

Carbon Balances and Energy Impacts of the Management of UK Wastes

Defra R&D Project WRT 237

Annex C

December 2006



Annex C

Carbon and Greenhouse Gas Balances

Carbon and greenhouse gas balances for each waste material and scenario are shown in the following diagrams. Each details:

- the carbon that remains within the material fraction following treatment or disposal (both carbon in inert fractions that have been deposited in land, as well as organic carbon that has not degraded but is sequestered in landfill or other soil carbon sink);
- carbon that is contained in products, such as recyclate or composts; and
- carbon that is released to atmosphere, as carbon dioxide (fossil/biogenically derived) or methane.

A greenhouse gas balance is shown in red, detailing:

- 'ancillary' greenhouse gas emissions predominantly associated with fuel, energy and transport;
- greenhouse gas releases directly associated with the degradation of waste materials (eg on biological processing or landfill of biogenic wastes, or combustion of fossil-derived materials); and
- avoided greenhouse gases through resource and energy recovery.

The information contained in these diagrams is summarised in *Table C1.1*.

Table C1.1 100-Year Carbon (Million Tonnes) and Greenhouse Gas (GHG – Million Tonnes CO₂-equivalents) Balance Summary

Material/Scenario	Carbon in Waste	Carbon Released as CO ₂ (Biogenic)	Carbon Released as CO ₂ (Fossil)	Carbon Released as CH ₄	Carbon in Products	Carbon Remaining in Landfill/ Soil	Ancillary GHG Emissions	GHG Released from Fraction	Avoided GHG (Max)	Avoided GHG (Min)	Net GHG (Max)	Net GHG (Min)
Paper/Card Baseline	118.0	57.7	0.0	4.6	47.2	8.5	4.6	140.0	-127.3	-68.4	17.2	76.1
Paper/Card High Resource	118.0	42.1	0.0	3.6	64.5	7.8	5.0	110.1	-150.8	-77.5	-35.7	37.6
Paper/Card High Energy	118.0	85.3	0.0	2.7	24.1	5.9	6.1	83.6	-187.9	-80.8	-98.1	8.9
Paper/Card Combined	118.0	42.7	0.0	3.4	64.6	7.3	5.2	103.7	-115.0	-78.5	-46.0	30.5
Kitchen/Food Baseline	43.0	33.0	0.0	2.2	1.9	5.9	3.2	66.5	-22.7	-17.8	47.0	52.0
Kitchen/Food High Resource	43.0	29.2	0.0	1.5	8.2	4.1	5.5	45.3	-15.2	-12.4	35.6	38.4
Kitchen/Food High Energy	43.0	27.7	0.0	1.2	10.7	3.3	8.6	38.3	-48.4	-27.1	-1.5	19.7
Kitchen/Food Combined	43.0	28.1	0.0	1.3	10.1	3.6	8.7	39.3	-20.0	-14.0	28.0	34.0
Green Baseline	49.2	34.5	0.0	1.0	3.2	5.1	3.2	29.9	-11.9	-8.5	21.2	24.6
Green High Resource	49.2	34.5	0.0	0.6	10.6	3.4	5.5	20.1	-7.6	-5.7	18.0	19.9
Green High Energy	49.2	33.1	0.0	0.5	12.7	2.9	6.1	17.42	-47.6	-24.0	-24.2	-0.5
Manure/Slurry Baseline	388.6	379.1	0.0	0.0	0.2	9.4	8.3	0.0	-17.2	-3.2	-8.8	5.2
Manure/Slurry High Resource	388.6	333.2	0.0	0.0	48.4	7.0	16.3	1.9	-14.7	-2.5	3.5	15.7
Manure/Slurry High Energy	388.6	333.0	0.0	0.0	48.6	7.0	22.7	2.2	-191.3	-84.6	-166.3	-59.6
Crop Waste Baseline	22.0	21.5	0.0	0.0	0.0	0.5	0.8	0.0	-4.7	-1.4	-3.9	-0.7
Crop Waste High Resource	22.0	19.0	0.0	0.01	2.5	0.5	1.3	0.6	-2.8	-0.8	-0.9	1.0
Crop Waste High Energy	22.0	21.5	0.0	0.0	0.1	0.4	1.5	0.1	-41.8	-14.6	-40.2	-13.0
Other Organics Baseline	28.6	26.1	0.0	0.1	1.7	0.7	1.7	2.6	-7.9	-3.0	-3.6	1.2
Other Organics High Resource	28.6	23.1	0.0	0.1	4.8	0.7	2.0	3.0	-4.5	-1.9	0.5	3.1
Other Organics High Energy	28.6	26.5	0.0	0.1	1.5	0.5	2.0	2.8	-29.3	-10.7	-24.5	-5.9
Other Organics Combined	28.6	23.0	0.0	0.1	5.0	0.5	0.0	3.0	-14.4	-5.0	-11.4	-2.0
Wood Baseline	88.7	70.3	0.0	1.6	12.0	4.7	1.7	50.6	-18.4	-11.5	338.	40.7
Wood High Resource	88.7	59.2	0.0	1.4	24.2	3.9	2.0	43.4	-16.8	-9.3	28.5	36.0
Wood High Energy	88.7	79.1	0.0	0.9	6.1	2.6	2.9	28.5	-110.6	-42.5	-79.2	-11.1
Wood Combined	88.7	60.8	0.0	1.0	24.2	2.7	2.6	31.2	-59.8	-23.4	-26.0	10.5
Textiles Baseline	15.0	10.3	0.8	0.2	1.7	1.9	0.3	9.7	-11.4	-6.1	-1.4	3.9
Textiles Resource	15.0	8.7	0.4	0.2	3.9	1.7	0.4	7.4	-19.6	-10.6	-11.8	-2.8
Textiles High Energy	15.0	9.1	3.7	0.1	0.9	1.1	0.6	17.6	-21.8	-8.8	-3.7	9.3

