



MLGP4
CLIMATE

How is carbon reduction calculated?

GHG Protocol based calculation logic for mitigation projects, and an introduction to the CITY-ACCEL Carbon Calculation Tool



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Why do we calculate carbon reduction?

The financier's first question: how many tonnes of CO₂e does this project avoid each year?



tCO₂e/yr

One question, one answer, for every project



The result goes into the Impact and indicators section of the Project Definition Form.

Credible and transparent

1

Reduction is calculated with a shared method in which every step can be traced.

A shared language

2

The same concepts and principles make different projects comparable.

Alignment with financiers

3

Funds and banks run different programmes; a common logic makes it easier to align across them.

Source: GHG Protocol for Project Accounting (WRI and WBCSD), Section 1.1. Photo: same report

Reduction is not a measurement, it is a comparison

A project is assessed against a 'without the project' scenario

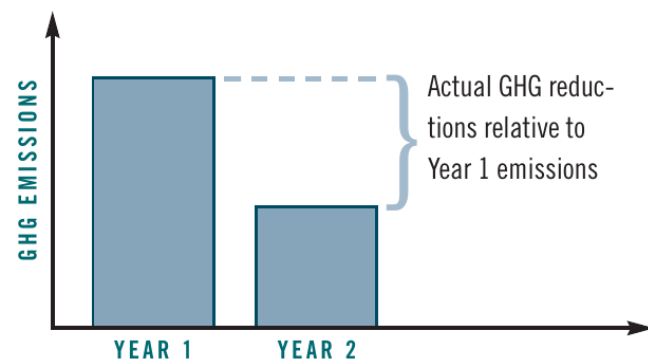


FIGURE 2.1a: Comparison against a base year for corporate/entity accounting

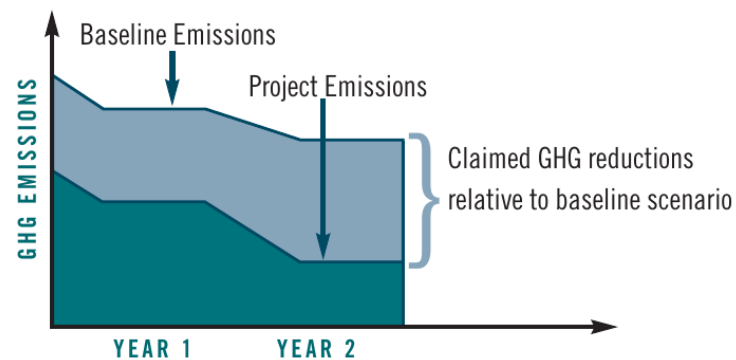


FIGURE 2.1b: Comparison against a baseline scenario for project accounting

TERMS IN FIGURE (b)

Baseline emissions

Upper line: emissions without the project

Project emissions

Dark area: emissions with the project

Claimed reductions

Light area: the gap between the two

FIGURE 2.1a • INVENTORY (LIKE A SECAP BASE YEAR)

Compares against an actual past year.

FIGURE 2.1b • PROJECT ACCOUNTING

Compares against a hypothetical baseline that never happened.

The hardest step in a project is defining the baseline correctly.

Source and figure: GHG Protocol for Project Accounting (WRI and WBCSD), Figure 2.1 (term explanations added)



Six concepts carry the whole calculation

Key terms from Chapter 2 of the GHG Protocol

1 Project activity

A specific action meant to change emissions, sinks or storage. The calculation is done separately for each activity.

2 Primary effect

The intended change in emissions. There is usually a single primary effect per activity.

3 Secondary effect

An unintended change. Usually small, but it can weaken the primary effect. The Protocol uses this term instead of 'leakage'.

4 Baseline scenario

What would most likely have happened without the project: a hypothetical reference case.

5 Additionality

Reductions that would happen anyway do not count. The Protocol asks for no separate test and builds it implicitly into the baseline procedure.

6 Assessment boundary

Primary effects and significant secondary effects. It is not a physical or legal project boundary.

Source: GHG Protocol for Project Accounting, Sections 2.1 to 2.14 and 1.5



The calculation takes six steps

GHG Protocol Chapters 5 to 11: from boundary to report

1 Draw the boundary

Identify the project activities, primary effects and significant secondary effects.

