2\text{e}$$

Supply chain B:

$$100'000 \text{ tonnes} * 500 \text{ km} * 70 \text{ g CO}_2\text{e/tonne.km} = 3'500'000 \text{ kg CO}_2\text{e}$$

The KPI "transport CO<sub>2</sub>e-effectiveness" of supply chain A is 7 kg CO<sub>2</sub>e per tonne of product and for supply chain B it is 35 kg CO<sub>2</sub>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<sub>2</sub>e-effectiveness of 30 kg CO<sub>2</sub>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<sub>2</sub>e-emissions (effectiveness) are identical for both supply chains:

Supply chain A and B :

$$100'000 \text{ tonnes} * 30 \text{ kg CO}_2\text{e/tonne of product} = 3'000'000 \text{ kg CO}_2\text{e}$$

However the transport CO<sub>2</sub>e -efficiency is different

Supply chain A:

$$3'000'000 \text{ kg CO}_2\text{e} / (100'000 \text{ tonnes} * 100\text{km}) = 300 \text{ gr CO}_2\text{e} / \text{tonne.km}$$

Supply chain B:

$$3'000'000 \text{ kg CO}_2\text{e} / (100'000 \text{ tonnes} * 500\text{km}) = 60 \text{ gr CO}_2\text{e} / \text{tonne.km}$$

The supply chain B reports therefore a better CO<sub>2</sub>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<sub>2</sub>e emissions for transport

(See page 15 graph)

The approach for the calculation of CO<sub>2</sub>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<sub>2</sub>e emissions by using the specific CO<sub>2</sub>e conversion 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<sub>2</sub>e emissions for outsourced transport.

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

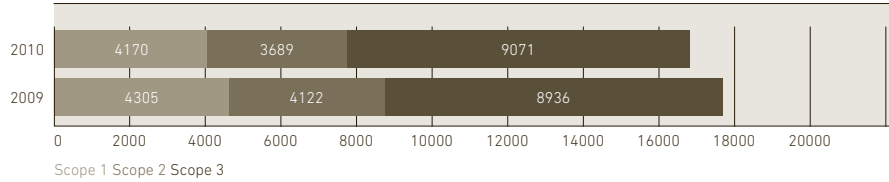
	Available data	Intermediate steps	Final result
1	Data on amount of fuel is available by fuel type		CO <sub>2</sub> e emissions = litre of fuel used x emission factor of fuel type (g CO <sub>2</sub> e per lt)
2	Data on distance travelled and vehicle's efficiency is available (lt/100km or mpg)	Fuel used = distance x vehicle's efficiency	CO <sub>2</sub> e emissions = litre of fuel used x emission factor of fuel type (g CO <sub>2</sub> e per lt)
3	Data on distance travelled by vehicle type is available	Fuel used = distance x standard vehicle's efficiency	CO <sub>2</sub> e emissions = litre of fuel used x emission factor of fuel type (g CO <sub>2</sub> e per lt)
4	Data on distance travelled by transport, tonnage and vehicle type available	Calculate tonne.km = distance travelled x tonnage	CO <sub>2</sub> e emissions = tonne.km x emissions factor for vehicle type (g CO <sub>2</sub> 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<sub>2</sub>e efficiency factors of the different transport modes – indicated in “g CO<sub>2</sub>e e per tonne.km” – and multiply these with the transport volume, expressed in “tonne.km”, as shown in the calculation approach 4.

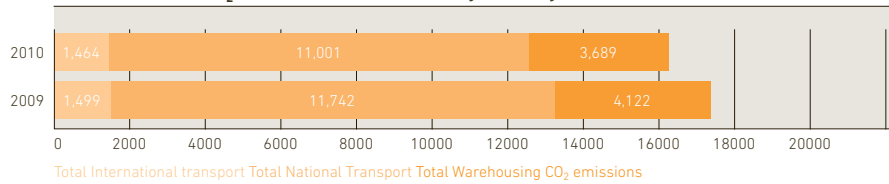
### Example of a company's CO<sub>2</sub>e-reporting

The CO<sub>2</sub>e-reporting should include at least the KPIs defined in this document. A graphical representation makes the year-on-year evolution more visible.

