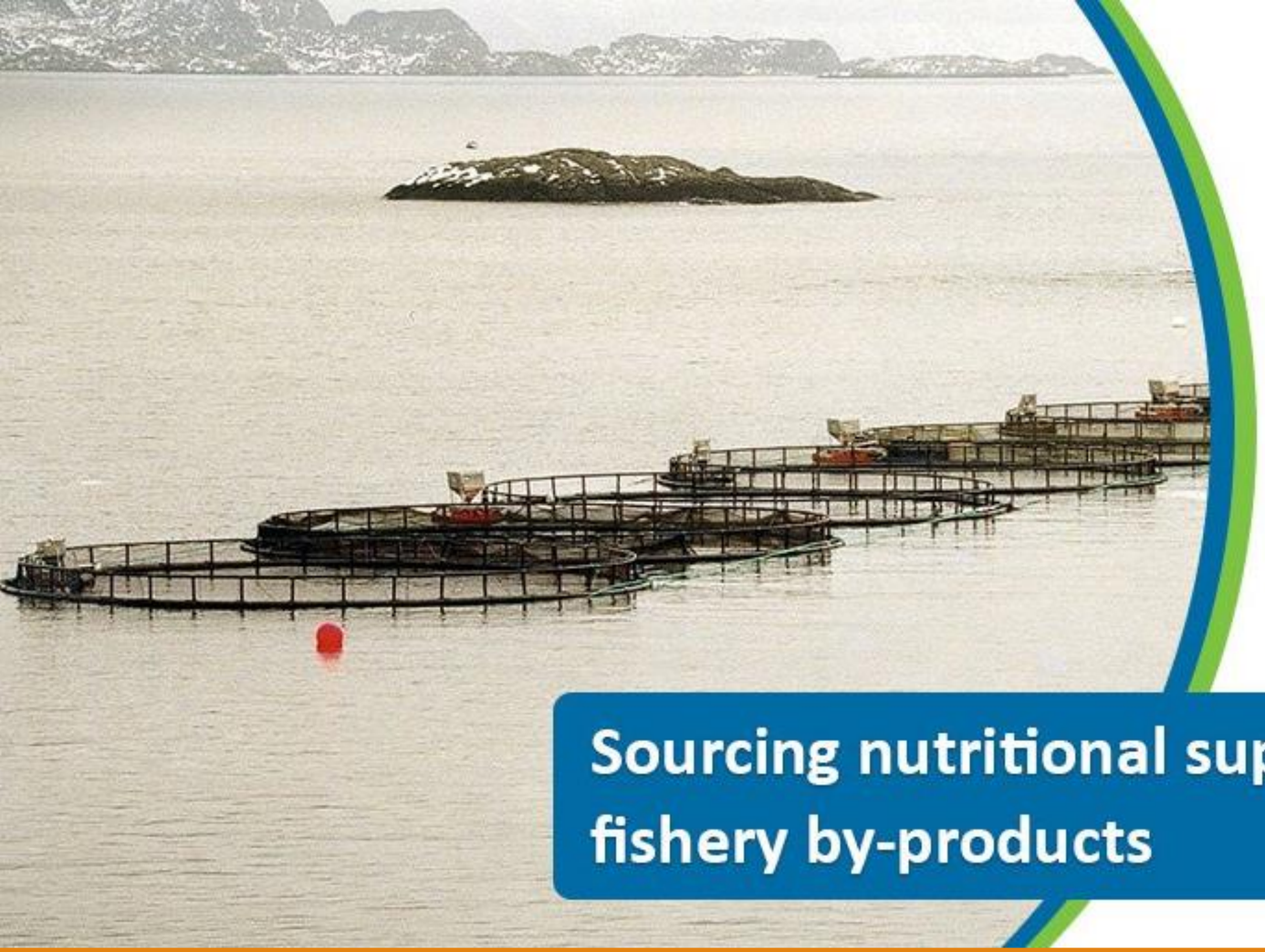


AQUABIO PRO-FIT

Sourcing nutritional supplements from fishery by-products

Carbon footprint calculation with CCaLC2 software

Module 4: Potential environmental impacts identification in side-streams valorization technologies

