UNIVERSITY BUSINESS • EXERCISE SHEET

10.7 Sustainability in operations

Name: _____ Class: _____ Date: _____ **Total: 15 marks**

KEY WORDS carbon footprint • system boundary

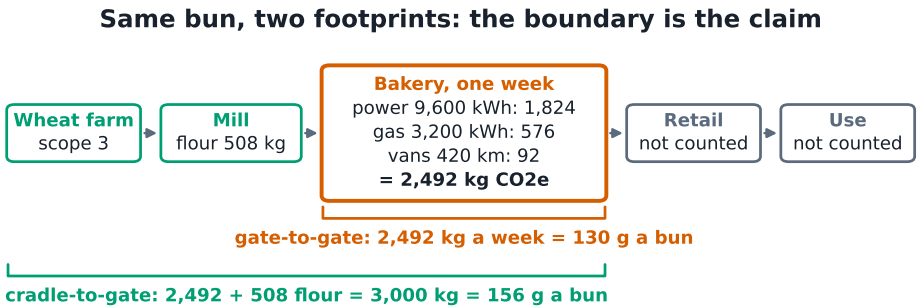
Objective

Measure a footprint inside a stated boundary, move the boundary and see the number move, and test a circularity claim with its loss rate.

1 Key knowledge and worked examples

Boundaries and loops

Gate-to-gate = scope 1 + 2 on site; cradle-to-gate adds upstream scope 3. Compare only inside one boundary. A reuse loop pays only if losses + washing cost less than the single-use item.



Same bun, two footprints - the boundary is the claim

Worked example. The bun

1,824 + 576 + 92 = 2,492 kg a week = 130 g a bun ✓; + 508 flour = 3,000 = 156 g ✓. Trays: breakeven return 96.5% ✓.

2 Practice

2.1 A pastry kitchen: 6,000 kWh electricity (0.19 kg/kWh), 2,000 kWh gas (0.18), 300 van km (0.22); 12,000 pastries a week. The gate-to-gate footprint and grams per pastry. [4]

2.2 Flour 600 kg a week at 0.55 kg CO2e a kg. The cradle-to-gate total and the rise in per cent. [3]

2.3 A renewable tariff at 0.06 kg/kWh. New site total, the site fall in per cent, and the cradle-to-gate fall in per cent. [4]

2.4 Trays: 26,000 single-use a year at 0.25. Returnable at 6.00, a two-week cycle, 97% returns, washing 0.04 each. Pool cost, running cost, saving, payback, and the breakeven return rate. [4]

Solutions

2.1

- $6{,}000 \times 0.19 = 1{,}140$; $2{,}000 \times 0.18 = 360$; $300 \times 0.22 = 66$; total 1,566 kg.
- $1{,}566{,}000/12{,}000 = 130.5$ g a pastry.

2.2

- Flour $600 \times 0.55 = 330$ kg; cradle-to-gate 1,896 kg.
- Rise $330/1{,}566 = 21.1\%$.

2.3

- Electricity $6{,}000 \times 0.06 = 360$; site $360 + 360 + 66 = 786$ kg.
- Site fall $1 - 786/1{,}566 = 49.8\%$; cradle-to-gate $1 - 1{,}116/1{,}896 = 41.1\%$.

2.4

- 500 trays a week; pool $1{,}000 \times 6 = 6{,}000$. Losses $500 \times 0.03 \times 52 = 780$ trays $= 4{,}680$; wash $26{,}000 \times 0.04 = 1{,}040$; running 5,720.
- Saves $6{,}500 - 5{,}720 = 780$ a year; payback $6{,}000/780 = 7.7$ years.
- Breakeven: losses may cost $6{,}500 - 1{,}040 = 5{,}460$, so $1 - 5{,}460/156{,}000 = 96.5\%$ returns.