10.7 Sustainability in operations

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

KEY WORDS carbon footprint • system boundary

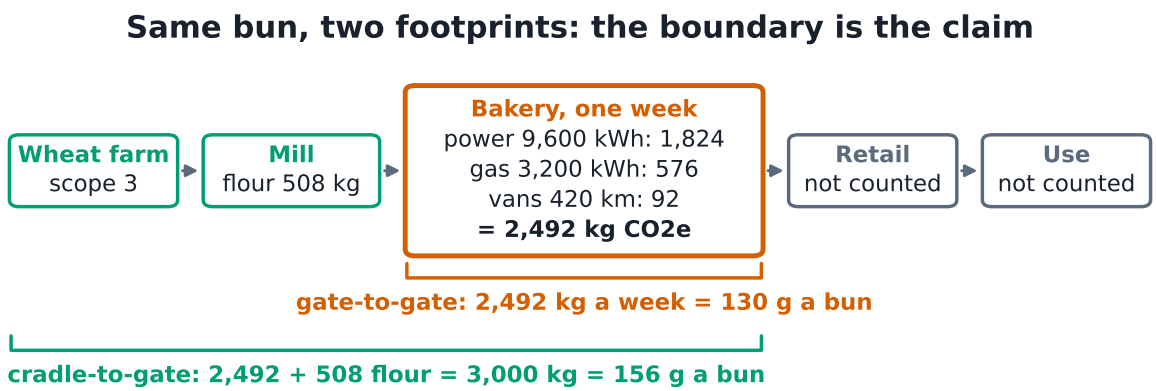
Objective

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.



renewable tariff at 0.06 kg/kWh cuts electricity 1,824 to 576: the site week halves to 1,244; the flour does not move

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]

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Solutions

2.1

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

2.2

- Flour 600 × 0.55 = 330 kg; cradle-to-gate 1,896 kg.
- Rise 330/1,566 = 21.1%.

2.3

- Electricity 6,000 × 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 × 6 = 6,000. Losses 500 × 0.03 × 52 = 780 trays = 4,680; wash 26,000 × 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.

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