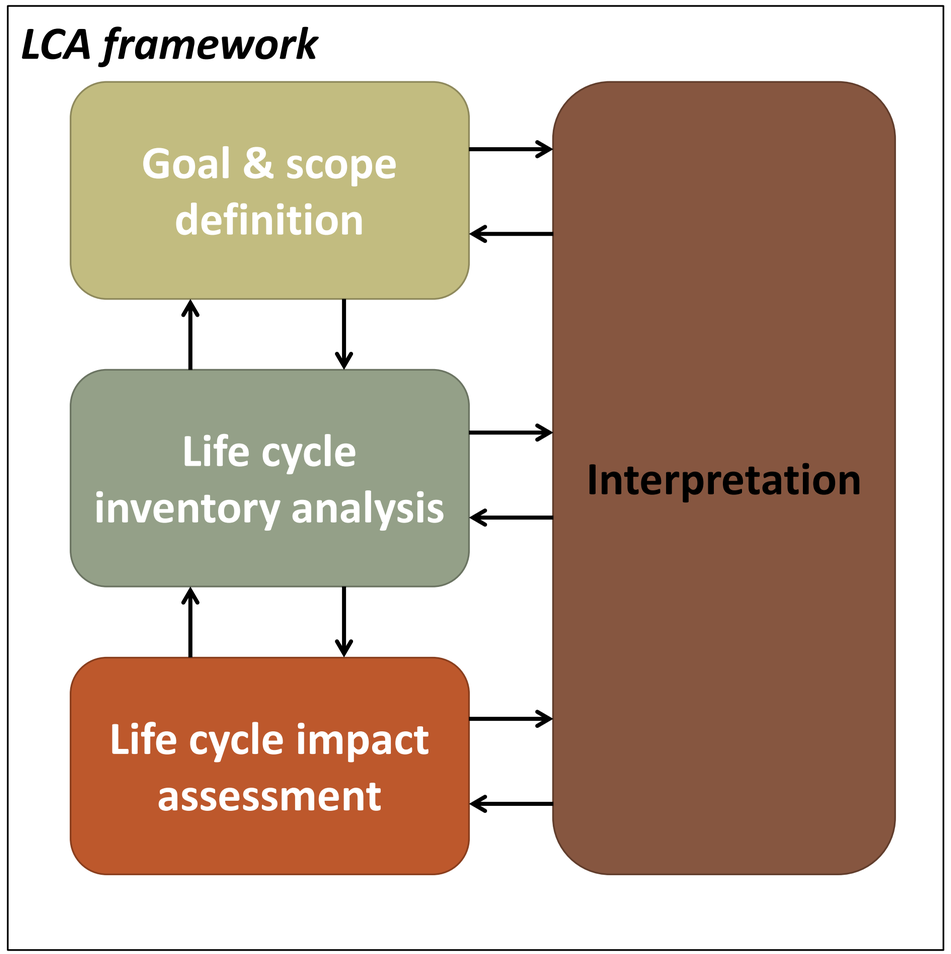
Vertech Group

VERTECH GROUP

Content

Carbon footprint definition

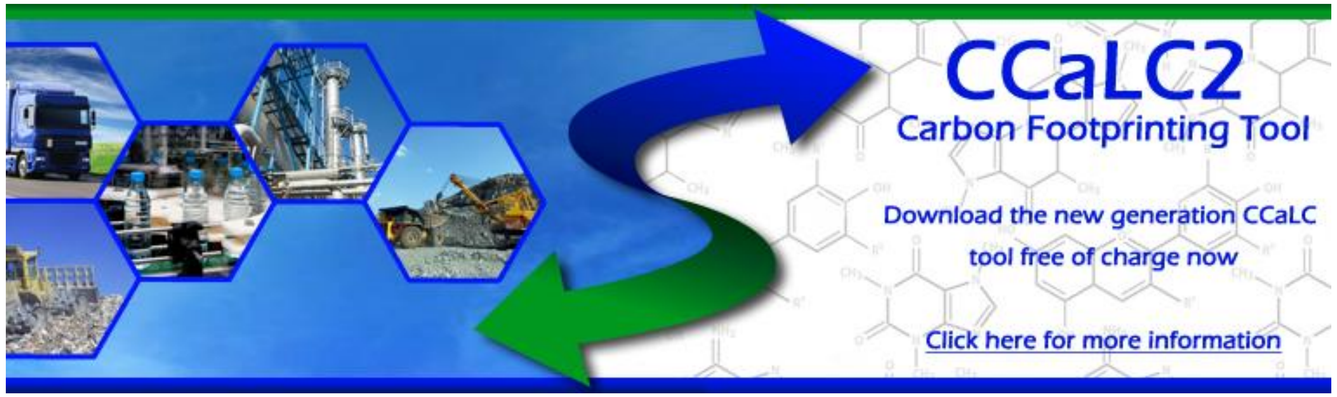
Carbon footprint definition



"A carbon footprint is the total greenhouse gas (GHG) emissions caused directly and indirectly by an individual, organization, event or product[1]"

The carbon footprint is calculated by summing the emissions resulting from every stage of a product or service's lifetime (material production, manufacturing, use phase, and end-of-life disposal). Throughout a product's lifetime, or lifecycle, different greenhouse gases (GHGs) may be emitted, such as methane and nitrous oxide, each with a greater or lesser ability to trap heat in the atmosphere. These differences are accounted for by calculating the global warming potential (GWP) of each gas in units of carbon dioxide equivalents (CO_2 eq.), giving carbon footprints a single unit for easy comparison[2].

[1]The Carbon Trust (2012). Carbon Footprinting.
[2]Jones C., Kammen D. (2011). Quantifying Carbon Footprint Reduction Opportunities for U.S. Households and Communities.



CCaLC2 software overview

CCaLC2 Software overview

Software developed by University of Manchester in 2007-2010, the ultimate version is the 2nd generation (3.3) with excel-based arrangement for calculation.

Features:

- **Carbon and water footprint**: either cradle-to-grave or cradle-to-gate with water scarcity taken into account.
- **Database specific**: energy, waste, materials, packaging and transportation.
- **Economic impacts**: showing the trade-off.
- **Cumulative energy demand**: estimation of the energy required.
- **Other environmental impact**: eutrophication, acidification, etc.
- **Optimization of results**: identification of hotspots.

CCaLC2
Carbon Footprinting Tool

CCaLC2 software

Funding bodies:

Partners:

- Kellogg's
- DEFRA
- Greggs
- Chemistry Innovation
- International Cuisine
- NWDA

Advantages:

- **Fast and responsive**: quick calculations, interface response and database access.
- **Intuitive**: Functionality thanks to table overview and visual representations.
- **New and updated databases**: CCaLC2 (2000+) & Ecoinvent (4000+) platforms.
- **Improved sharing**: Easy to use (handling small files).
- **Always up to date**: Automatically checks for updates.

