

HOW-TO GUIDE · SCOPE 3

How to calculate Scope 3 emissions in Excel: a step-by-step guide with formulas

DEISO · How-to guide · 11 steps

Scope 3 emissions are the indirect greenhouse gas emissions in your value chain — from the materials you buy to the use and disposal of what you sell. For most companies they are the largest part of the footprint, and you can calculate them in Excel with one equation applied consistently.

This guide walks through the full method, step by step: the core formula, the 15 categories, the four calculation methods, emission factors, unit conversion, CO₂e conversion, the Excel model, quality checks and reporting. Every formula is shown, and a worked example runs from raw data to a final total.

WHAT YOU WILL HAVE AT THE END

- A clear formula for every Scope 3 category
- An Excel model that calculates emissions automatically from activity data
- Quality checks that catch missing factors and unit mismatches
- A worked example you can reproduce with the free DEISO calculator

STEP 1

1

Understand the core equation

Every Scope 3 calculation follows the same structure: an amount of activity multiplied by an emission factor for that activity.

$$E = AD \times EF$$

- **E** — emissions, in kg CO₂e
- **AD** — activity data: the amount of activity, such as kg purchased, tonne-km shipped or kWh used

- **EF** — emission factor: the emissions per unit of activity, such as kg CO₂e per kg

Applied to each activity i and summed, it gives your total Scope 3 emissions:

$$E_i = AD_i \times EF_i$$

$$E_{\text{Scope 3}} = \sum_i (AD_i \times EF_i)$$

When your emission factors are given per gas rather than in CO₂e, calculate each gas separately and convert with its global warming potential (Step 8):

$$E_{i,g} = AD_i \times EF_{i,g} \rightarrow E_{\text{CO}_2\text{e}} = \sum_g (E_g \times \text{GWP}_g)$$

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STEP 2

Screen the 15 Scope 3 categories

The GHG Protocol Corporate Value Chain (Scope 3) Standard divides value-chain emissions into 15 categories. Start by screening all 15 to find the ones that matter most for your company, then focus data collection there.

UPSTREAM	DOWNSTREAM
1. Purchased goods and services	9. Downstream transportation and distribution
2. Capital goods	10. Processing of sold products
3. Fuel- and energy-related activities	11. Use of sold products
4. Upstream transportation and distribution	12. End-of-life treatment of sold products
5. Waste generated in operations	13. Downstream leased assets
6. Business travel	14. Franchises
7. Employee commuting	15. Investments
8. Upstream leased assets	

Report every relevant category, and document the reason for any category you exclude. The inventory should cover all seven Kyoto gases: CO₂, CH₄, N₂O, HFCs, PFCs, SF₆ and NF₃.

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STEP 3

Choose a calculation method

Four methods are used in practice. They share the same equation; what differs is the quality of the data behind each factor.

METHOD	FORMULA	WHEN TO USE
Supplier-specific	$E = \sum Q_j \times EF_{\text{supplier},j}$	Suppliers provide product-level emissions data
Hybrid	$E = \sum AD_i \times EF_i$, mixing supplier and secondary data	The usual approach for material categories
Average-data	$E = \sum AD_i \times EF_{\text{average},i}$	Physical quantities are known, supplier data is not
Spend-based	$E = \sum \text{Spend}_i \times EF_{\text{EEIO},i}$	Screening, or when only spend data exists

Spend-based factors come from environmentally extended input–output (EEIO) models and are expressed per unit of currency (kg CO₂e per USD, for example). Use them for screening and fill gaps with physical data as it becomes available.

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STEP 4

Collect activity data

Activity data is the backbone of the inventory. Record one row per activity, with the quantity, its unit and the emission factor it links to.

CATEGORY	ACTIVITY	QUANTITY	UNIT	REGION	EF_ID
1 Purchased goods	Steel procurement	10,000	kg	Global	EF_STEEL_01
1 Purchased goods	Plastic procurement	2,500	kg	Global	EF_PLASTIC_01
4 Upstream transport	Road freight	20,000	tonne-km	EU	EF_TRUCK_EU
6 Business travel	Long-haul air travel	15,000	passenger-km	Global	EF_AIR_LONG
7 Employee commuting	Car commuting	120,000	passenger-km	Japan	EF_CAR_JP
5 Waste	Landfill waste	350	tonne	Japan	EF_LANDFILL_JP
3 Fuel upstream	Natural gas upstream	50,000	kWh	Japan	EF_NG_UPSTREAM
11 Use of sold products	Appliance electricity use	400,000	kWh	US	EF_GRID_US

Typical sources are purchase orders and invoices, ERP exports, carrier reports, travel booking data, employee surveys, waste manifests and supplier questionnaires. Record the source and a data quality rating (primary, secondary or estimated) for every row.