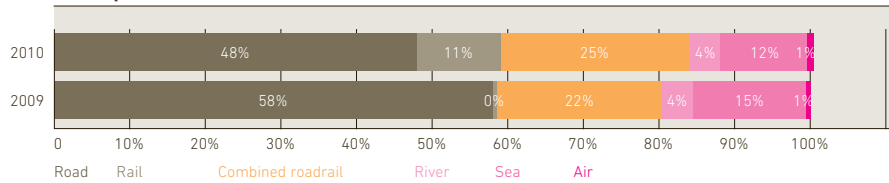
**Distribution - CO<sub>2</sub>e emissions (tonnes) by GHG scope**



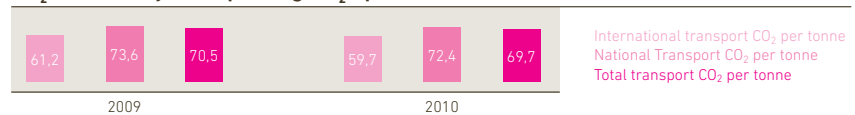
**Distribution - CO<sub>2</sub>e emissions (tonnes) by activity**



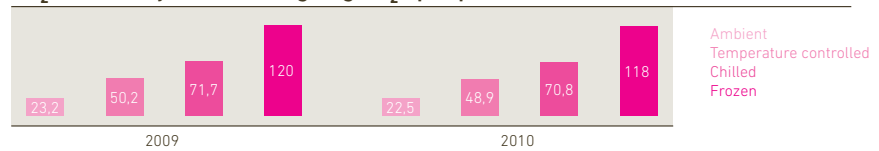
**Transport modes**



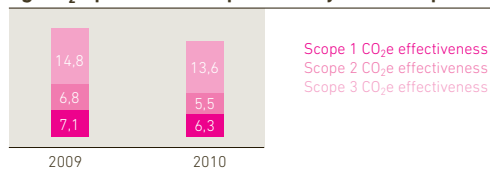
**CO<sub>2</sub>e efficiency transport - g CO<sub>2</sub>e per tonne.km**



**CO<sub>2</sub>e efficiency warehousing - kg CO<sub>2</sub>e per pallet stored**



**CO<sub>2</sub>e effectiveness  
kg CO<sub>2</sub>e per tonne of product by GHG scope**



**CO<sub>2</sub>e effectiveness  
kg CO<sub>2</sub>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 CO<sub>2</sub>-reporting, when no other emission factors are available from local governmental organizations. Once the CO<sub>2</sub>-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 <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O	Total Direct GHG
Fuel Type	Units	kg CO <sub>2</sub> per unit	kg CO <sub>2</sub> e per unit	kg CO <sub>2</sub> e per unit	kg CO <sub>2</sub> e 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/>

### CO<sub>2</sub>e emission factors by weight distance (tonne.km) for freight

Transport mode	Kg CO <sub>2</sub> e 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 CO<sub>2</sub>e 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<sub>2</sub> emissions calculation for road freight

Available Data	Intermediate steps	Final result	
<b>1 Data on amount of fuel is available by fuel type</b>			
Total fuel usage: 1'000'000 lt of Diesel (100% mineral diesel)		1'000'000 lt * 2.6676 kg CO <sub>2</sub> e per lt	2.667.600 kg of CO <sub>2</sub> e
500'000 lt of Petrol (100% mineral petrol)		500'000 lt * 2.3117 kg CO <sub>2</sub> e per lt	1.155.850 kg of CO <sub>2</sub> e
			<b>Total 3.823.450 kg of CO<sub>2</sub>e</b>

<b>2 Data on distance travelled and vehicle's efficiency is available</b>				
Truck A: 150'000 km, 33.4 lt / 100 km - Diesel	Diesel used = 150'000 km * 33.4 lt / 100km	50.100 lt of Diesel	50'100 lt * 2.6676 kg CO <sub>2</sub> e per lt	133.647 kg of CO <sub>2</sub> e
Truck B: 90'000 km, 36.2 lt / 100 km - Diesel	Diesel used = 90'000 km * 36.2 lt / 100km	32.580 lt of Diesel	32'580 lt * 2.6676 kg CO <sub>2</sub> e per lt	86.910 kg of CO <sub>2</sub> e
Truck C: 90'000 km, 28.4 lt / 100 km - Petrol	Petrol used = 90'000 km * 28.4 lt / 100 km	25.560 lt of Diesel	25'560 lt * 2.3117 kg CO <sub>2</sub> e per lt	59.087 kg of CO <sub>2</sub> e
				<b>Total 279.644 kg of CO<sub>2</sub>e</b>