CCaLC2 software

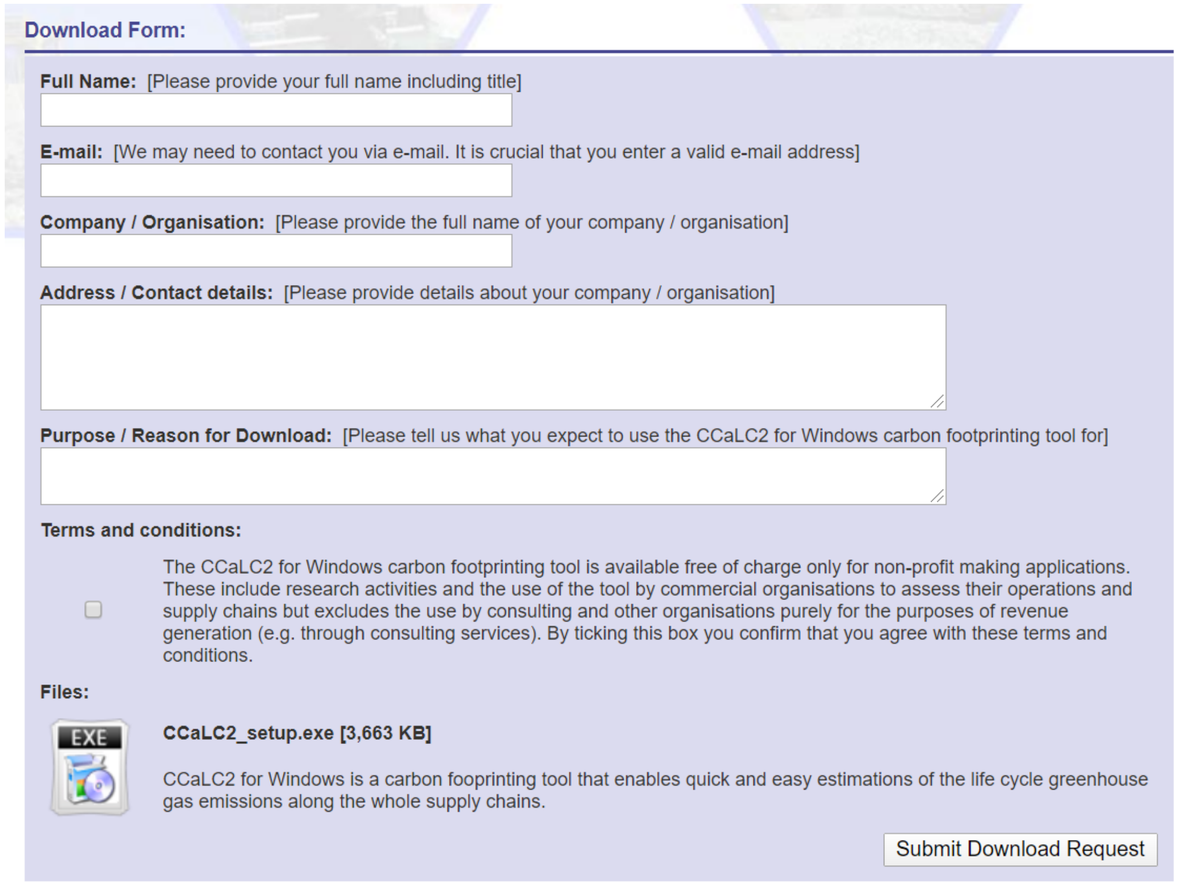
More details:

CCaLC2 is the second generation of the CCaLC carbon footprinting tool that enables quick and easy estimations of life cycle greenhouse gas emissions along different supply chains. CCaLC2 for Windows **provides a standalone desktop application for you to perform your CCaLC analysis without requiring Microsoft Excel**. It provides a powerful tool for reducing and managing carbon footprints of products, processes or supply chains.

The methodological approach follows the internationally accepted life cycle methodology as defined by **ISO 14044 and PAS 2050**.

CCaLC2 software – download instructions

- Go to *http://www.ccalc.org.uk/download2.php*
- Fill up the following form with your details:

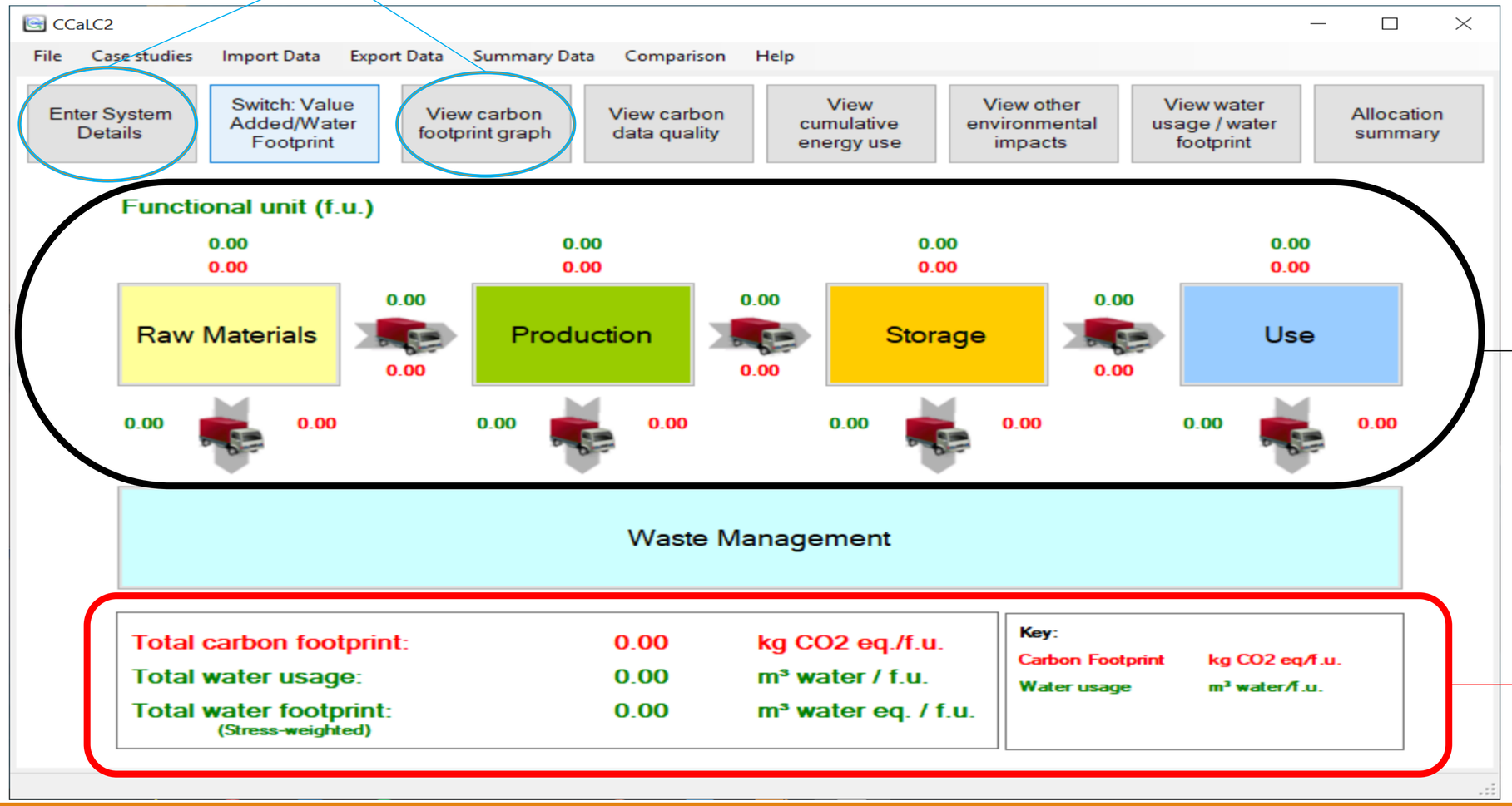


Prior to installation, make sure your operating system is set as ENGLISH language version. This software is only available for Microsoft Windows.

