



QUICK START GUIDE 7: CARBON EQUIVALENTS

The CO₂ calculator in Quantifire is designed to help inform estimators and designers understand the equivalent amount of carbon dioxide (CO₂) emissions associated with their estimate. These values can subsequently feed into green design solutions to achieve credits and compliance with sustainable building certificate programmes such as LEED (Leadership in Energy and Environmental Design) and BREEAM (Building Research Establishment Environmental Assessment Method).

The calculation within Quantifire uses certified and published EPD (Environmental Product Declaration) datasets for both steel and fire protection materials. These are contained as a library within Quantifire but can be modified at the user's discretion.

To add your company's EPD values to the Quantifire database please contact Quantifire@pfpspecialists.co.uk

The steel and protection's contributions are based on their declared Global Warming Potential (GWP). This results in a value of carbon equivalent with units kgCO₂e/kg, where the 'e' stands for equivalent.

Note that carbon equivalent calculations are only undertaken for steel and product. No calculation is undertaken for any type of application or installation process. Users should familiarise themselves with sustainability approaches, industry terminology and EPDs to ensure that the output within Quantifire is understood and properly communicated across the contract chain.

1. STEEL CO₂E VALUES

The calculation values used for the steel carbon equivalent calculation are accessed via the **Main menu** -> **Edit system costs and application settings** -> **Steel CO₂** button. This will open a dialogue box as shown below. It presents a library of known steel CO₂ datasets based on publicly accessible EPDs.

The CO₂ values depend on the structural shape/type of steel section. The library is split into Structural, Tubular and Plate sections. These in turn can be selected for different structural designations as per the options in the lower half of the dialogue box. The user can, if desired, modify these values for their own needs.

Note that the unit of tCO₂e/t is the same as kgCO₂e/kg, where tonnes and kg cancel each other out.

Embodied carbon of steelwork

The following datasets have been taken from a range of Environmental Product Declaration (EPD) sources.

| STRUCTURAL SECTIONS | | TUBULAR SECTIONS | | PLATE SECTIONS | |
|---------------------|----------------------|------------------|----------------------|----------------|----------------------|
| Product | tCO ₂ e/t | Product | tCO ₂ e/t | Product | tCO ₂ e/t |
| ICE/worldsteel | 1.55 | worldsteel | 2.78 | worldsteel | 2.46 |
| Europe | 1.13 | Tata Celsius | 2.69 | Spartan | 2.23 |
| UK/BCSA | 1.74 | Tata SHS | 2.50 | DanSteel | 3.12 |
| British Steel | 2.45 | ArcelorMittal | 2.27 | ArcelorMittal | 2.60 |
| ArcelorMittal | 0.57 | | | | |
| Xcarb | 0.33 | | | | |

| Structural description | Built-in dataset | Steel Product | tCO ₂ e/t | Custom value | tCO ₂ e/t |
|----------------------------|----------------------------------|---------------|----------------------|-----------------------|----------------------|
| Serial open sections | <input checked="" type="radio"/> | Europe | 1.13 | <input type="radio"/> | 0 |
| Serial CHS sections | <input checked="" type="radio"/> | Tata Celsius | 2.69 | <input type="radio"/> | 0 |
| Serial RHS/SHS sections | <input checked="" type="radio"/> | Tata SHS | 2.5 | <input type="radio"/> | 0 |
| Custom fabricated sections | <input checked="" type="radio"/> | Spartan | 2.23 | <input type="radio"/> | 0 |
| Rolled cellular beams | <input checked="" type="radio"/> | British Steel | 2.45 | <input type="radio"/> | 0 |
| Plate cellular beams | <input checked="" type="radio"/> | Spartan | 2.23 | <input type="radio"/> | 0 |

2. PRODUCT CO₂ VALUES

Manufacturers of passive fire protection may undertake EPD assessments to determine the GWP value of their products. This may just be for the protection material, or in the case of coating systems, it may additionally be for primers, topcoats, etc.

To check the value, go to the **Main menu** -> **Edit system costs and application settings**. This shows the product-specific value of kgCO₂e/kg used for the calculation, see image below. This can be overwritten or entered as desired by the user. This dialogue box also allows product-specific systems such as primers and topcoats to be defined. Their own carbon equivalent values can be entered if known.