<b>3 Data on distance travelled by vehicle type is available</b>					
1'000'000 km travelled with 40 tons truck	40 tons truck using in average 32.0 lt / 100 km	Fuel used = 1'000'000 km * 32.0 lt / 100 km	320.000 lt of Diesel		
2'500'000 km travelled with 28 tons truck	28 tons truck using in average 27.2 lt / 100 km	Fuel used = 2'500'000 km * 27.2 lt / 100 km	680.000 lt of Diesel		
<b>Total</b>			<b>1.000.000 lt of Diesel</b>	<b>1'000'000 lt * 2.6676 kg CO<sub>2</sub>e per lt</b>	<b>Total 2.667.600 kg of CO<sub>2</sub>e</b>

<b>4 Data on distance travelled by transport, tonnage and vehicle type available</b>					
Shuttle from factory to DC A, 150 km distance, 500'000 tonnes trans- port in articulated HGV	standard articulated HGV efficiency = 0,0887 Kg CO <sub>2</sub> e per tonne.km	tonne.km = 500'000 tonnes * 150 km	75.000.000 tonne.km	150'000'000 tonne.km * 0,0887 Kg CO <sub>2</sub> e per tonne.km	6.652.500 kg of CO <sub>2</sub> e
Shuttle from factory to DC B, 75 km distance, 500'000 tonnes trans- port in articulated HGV		tonne.km = 500'000 tonnes * 75 km	37.500.000 tonne.km	37'500'000 tonne.km * 0,0887 Kg CO <sub>2</sub> e per tonne.km	3.326.250 kg of CO <sub>2</sub> e
					<b>Total 9.978.750 kg of CO<sub>2</sub>e</b>

### CO<sub>2</sub> emissions calculation for rail, intermodal, ship and air freight

Available Data	Intermediate steps	Final result		
<b>1 Rail freight</b>				
Rail factory 1 to DC A, 700 km, 500'000 tonnes transported	tonne.km = 500'000 tonnes * 700 km	350.000.000 tonne.km	350'000'000 tonne.km * 0,0285 Kg CO <sub>2</sub> e per tonne.km	9.975.000 kg of CO <sub>2</sub> e
Rail factory 1 to DC B, 1'500 km, 200'000 tonnes transported	tonne.km = 200'000 tonnes * 1'500 km	300.000.000 tonne.km	300'000'000 tonne.km * 0,0285 Kg CO <sub>2</sub> e per tonne.km	8.550.000 kg of CO <sub>2</sub> e
				<b>Total 18.525.000 kg of CO<sub>2</sub>e</b>

<b>2 Air freight</b>				
Air from country A to country B, 10'000 km, 500 tonnes transported	tonne.km = 500 tonnes * 10'000 km	5.000.000 tonne.km	5'000'000 tonne.km * 0,6132 Kg CO <sub>2</sub> e per tonne.km	<b>Total 3.066.000 kg of CO<sub>2</sub>e</b>

## Calculation of total CO<sub>2</sub>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<sub>2</sub>e by applying the specific CO<sub>2</sub>e conversion factor by fuel type.

Electricity consumption is converted into CO<sub>2</sub>e emissions by applying a country-specific conversion factor of indirect CO<sub>2</sub>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 CO<sub>2</sub>-reporting, when no other emission factors are available from local governmental organizations.

### Emission factor for fuel

Converting fuel types by unit volume		CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O	Total Direct GHG
Fuel Type	Units	kg CO <sub>2</sub> per unit	kg CO <sub>2</sub> e per unit	kg CO <sub>2</sub> e per unit	kg CO <sub>2</sub> 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<sub>2</sub>e emissions related to purchased electricity depends on the way this electricity was generated. This conversion factor, in kg CO<sub>2</sub>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<sub>2</sub>e emissions of warehousing.