- Click on **Submit download request.**
- Download the next link to install the software.

CCaLC2 software – Dashboard

Main settings



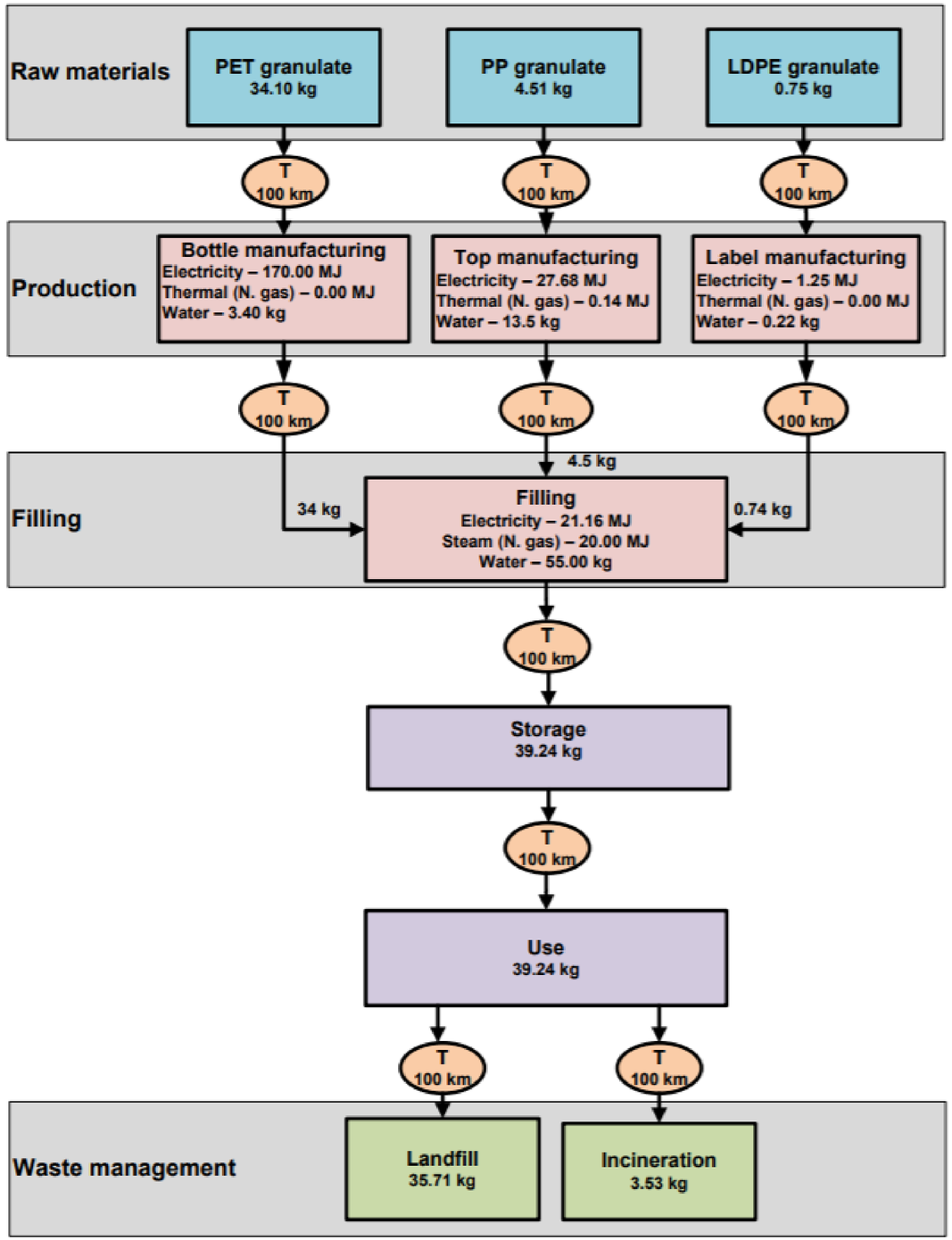
Work plan

Preliminary results

Case study description

Case study description: Bottled water (PET)

- **Goal of the analysis**: to provide a carbon footprint analysis of packaging used for mineral water in the UK, PET water bottle (0.5 L).
- **Functional unit:** is defined as “the packaging system required to deliver 1000 litres of beverage”
- **System boundaries:** Cradle-to-grave assessment.
- **Impact categories:** Global Warming potential (kg $CO_{2,eq}$/functional unit).



System boundaries for the PET water bottle (0.5 L)