5 STEP 5 Select emission factors

Match each activity to an emission factor with the same unit, geography and system boundary. Follow this order for every row:

- Identify the activity data type and its unit
- Find a factor with a matching unit
- Convert the activity unit if it does not match (Step 6)
- Check the factor's system boundary
- Apply the factor, convert gases to CO₂e, and aggregate

A key boundary rule: life cycle factors for fuels already include combustion. For Category 3, use only the upstream part, or you will double-count Scope 1:

$$EF_{\text{upstream}} = EF_{\text{life cycle}} - EF_{\text{combustion}}$$

Common factor sources include government sets (UK DESNZ conversion factors, US EPA Emission Factors Hub, Japan's national factors), international bodies (IPCC, IEA, ICAO, IMO, the GLEC Framework for freight), life cycle databases (ecoinvent, LCA for Experts (GaBi), IDEA for Japan) and EEIO models (USEEIO, EXIOBASE).

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STEP 6

Convert units

The activity unit must match the factor's denominator. Convert before multiplying.

FROM	TO	CONVERSION
kg	tonne	$\text{tonne} = \text{kg} \times 0.001$
tonne and km	tonne-km	$\text{tonne-km} = \text{tonne} \times \text{km}$
MWh	kWh	$\text{kWh} = \text{MWh} \times 1,000$
one-way km	round-trip km	$\text{round trip} = \text{one-way} \times 2$

Freight is the most common conversion. A 25-tonne shipment over 800 km is:

$$\text{Tonne-km} = 25 \times 800 = 20,000 \text{ tonne-km}$$

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STEP 7

Calculate each category

Each category applies the core equation to its own activity data. Use this formula library:

CATEGORY	FORMULA
1 Purchased goods and services	$E = \sum \text{Mass}_i \times \text{EF}_{\text{material},i} \text{ or } \sum \text{Spend}_i \times \text{EF}_{\text{sector},i}$
2 Capital goods	$E = \sum \text{Quantity}_i \times \text{EF}_{\text{product},i}$
3 Fuel- and energy-related	$E = \sum \text{Fuel}_f \times \text{EF}_{\text{upstream},f} + \text{Electricity} \times \text{EF}_{\text{life cycle}} \times \text{Loss rate}$
4 Upstream transportation	$E = \sum \text{Mass}_i \times \text{Distance}_i \times \text{EF}_{\text{transport},i} \text{ or } \sum \text{Fuel}_f \times \text{EF}_f$
5 Waste in operations	$E = \sum \text{Waste}_i \times \text{EF}_{\text{treatment},i}$
6 Business travel	$E = \sum \text{Distance}_i \times \text{EF}_{\text{mode},i} + \text{Nights} \times \text{EF}_{\text{hotel}}$
7 Employee commuting	$\text{Distance}_{\text{annual}} = \text{Employees} \times \text{One-way km} \times 2 \times \text{Working days}; E = \sum \text{Distance}_{\text{mode}} \times \text{EF}_{\text{mode}}$
8 Upstream leased assets	$E = \sum \text{Fuel}_f \times \text{EF}_f + \text{Electricity} \times \text{EF}_{\text{grid}}$
9 Downstream transportation	$E = \sum \text{Mass}_i \times \text{Distance}_i \times \text{EF}_{\text{transport},i}$
10 Processing of sold products	$E = \sum \text{Fuel}_f \times \text{EF}_f + \sum \text{Process emission}_p \times \text{GWP}_p$
11 Use of sold products	$E = \text{Units sold} \times \text{Annual energy} \times \text{Lifetime} \times \text{EF}_{\text{energy}}$
12 End-of-life treatment	$E = \sum_m \sum_t \text{Mass}_m \times \text{Share}_t \times \text{EF}_{m,t}$
13 Downstream leased assets	$E = \text{Fuel} \times \text{EF}_{\text{fuel}} + \text{Electricity} \times \text{EF}_{\text{grid}}$
14 Franchises	$E = \sum (E_{\text{Scope 1},i} + E_{\text{Scope 2},i})$
15 Investments	$E = \sum (E_{\text{Scope 1+2, investee}} \times \text{Share of investment})$

STEP 8

8

Convert gases to CO₂e

When you have emissions per gas, multiply each by its 100-year global warming potential (GWP) and add them up:

$$\text{CO}_2\text{e} = m_{\text{CO}_2} + m_{\text{CH}_4} \times \text{GWP}_{\text{CH}_4} + m_{\text{N}_2\text{O}} \times \text{GWP}_{\text{N}_2\text{O}}$$

GAS	GWP100 (IPCC AR6)
CO ₂	1
CH ₄ (fossil)	29.8
CH ₄ (non-fossil)	27.0
N ₂ O	273
HFC-134a	1,530
HFC-23	14,600
CF ₄ (PFC-14)	7,380
SF ₆	25,200
NF ₃	17,400

Example: 10 kg of fossil methane is $10 \times 29.8 = 298$ kg CO₂e. Use one GWP set consistently across the whole inventory, and state which one you used.