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

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

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

<sup>2</sup>) 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	1111
	Name	Paris
	Country	Texas, USA
	Contact	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)
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### 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	1111
Name	Paris
Country	Texas, USA
Contact	name@company.com

### Energy Consumption

	Energy in KWh	Energy in GJ
Electricity	1.000.000	3.600
From renewable sources	15%	

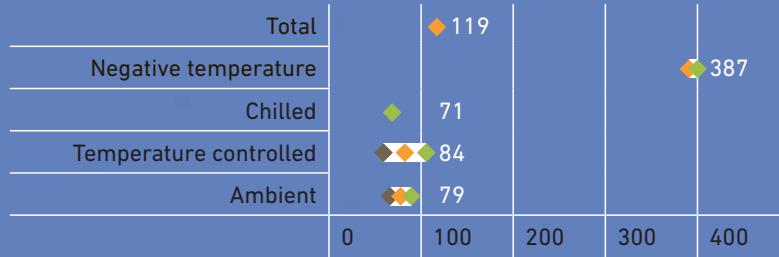
Natural gas	0	0
Diesel	120,333	433
LPG	0	0
Indicate other fuel	0	0
<b>Total energy consumption</b>	<b>1,120,333</b>	<b>4,033</b>

### Energy Consumption analysis

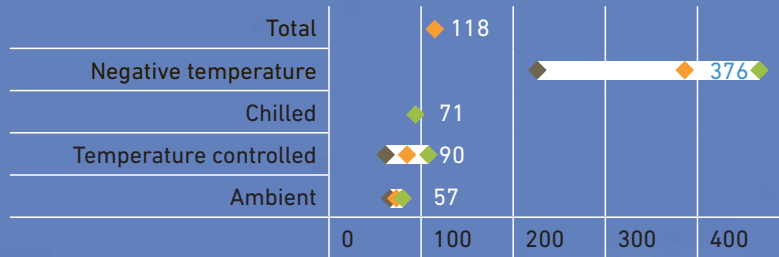
by surface	40	kWh / square meter	142	MJ / square meter
by storage place	43	kWh / pallets	155	MJ / pallets
by storage place	12	kWh / cubic meter	45	MJ / cubic meter
by products distributed	9.0	kWh / tonne (metric ton)	32	MJ / tonne (metric ton)