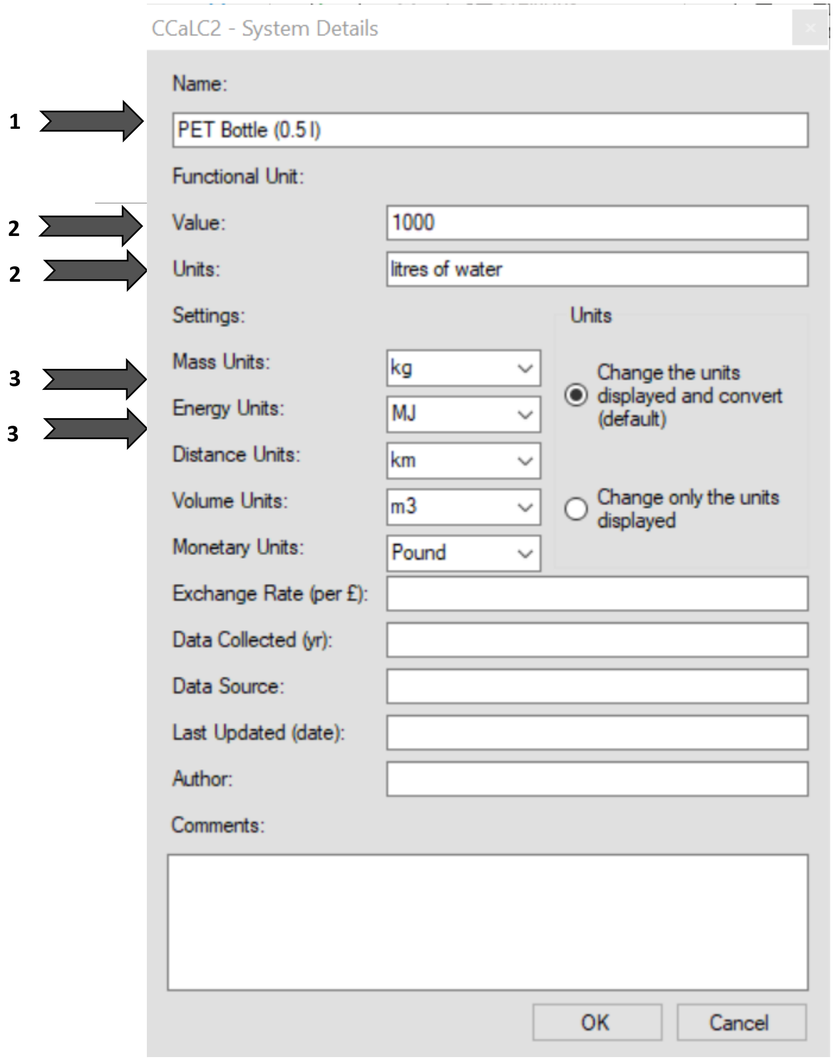
CCaLC2 implementation

1. Naming and modification

- Go to Enter System details:

1. **Under Name:** PET Bottle (0.5 l).
2. **Under Functional Unit:**
   - **Value**: 1000.
   - **Units**: litres of water.
3. **Under Mass Unit:**
   - Mass units: kg.
   - Energy Unit: MJ.

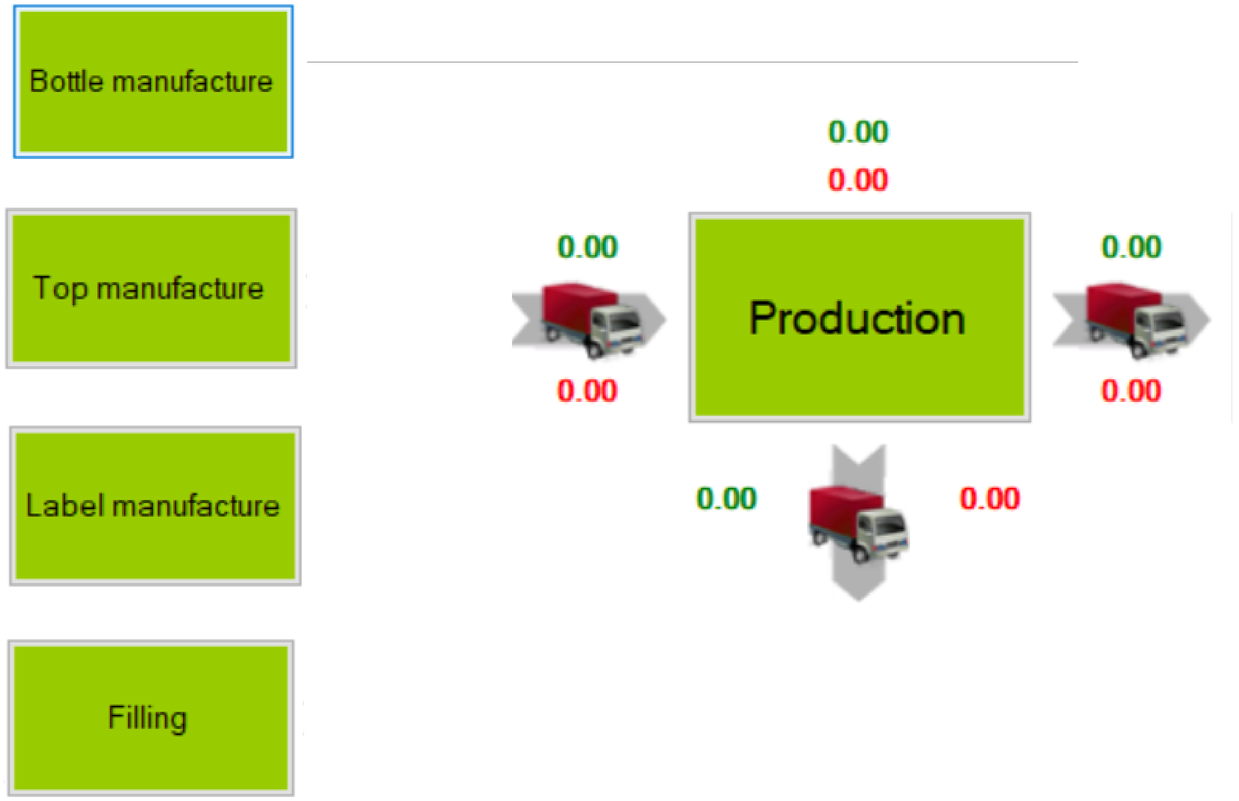
<u>For any input, the data quality will be set as **High**.</u>



2. Production stages

- **Stage 1** → Bottle manufacture
- **Stage 2** → Top manufacture
- **Stage 3** → Label manufacture
- **Stage 4** → Filling

Keep blanks all the others.



3. Description and weight of the packaging materials

Description	PET bottle
Capacity (L)	0.500
Number of bottles weighted	3
Average weight per bottle (g)	17
Material for top	PP
Average weight of top (g)	2.25
Material for label	LDPE film
Average weight of label (g)	0.37
Bottle weight per functional unit (kg per 1000 L)	34
Top weight per functional unit (kg per 1000 L)	4.5
Label weight per functional uni (kg per 1000 L)	0,74
Total weight per functional unit (kg per 1000 L)	0.74

4. Manufacturing data for PET water bottles (0.5 L)

Inventory	Bottle manufacture	Tops manufacture	Label manufacture	Comments
Electricity (MJ/FU)	170	27.68	1.25	UK grid
Steam (MJ/FU)	0.00	0.14	0.00	Natural gas
Water (kg/FU)	3.40	13.50	0.22	

5. Energy and water data for filling the PET water bottle

Inventory	Amount	Comments
Electricity (MJ/FU)	21.16	UK grid
Steam (MJ/FU)	20.00	Natural gas
Water (kg/FU)	55.00	

6. Transportations

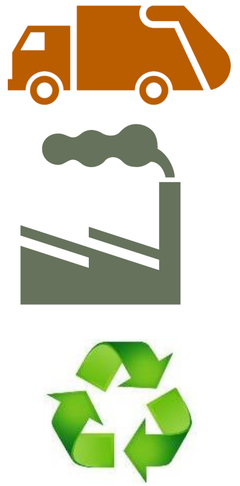
All transport distances in the life cycle stages are assumed to be **100 km using 22 t trucks**. The transport stages include:

- Transport of raw materials to the manufacturing site;
- Transport of packaging, tops/ends and labels from the manufacturing site to the filling stage;
- Transport of the filled packaging from the filling site to storage at consumer, which includes transport to warehouse and retail centers;
- Transport to landfill, incineration and recycling sites.