Chapter 5

2 Choose the baseline procedure

Choose between the project-specific and performance standard procedures, and justify the choice.

Chapter 6

3 Identify baseline candidates

List the alternative technologies and practices that could provide the same service.

Chapter 7

4 Estimate baseline emissions

Calculate the emissions of the no-project case with the chosen procedure.

Chapters 8 and 9

5 Monitor and calculate

Collect data per the monitoring plan, then compare baseline and project emissions.

Chapter 10

6 Report

Document the boundary, assumptions, data and result transparently.

Chapter 11

 **The Excel tool simplifies this chain for municipalities: baselines and emission factors are built in, the municipality enters its activity data.**

Source: GHG Protocol for Project Accounting, Part II (Chapters 5-11)



Effects: intended and unintended

The assessment boundary consists of primary effects and significant secondary effects

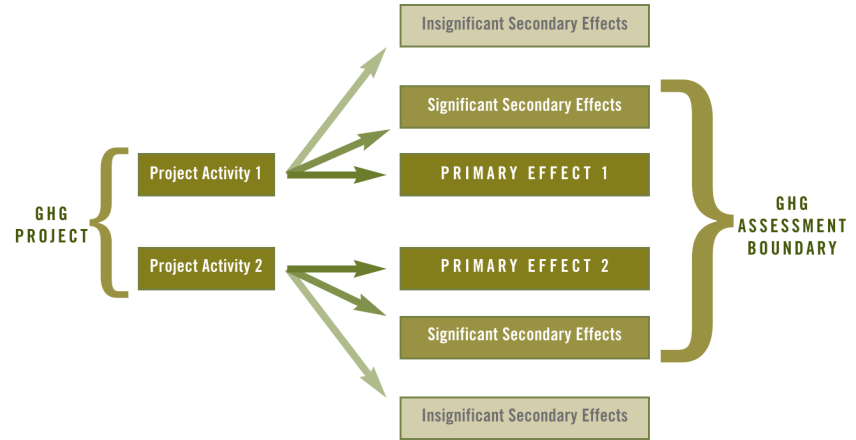
PRIMARY EFFECT: SIX GENERAL TYPES

Combustion emissions from grid electricity generation
Combustion emissions from energy or off-grid electricity generation
Industrial process emissions
Fugitive emissions
Waste emissions
Increased biological storage or uptake

IN THE TOOL

Solar PV, LED, building electricity
Fuel switching, building fuel
Not in the tool
Not in the tool
Waste management, wastewater
Green space (sink, not added to totals)

FIGURE 5.1 The GHG assessment boundary



Secondary effects and significance

One-time: construction, installation, decommissioning.
Recurring: inputs (upstream) and products (downstream). Only significant ones count. The tool covers the operating phase; embedded carbon is out of scope.

Source and figure: GHG Protocol for Project Accounting, Figure 5.1, Sections 2.4 and 5.2; CITY-ACCEL Carbon Calculation Tool, README sheet (OKU)



The baseline is built with two procedures

The Protocol states clearly when each procedure is suitable

Project-specific procedure

HOW IT WORKS

A structured analysis of the project and its alternatives identifies a baseline scenario specific to that project.

WHEN IT IS PREFERRED

- When the number of baseline candidates is limited
- When emission rate data for candidates is hard to get

Performance standard procedure

HOW IT WORKS

A numerical benchmark is derived from the emission rates of candidates providing the same service and reused across many similar projects.

WHEN IT IS PREFERRED

- When there are many similar projects
- When data on alternatives is hard to get
- When confidentiality is a concern



In municipal projects the baseline is mostly a continuation of today: the existing luminaires, the existing fleet, the existing disposal route. For solar PV it is electricity drawn from the grid. The tool works this way.

Source: GHG Protocol for Project Accounting, Sections 2.8, 2.10 and Chapter 6; CITY-ACCEL Carbon Calculation Tool



The formula: baseline minus project

The same logic for every project type, with different activity data

$$\text{Reduction} = \text{Baseline emissions} - \text{Project emissions}$$

Emissions = activity level $\times$ emission factor. Significant secondary effects are added.