## Example: benchmarking reporting across your company

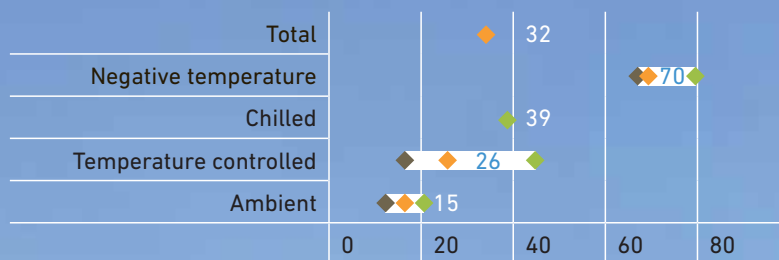
Energy consumption kWh/square meter



Energy consumption kWh/storage place



Energy consumption kWh/tonne of product distributed



# Improving CO<sub>2</sub>e & Energy Consumption

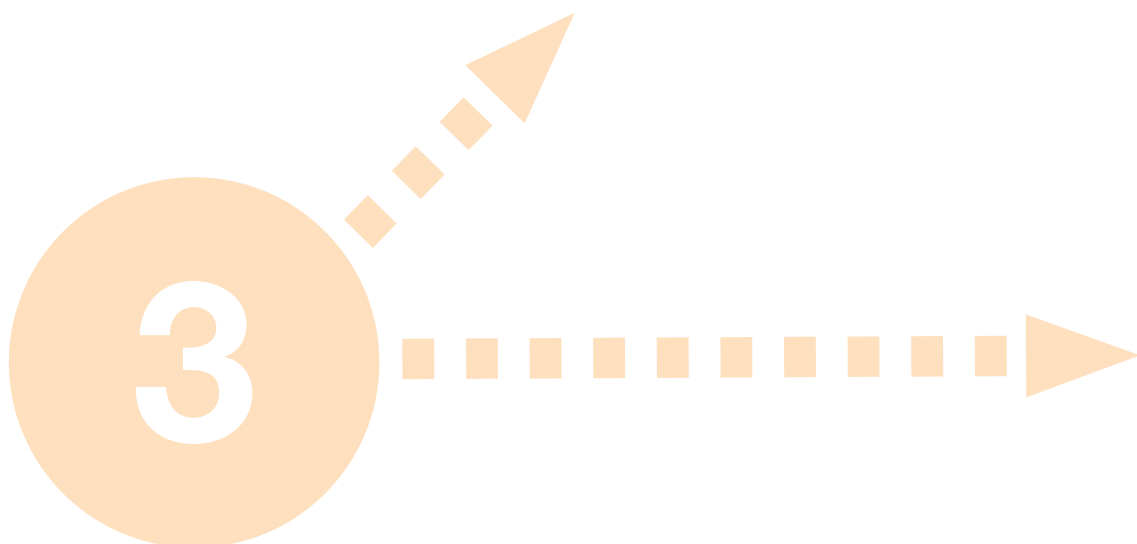
## 1/ Improving CO<sub>2</sub>e

The end goal of decision-makers in logistics has always been to optimize costs, subject to service level constraints. The CO<sub>2</sub>e KPIs defined in this document help to see the impact of the different logistics decisions on CO<sub>2</sub>e emissions.

The following table captures the impact of logistics decisions at different levels – strategic, tactical and operational – on CO<sub>2</sub>e efficiency and CO<sub>2</sub>e effectiveness

### Strategic, Tactical and Operational Levels

Level	Area of Impact	Result
STRATEGIC	Supply Chain Design and Production Allocation (less km, less weight)	Affects CO <sub>2</sub> e <b>effectiveness</b> (via optimizing ton.km vs cost of supply)
	Product Design (less weight)	
	Distribution Network Design	Affects CO <sub>2</sub> e <b>effectiveness</b> and CO <sub>2</sub> e <b>efficiency</b> (via optimizing ton.km, transportation efficiency levels and storage requirements)
	Modal Shift / Transport Mode Selection	Affects CO <sub>2</sub> e <b>efficiency</b> (via shifting to more efficient transportation modes)
TACTICAL	LSP / Carrier selection	Affects CO <sub>2</sub> e <b>efficiency</b> (via selection of more efficient LSPs)
	Fleet Management	Affects CO <sub>2</sub> e <b>efficiency</b> (via improving efficiency of own fleet)
	Inventory Optimisation	Affects CO <sub>2</sub> e <b>effectiveness</b> (via reducing stock levels for same service level)
OPERATIONAL	Route Planning	Affects CO <sub>2</sub> e <b>effectiveness</b> (via reducing kilometers driven while meeting service constraints)
	Order Management & Fulfilment	Affects CO <sub>2</sub> e <b>efficiency</b> (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 - right-sized warehouse	Affects <b>Energy efficiency</b> - no energy waste through oversized operations
	Shared warehouses with other companies	Affects <b>Energy efficiency</b> , as warehouse space and operations can be optimized for larger operations.
TACTICAL	Warehouse design - isolation - heat reflection on roofs and walls - natural lighting - low energy bulbs - movement sensors for lighting - coupled electricity/heat generation - etc.	Affects <b>Energy efficiency</b>
	Inventory Optimisation	Affects <b>Energy effectiveness</b> (via reducing stock levels for same service level)
OPERATIONAL	Best practices for warehouses - avoidance of unnecessary movements in warehouse - avoidance of energy loss in refrigerated/negative temperature warehouse (no open doors etc.) - preventive maintenance of warehouse equipment	Affects <b>Energy effectiveness and efficiency</b>

