



FUEL / ENERGY CALCULATOR

Fuel & Energy Carbon Calculator

Methodology, Assumptions & Data Sources

Overview

This calculator quantifies the greenhouse gas emissions (CO₂e) associated with fuel combustion and energy use; intended for use in research, carbon audits, operational assessments, and reporting.

It follows recognised carbon accounting principles and uses emissions conversion factors from the UK Government (DESNZ/DEFRA) greenhouse gas reporting dataset.

All emission factors are based on average conditions and include upstream (well-to-tank, WTT) emissions where applicable, ensuring consistency with standard UK methodology and alignment with the GHG Protocol and ISO 14064.

The model is designed to provide:

- Credible, activity-based emissions estimates
- Consistency across fuel types and energy sources
- Practical usability for businesses and individuals

Scope & Boundaries

This calculator captures emissions associated with the consumption of fuels and energy across a range of applications.

Included:

- Liquid fuels (e.g. petrol, diesel, gas oil)
- Gaseous fuels (e.g. natural gas, LPG, propane, butane)
- Biofuels (where DEFRA factors are available)

- Grid electricity consumption
- Direct CO₂ use (e.g. gas cylinders for dispensing systems)

Excluded:

- Capital equipment and infrastructure
- Embedded emissions in fuel production beyond WTT
- Renewable electricity contracts (unless specified)

Methodological Approach

All emissions are calculated using:

$$\text{Activity Data} \times \text{Emission Factor} = \text{Emissions (kgCO}_2\text{e)}$$

Emission factors are sourced directly from:

- Department for Environment, Food & Rural Affairs (DEFRA)

These factors incorporate:

- Fuel combustion emissions
- Energy consumption emissions
- Upstream (well-to-tank) emissions where applicable

Direct CO₂ emissions (e.g. gas release) are calculated on a 1:1 mass basis.

Fuel & Energy Types

Liquid Fuels

- Includes petrol, diesel and gas oil
- Used across vehicles, generators and plant

Gaseous Fuels

- Includes natural gas, LPG, propane and butane
- Applied to heating, cooking and portable systems

Electricity

- Based on UK grid average emission factors
- Reflects national generation mix

Biofuels

- Included where DEFRA lifecycle factors are available
- Reflects standard UK reporting assumptions

CO₂ Gas

- Direct emissions calculated at point of release
- Includes applications such as beverage dispensing systems

Data Inputs

Users are required to input:

- Fuel consumption (litres, kg or kWh)
- Electricity consumption (kWh)
- Quantity of CO₂ gas (kg or cylinders where applicable)

Assumptions

- Average emission factors are applied across all fuel types
 - Default values reflect typical UK conditions
 - Combustion and energy use are assumed to be complete and efficient
 - CO₂ gas is assumed to be fully released to atmosphere

1. Fuel composition

- Real fuels vary (bio content, impurities, blends)
- DEFRA uses **typical UK mix** (e.g. diesel with standard bio blend)

2. Combustion performance

- Engines/boilers vary in efficiency
- Factors assume **standard, well-maintained operation** (not perfect, not faulty — middle ground)

3. Upstream (WTT) supply chain

- Extraction, refining, transport all vary
- Factors use **UK-relevant averages**:
 - import mix
 - refinery efficiency
 - transport distances

4. Operating conditions

- Load, temperature, usage patterns vary
- Factors assume **typical use**, not extremes

Data Quality & Accuracy

This model is based on activity-based data, which represents a higher level of accuracy compared to spend-based estimation methods.

Results are:

- Directly linked to physical fuel and energy consumption

- Consistent with recognised emissions methodologies
- Suitable for use in carbon reporting and offsetting when supported by appropriate input data

Appropriate Use

The calculator is suitable for:

- Estimating emissions from fuel and energy use
- Supporting Scope 1 and Scope 2 reporting
- Assessing operational energy impacts
- Informing carbon reduction strategies
- Quantifying emissions for voluntary carbon offsetting

Limitations

- Results depend on the accuracy of input data
- Does not account for:
 - specific equipment efficiency variations
 - real-time energy mix fluctuations
 - supplier-specific fuel characteristics
- Emission factors represent averages and may not reflect individual operations

Use in Carbon Audits

This calculator can be used as:

- A primary tool for estimating fuel and energy-related emissions
- A supporting dataset within an ISO-aligned carbon audit
- A method for quantifying operational emissions across activities

When supported by appropriate documentation, outputs align with reporting expectations under ISO 14064.

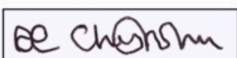
Final Note

This methodology provides a robust, activity-based approach to fuel and energy emissions estimation, offering a high level of credibility while remaining practical for real-world application.

It enables users to:

- understand fuel and energy-related emissions

- identify reduction opportunities
- and integrate energy use into wider carbon management strategies



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Appendix

CO₂ note

A small additional factor is applied to account for the energy required to compress, liquefy and distribute CO₂. Based on typical process energy of ~80–120 kWh per tonne of CO₂ and UK grid electricity factors, this equates to approximately **0.02 kgCO₂e per kg CO₂**. This is added to the direct 1:1 emissions from CO₂ release, providing a more complete representation of its overall impact while remaining consistent with standard carbon accounting practice.

CO₂ supplied in cylinders is commonly specified by volume; for calculation purposes, liquid CO₂ is converted to mass using a standard density assumption (≈0.77 kg per litre), with emissions expressed on a mass basis (1 kg CO₂ = 1 kg CO₂e) and a small upstream (well-to-tank) factor applied for compression, storage and transport.