7. End-of-Life

- Waste management considered for the packaging systems.

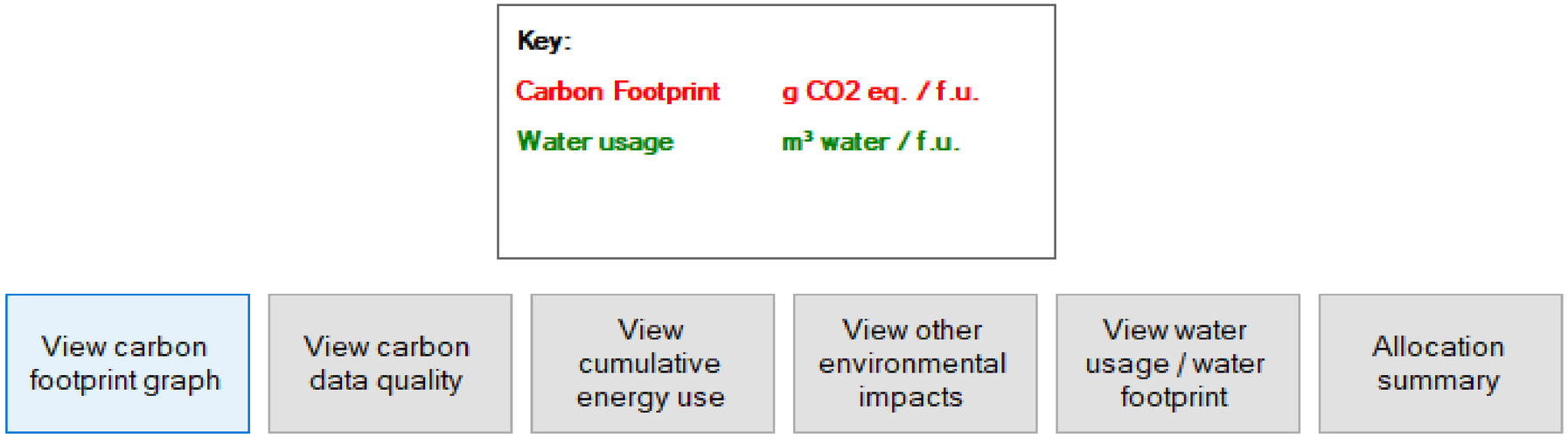
Type of waste management	PET bottle (%)
Landfill	91
Incineration	9
Recycling	n/a



8. Impact assessment

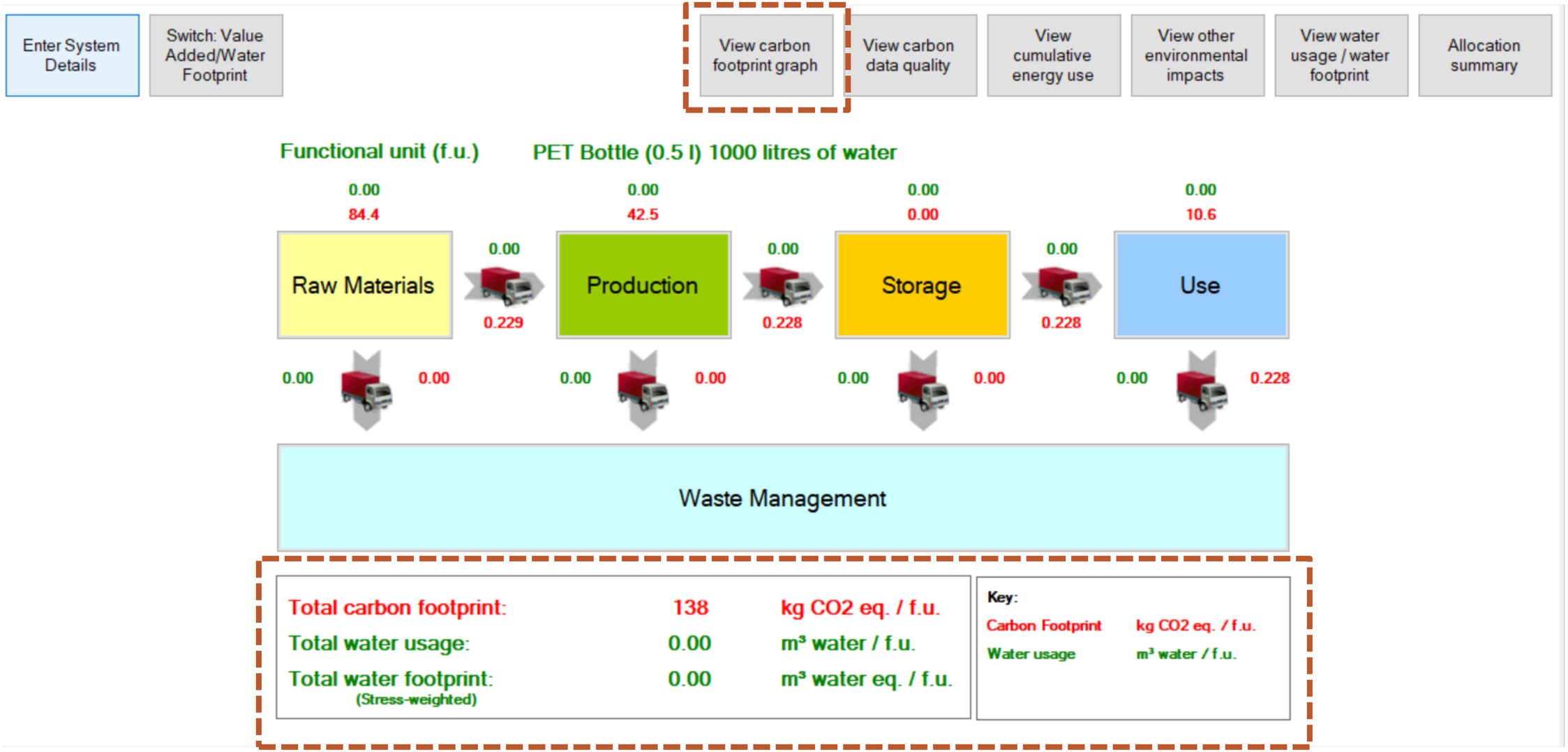
Now, we have set up the entire system. Make sure you properly insert all the inputs/outputs for materials and energy consumptions, as well as the transportation and waste treatment.