## 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

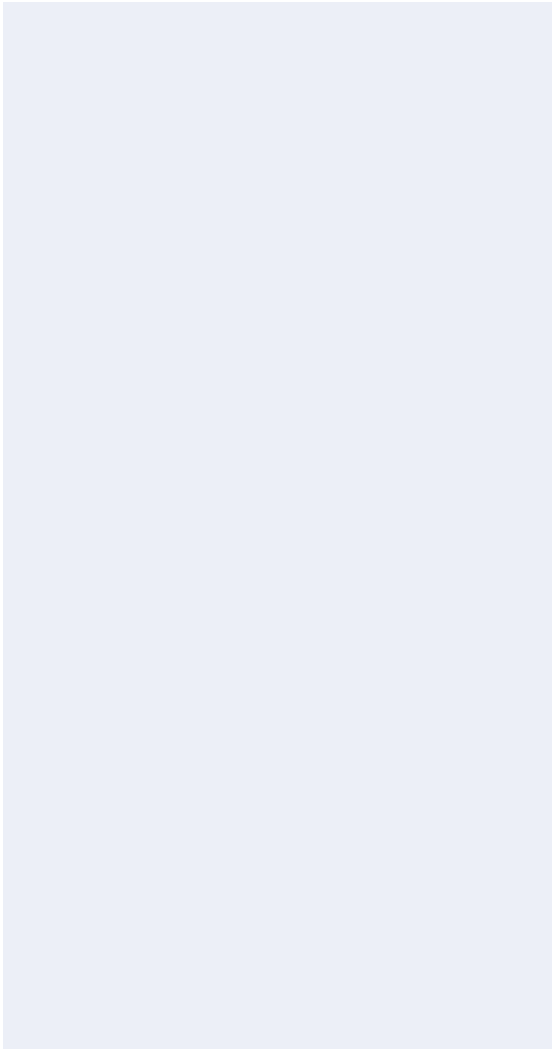
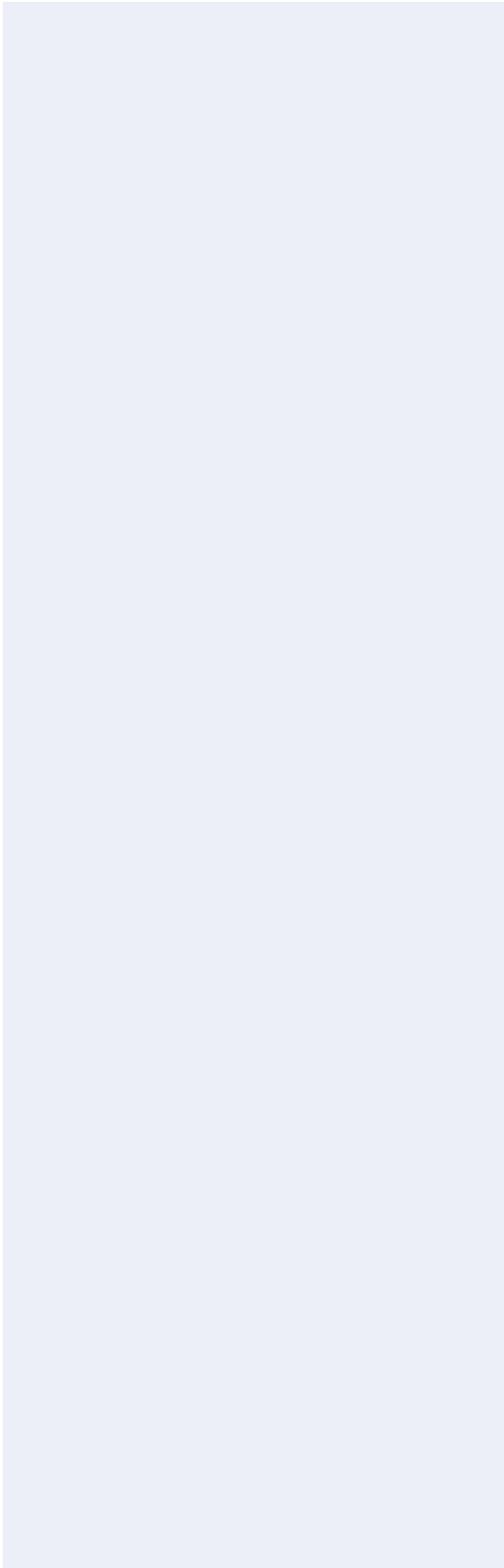
The activities of the Consumer Goods Forum is organised into a series of strategic pillars. 'Sustainability' is one of the strategic pillars.

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.

My Notes:





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