Rooftop solar PV

Building-connected, self-consumed

Baseline: grid electricity
Project: 0 in operation

56,2 tCO₂e/yr



LED retrofit

2,000 luminaires, 150 W $\rightarrow$ 60 W

Baseline: old luminaires
Project: LED luminaires

324,0 tCO₂e/yr



Electrification

10 diesel buses $\rightarrow$ electric

Baseline: 374.8 (diesel)
Project: 237.1 (electric)

137,7 tCO₂e/yr



Fuel switching

1,200 t coal $\rightarrow$ natural gas

Baseline: 2,899 (coal)
Project: 1,715 (gas)

1.184 tCO₂e/yr

Source: the tool's Example sheet (illustrative numbers; solar PV is detailed next). Photos: GHG Protocol for Project Accounting



Example project: 100 kWp rooftop solar PV

A hypothetical but internally consistent municipal service building project



SITE	Service building roof
PANEL	200 panels × 500 Wp
ROOF	About 600 m ² , 30° tilt, south
DEMAND	160,000 kWh/yr, all used on site
LIFETIME	25 years, 0.5% annual loss

SPECIFIC YIELD

1,600

kWh/kWp·yr, gross (before PR)

PERFORMANCE RATIO

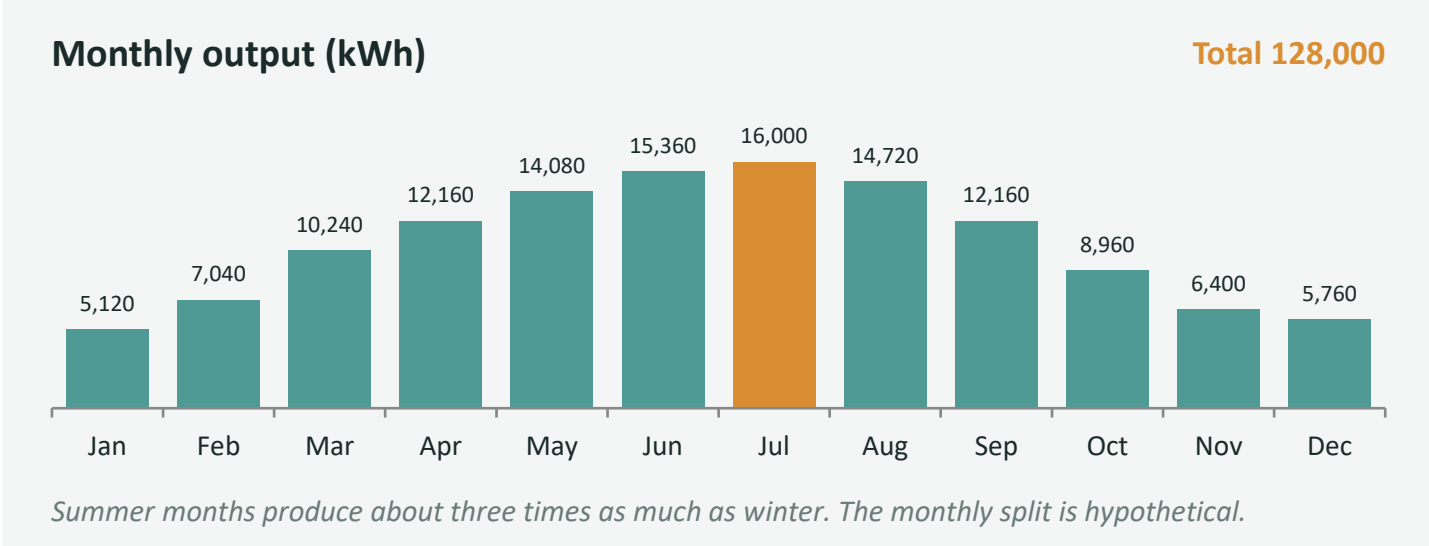
0.80

shading, cable and inverter losses

ANNUAL OUTPUT

128,000

kWh/yr = 100 × 1,600 × 0.80



Hypothetical example, consistent with the tool's 1-GES sheet rules. Photo: GHG Protocol for Project Accounting