Product and System Details

Select product: DummycharCB - CF 1234 | Product sold by: Volume

Cost per litre: [] | Currency: EUR | Volume solids: 70 % | Density (s.g.): 1.32 | Bd. ft/bag: [] (0 m3/tonne x 25mm)

Application method: Spray | Loss factor: 30 % | Kit size: 20 (L) | Max W.F.T.: 1.8 (mm) | **kgCO₂e/kg: 2.66** | Steel CO₂ | CO₂ help

Mesh

Set coverage automatically | Meshed | Mesh type: [] | I-sections: [] %
 Fully mesh JF | Hollows: [] %
 Mesh depth: [] | Other sections: [] %

Specify system | Copy to all products

Primers/topcoats vary by zone: none | Copy to all zones

| | Name | DFT (mm) | Vol. solids (%) | Cost per litre | kgCO₂e/L |
|--------------------------|-----------|----------|-----------------|----------------|----------------------------|
| <input type="checkbox"/> | Primer 1 | [] | [] | [] | [] |
| <input type="checkbox"/> | Primer 2 | [] | [] | [] | [] |
| <input type="checkbox"/> | Topcoat 1 | [] | [] | [] | [] |
| <input type="checkbox"/> | Topcoat 2 | [] | [] | [] | [] |

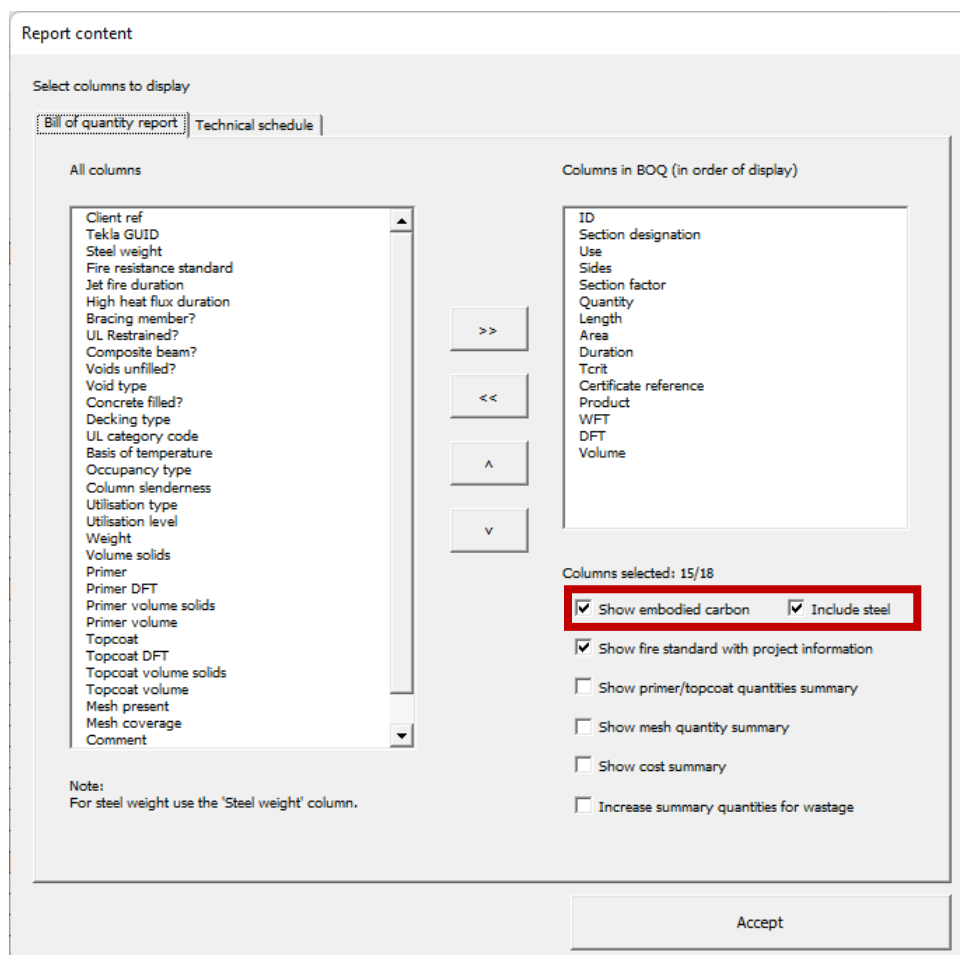
Loss factor for primers/topcoats: [] % | Save changes and close

Be aware that for primers and topcoats, density of the material is not stored within Quantifire due to the large number of variations that could exist. Therefore, the carbon equivalent calculations are undertaken with respect to litres (L). On interpreting the resulting values, the user will need to use the resultant carbon equivalent as an indication only, or multiply by the product density to determine the correct value (click the CO₂ help button for more info and a handy calculator).