9 STEP 9 Build the Excel model

A clean model separates inputs, factors and calculations, so every number can be traced. The free DEISO calculator uses this structure:

- **Activity_Data** — the only sheet you type in: one row per activity
- **EF_Library** — the controlled list of emission factors, with source and boundary
- **GWP_Table** — global warming potentials for gas-specific factors
- **Unit_Conversion** — conversions and small calculators for tonne-km and commuting
- **Calc** — formulas only: pulls each factor and calculates emissions
- **QA_Checks** — automatic checks for missing data and mismatches
- **Summary** — totals by category, shares and a chart
- **Source_Log and Assumptions** — the audit trail for every factor and assumption

The key formula looks up the factor for each row and multiplies it by the quantity. In Excel 365:

```
=Quantity * XLOOKUP(EF_ID, EF_Library!A:A, EF_Library!I:I)
```

For compatibility with every Excel version, the calculator uses INDEX and MATCH:

```
=Quantity * INDEX(EF_Library!I:I, MATCH(EF_ID, EF_Library!A:A, 0))
```

When a factor is given per gas instead of in CO₂e, the calculator switches automatically to the gas route: CO₂ + CH₄ × GWP + N₂O × GWP.

STEP 10

10

Run quality checks

Before you report, check the inventory for the errors that most often distort Scope 3 results:

CHECK	WHAT IT CATCHES
Missing EF_ID	Activities with no factor assigned
Factor not found	An EF_ID that does not exist in the library
Unit mismatch	Activity units that differ from the factor unit
Zero result	A quantity above zero that produced zero emissions
Duplicate Record_ID	The same activity counted twice
Missing geography	Rows where the factor region cannot be checked

In Excel, a missing-factor check is as simple as `=COUNTIF(Activity_Data!K:K, "")` for the rows you have filled. All checks should pass before the numbers leave the workbook.

STEP 11

11

Aggregate and report

Sum the row results by category, and report each category's share of the total. The example data from Step 4 gives:

CATEGORY	ACTIVITY	CALCULATION	EMISSIONS (KG CO ₂ E)
1	Steel procurement	$10,000 \times 1.90$	19,000
1	Plastic procurement	$2,500 \times 2.70$	6,750
3	Natural gas upstream	$50,000 \times 0.02$	1,000
4	Road freight	$20,000 \times 0.10$	2,000
5	Landfill waste	350×450	157,500
6	Long-haul air travel	$15,000 \times 0.15$	2,250
7	Car commuting	$120,000 \times 0.19$	22,800
11	Appliance electricity use	$400,000 \times 0.38$	152,000
Total Scope 3			363,300 (363.3 t CO ₂ e)

ILLUSTRATIVE VALUES

The emission factors in this example are training values chosen to show the method. Replace them with factors from a recognised source before you report any result.

AVOID THESE

Common Scope 3 mistakes

- **Double-counting fuel** — using a full life cycle factor in Category 3 instead of the upstream part only
- **Unit mismatches** — multiplying tonnes by a factor per kg, or kilometres by a factor per tonne-km
- **Mixed GWP sets** — combining AR5 and AR6 values in one inventory
- **Spend-based only** — never moving the largest categories to physical or supplier data
- **No audit trail** — factors without a recorded source, year and boundary

FREE DOWNLOADS

Scope 3 Excel calculator and PDF guide

Reproduce the worked example with the free DEISO Scope 3 calculator: activity data, emission factor library, automatic CO₂e calculation, quality checks and a category summary. A printable PDF version of this guide is also available.

Download the calculator and the online version of this guide at www.dei.so.

FAQ

Scope 3 calculation: frequently asked questions

What is the formula for calculating Scope 3 emissions?

Scope 3 emissions are calculated as activity data multiplied by an emission factor, $E = AD \times EF$, for each activity, and then summed across all activities and categories.

How many Scope 3 categories are there?

The GHG Protocol Corporate Value Chain (Scope 3) Standard defines 15 categories: 8 upstream and 7 downstream.

Do I have to report all 15 Scope 3 categories?

You should report every relevant category and document the reason for excluding any category that is not relevant or not material.

Which Scope 3 calculation method should I use?

Use supplier-specific or hybrid methods for the categories that matter most, average-data methods where you know physical quantities, and spend-based methods for screening or where only spend data exists.

Can I calculate Scope 3 emissions in Excel?

Yes. A well-structured Excel model with an activity data sheet, an emission factor library, a calculation sheet and quality checks is enough for a complete, auditable Scope 3 inventory.

Which GWP values should I use?

Use one set consistently. Current practice is the 100-year global warming potentials from the IPCC Sixth Assessment Report (AR6), for example 29.8 for fossil methane and 273 for nitrous oxide.

DEISO TRAINING

Scope 3 emissions and product carbon footprint (PCF)

Practical Scope 3 value-chain accounting and **product carbon footprint** analysis on the **GHG** Protocol framework — instructor-led, for sustainability professionals, engineers and consultants.

View the training: dei.so/carbon-footprint-scope-3-training →

NEXT STEP

Need a Scope 3 inventory built for you?

DEISO builds GHG Protocol and ISO 14064-1 inventories, including Scope 3 screening across all 15 categories and Scope 3-only inventories. Visit www.dei.so or email info@dei.so.