The same project: carbon reduction

The calculation chain, in the column order of the tool's 1-GES sheet

Installed capacity (kWp)	Specific yield (kWh/kWp-yr)	Performance ratio (0-1)	Annual output (kWh)	Grid EF (kg CO ₂ e/kWh)	Annual reduction (tCO ₂ e)	Lifetime (years)	Lifetime reduction (tCO ₂ e)
100	1,600	0.80	128,000	0.439	56.2	25	1,320.5

Yellow: municipality enters

Gray: formula or Coefficients sheet

Green: result

1

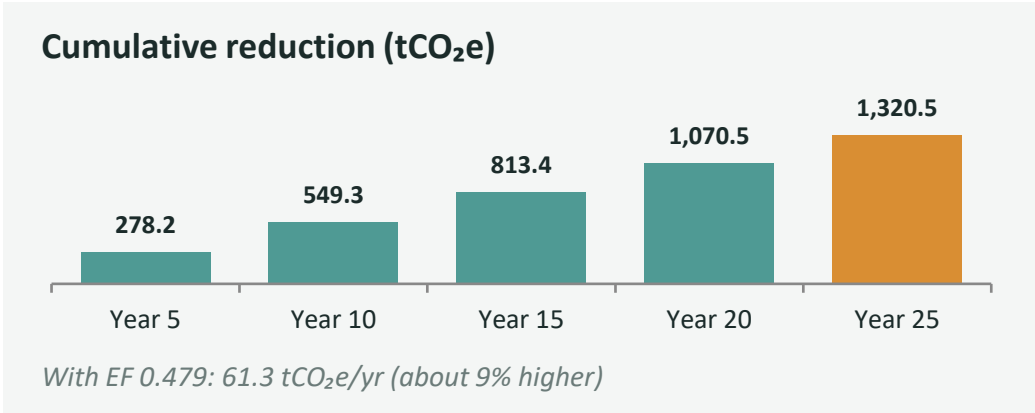
ANNUAL OUTPUT
 $100 \text{ kWp} \times 1,600 \times 0.80 = 128,000 \text{ kWh/yr}$

2

YILLIK AZALTIM
 $128.000 \text{ kWh} \times 0,439 \div 1.000 = 56,2 \text{ tCO}_2\text{e/yr}$

3

LIFETIME (UPPER BOUND)
 $56.2 \times 25 \times (1 - 0.005 \times 24 \div 2) = 1,320.5 \text{ tCO}_2\text{e}$



For the form: 56.2 tCO₂e/yr · 1,320.5 tCO₂e lifetime (upper bound) · EF 0.439 (with its source)

Hypothetical example; the calculation is identical to the formulas in the 1-GES sheet of the CITY-ACCEL Carbon Calculation Tool



Six principles of a credible calculation

GHG Protocol Chapter 4 and how the tool applies each principle

PRINCIPLE	WHAT THE PROTOCOL ASKS	IN THE TOOL
Relevance	Data, methods and assumptions must suit the intended use of the output	➡ Output matches the Project Definition Form impact section
Completeness	All relevant information and effects that could affect the result must be considered	➡ New electricity emissions are subtracted from old fuel emissions
Consistency	The same methods and assumptions must be applied consistently throughout	➡ All project sheets read one Coefficients sheet
Transparency	A reviewer must be able to understand how the result was reached	➡ Each step has its own column; every coefficient has a source
Accuracy	Uncertainties must be reduced as far as practical and bias avoided	➡ Site-specific values (e.g. PV yield) are left blank for the municipality
Conservativeness	When uncertainty is high, reductions must not be overstated	➡ Lifetime figures are upper bounds; sinks are not added to totals

Source: GHG Protocol for Project Accounting, Chapter 4; CITY-ACCEL Carbon Calculation Tool, README (OKU) and Summary (Özet) sheets



Now, into Excel

Coefficients, project sheet, Summary: a project in three steps. The municipality fills the yellow cells.

CONTACT

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Three messages to remember

1

Reduction is calculated against a baseline.

The answer to 'what would have happened without the project' is the most important assumption in the calculation.

2

Every number is written with its source.

Reduction is activity data times an emission factor. State the grid factor you used (0.439 or 0.479) and its source in your report.

3

The tool drafts, the expert verifies.

Cost, embedded carbon and adaptation actions are not included. Confirm the result against municipal data before any official claim.