3. VIEWING ON REPORTS

The carbon equivalent calculations can be displayed as a summary on output reports.

To see this, click **Main menu** -> **Create report** -> **Select data to display** and select to show embodied carbon, either as product alone, or including steel values.



After the report is created, the carbon equivalent values will be summarised towards the end of the report, as shown below.


| CO2 summary | kgCO ₂ e | Total CO ₂ e (kg) |
|-------------|---------------------|------------------------------|
| DummycharCB | 2.66/kg | 1196805 |
| Steel | | 9095893 |

4. VIEWING IN THE OPTIMISER

Within the optimiser, carbon equivalent calculations are included to aid a designer's and project team's decision making on member substitution. The final three columns of each product show the respective steel, product, and overall total carbon equivalents.

The optimiser CO₂ calculations only account for steel and product. They do not account for the extra components of any system such as primers or topcoats.

Where no product CO₂ values have been defined, the steel CO₂ values will still be displayed.

|  Generate alternate sections Replace parent section Edit cost settings Print Back | | | | | | | | | | | | | | | | | | | |
|---|-----------------|--------------|------------------|---------|-------|------------|----------|------------|------------------------|-------------|---------|------------|----------|--------------|-------|------------|------------------------------|--------------------------------|------------------------------|
| Section for optimisation | | | | | | | | | | | | | | | | | | | |
| ID | Duration (mins) | Section type | Size/designation | Used as | Sides | Am/V (m-1) | Quantity | Length (m) | Area (m ²) | Weight (kg) | Bracing | Tcrit (°C) | DFT (mm) | Quantity (L) | Coats | Cost (EUR) | Steel (kg/CO ₂ e) | Product (kg/CO ₂ e) | Total (kg/CO ₂ e) |
| 1 | 60 | UB (UK) | 406x140x39 | beam | 3 | 239.6 | 10 | 6 | 71.46 | 2340 | N | 500 | 3.286 | 335.454 | 3 | 5875.23 | 5733 | 1177.8 | 6910.8 |
| Alternative sections | | | | | | | | | | | | | | | | | | | |
| Alternate section | Duration (mins) | Section type | Size/designation | Used as | Sides | Am/V (m-1) | Quantity | Length (m) | Area (m ²) | Weight (kg) | Bracing | Tcrit (°C) | DFT (mm) | Quantity (L) | Coats | Cost (EUR) | Steel (kg/CO ₂ e) | Product (kg/CO ₂ e) | Total (kg/CO ₂ e) |
| 1-1 | 60 | UB (UK) | 406x140x39 | beam | 3 | 240 | 10 | 6 | 71.46 | 2340 | N | 500 | 3.286 | 335.454 | 3 | 5875.23 | 5733 | 1177.8 | 6910.8 |
| 1-2 | 60 | UB (UK) | 406x140x46 | beam | 3 | 205 | 10 | 6 | 72.06 | 2760 | N | 500 | 2.935 | 302.137 | 3 | 6144.24 | 6762 | 1060.9 | 7822.9 |
| 1-3 | 60 | UB (UK) | 406x140x53 | beam | 3 | 178 | 10 | 6 | 72.54 | 3198 | N | 500 | 2.66 | 275.652 | 3 | 6462.3 | 7835.1 | 967.9 | 8803 |
| 1-4 | 60 | UB (UK) | 406x178x54 | beam | 3 | 189 | 10 | 6 | 78.3 | 3246 | N | 500 | 2.772 | 310.068 | 3 | 6832.14 | 7952.7 | 1088.7 | 9041.4 |
| 1-5 | 60 | UB (UK) | 406x178x60 | beam | 3 | 172 | 10 | 6 | 78.78 | 3606 | N | 500 | 2.594 | 291.936 | 3 | 7113.96 | 8834.7 | 1025 | 9859.7 |
| 1-6 | 60 | UB (UK) | 406x178x67 | beam | 3 | 154 | 10 | 6 | 79.2 | 4026 | N | 500 | 2.418 | 273.579 | 2 | 6819.5 | 9863.7 | 960.6 | 10824.3 |
| 1-7 | 60 | UB (UK) | 406x178x74 | beam | 3 | 140 | 10 | 6 | 79.62 | 4452 | N | 500 | 2.276 | 258.879 | 2 | 7179.56 | 10907.4 | 909 | 11816.4 |
| 1-8 | 60 | UB (UK) | 406x178x85 | beam | 3 | 123 | 10 | 6 | 80.4 | 5118 | N | 500 | 2.1 | 241.2 | 2 | 7771.2 | 12539.1 | 846.9 | 13386 |