In *CCaLC2*, the impact assessment is instantly done. So no run of simulations are needed. Hence, let's look at the results:

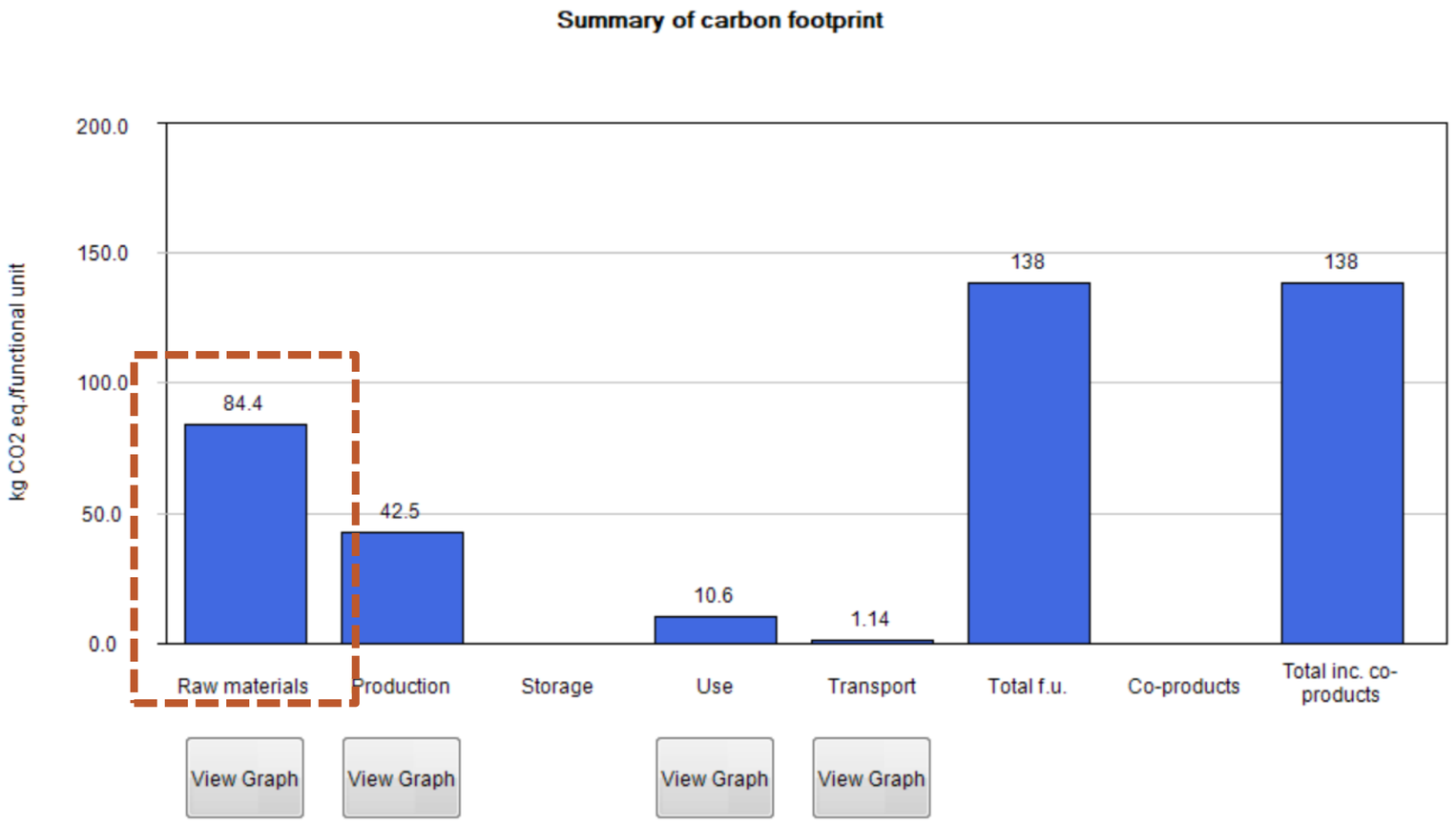


Case study results & conclusions

9. Carbon footprint results



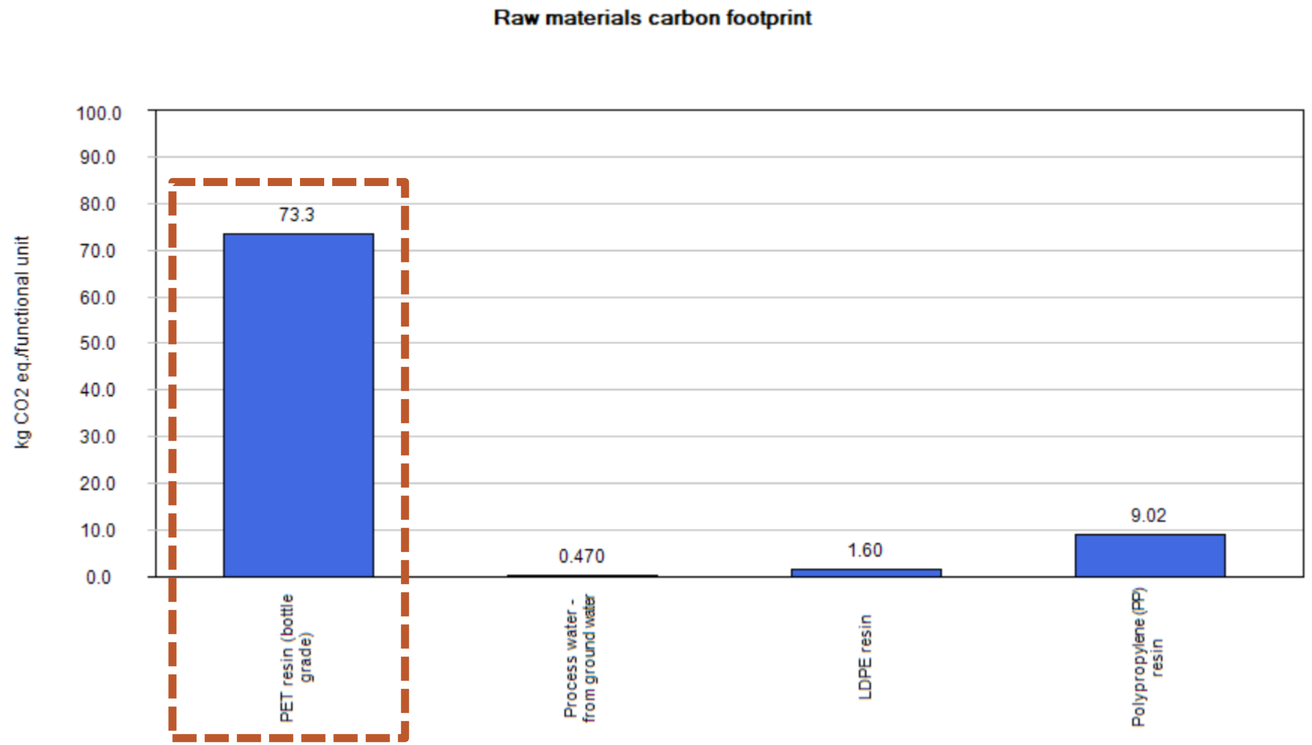
9. Carbon footprint results



- The carbon footprint of the case study is 138 kg CO_2 eq. per 1000 liters of beverage.
- The raw materials stage was the major hot spot, contributing 71% of the total carbon footprint for the PET containers.

9. Carbon footprint results

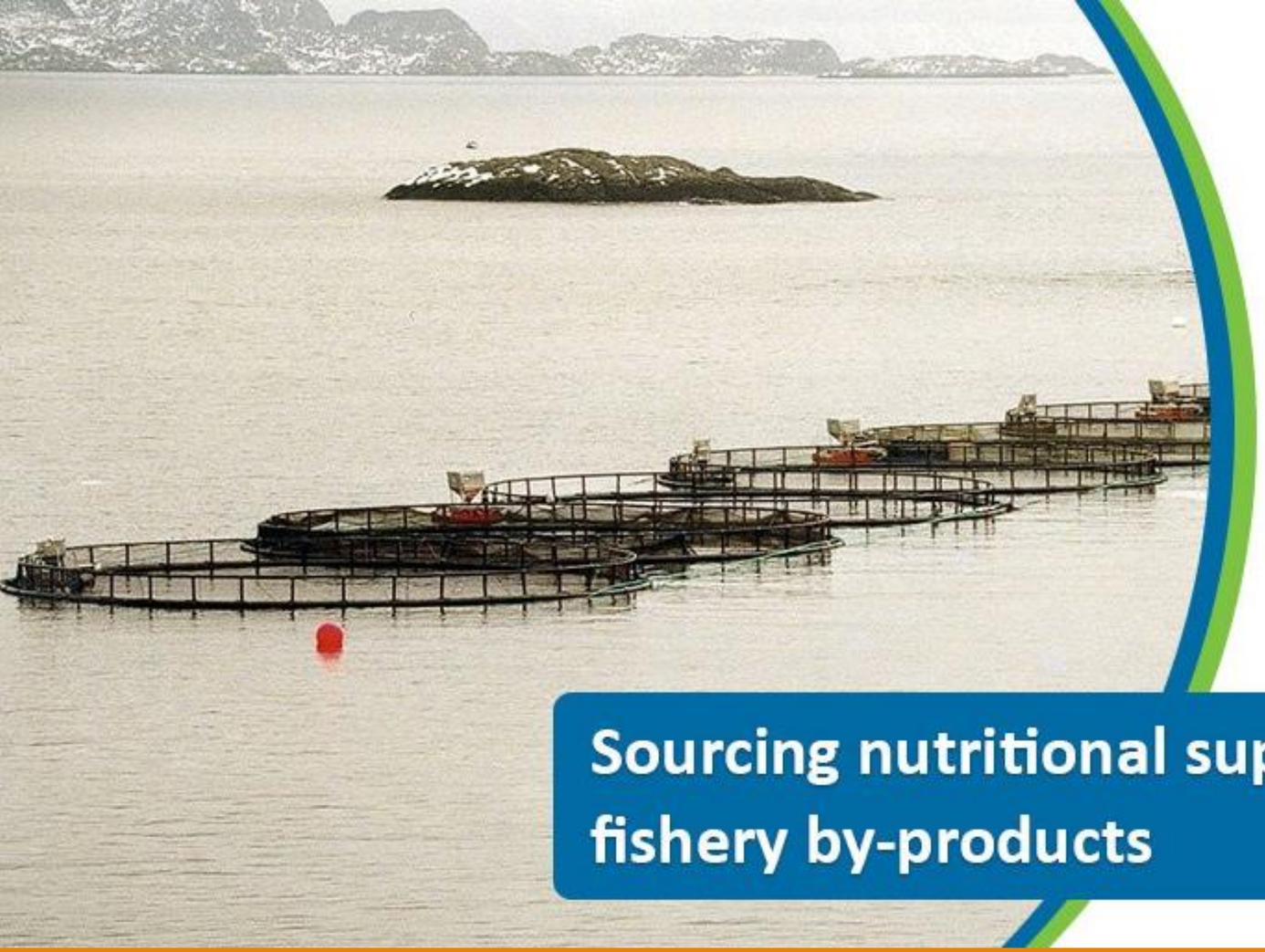
View higher level graph



- Among the raw materials used, the main impact was due to the PET resin employed.

10. Interpretation

- Raw materials owns the biggest impact.
- Among the raw materials used, the PET resin employed for the bottles production represents the highest impact.
- Overall, the transportation and waste treatments shown low impacts.
- Production stage represents the second biggest contributor of the whole assessment.
- Results can change drastically, according to the data quantity considered.



AQUABIO PRO-FIT

Sourcing nutritional supplements from fishery by-products

Carbon footprint calculation with CCaLC2 software

Module 4: Potential environmental impacts identification in side-streams valorization technologies

Vertech Group

VERTECH GROUP