Material/Scenario	Carbon in Waste	Carbon Released as CO ₂ (Biogenic)	Carbon Released as CO ₂ (Fossil)	Carbon Released as CH ₄	Carbon in Products	Carbon Remaining in Landfill/ Soil	Ancillary GHG Emissions	GHG Released from Fraction	Avoided GHG (Max)	Avoided GHG (Min)	Net GHG (Max)	Net GHG (Min)
Textiles Combined	15.0	7.8	1.9	0.1	4.0	1.2	0.5	11.1	-26.6	-13.0	-15.0	-1.3
Dense Plastic Baseline	41.2	0.0	3.7	0.0	1.4	36.0	0.6	13.8	-13.3	-0.8	1.0	13.5
Dense Plastic High Resource	41.2	0.0	1.9	0.0	10.9	28.4	0.7	6.88	-40.5	15.4	-32.9	23.0
Dense Plastic High Energy	41.2	0.00	20.2	0.0	0.8	20.2	1.1	74.2	-62.0	-20.0	13.5	55.3
Dense Plastic Combined	41.2	0.0	8.0	0.0	10.9	22.3	0.9	29.3	-59.3	8.7	-29.1	39.0
Plastic Film Baseline	39.8	0.0	2.7	0.0	3.2	34.0	0.6	9.7	-15.7	3.5	-5.4	13.9
Plastic Film High Resource	39.8	0.0	1.3	0.0	11.4	27.1	0.8	4.87	-38.1	19.3	-32.4	24.9
Plastic Film High Energy	38.8	0.00	19.0	0.0	1.7	19.1	1.2	69.62	-60.2	-16.7	10.6	54.1
Plastic Film Combined	39.8	0.0	7.2	0.0	11.5	21.1	1.0	26.5	-55.8	13.0	-28.3	40.5
Ferrous Metals Baseline	0.0	0.0	0.0	0.0	0.0	0.0	1.4	0.0	-50.0	-34.9	-48.6	-33.5
Ferrous Metals High Resource	0.0	0.00	0.0	0.0	0.0	0.0	1.6	0.0	-60.6	-42.3	-59.0	-40.7
Non-Ferrous Baseline	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	-452.1	-424.5	-451.4	-423.8
Non-Ferrous High Resource	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	-497.9	-467.5	-497.2	-466.7
Soils Baseline	95.9	0.00	0.0	0.0	1.6	94.3	17.5	0.0	-0.1	0.0	17.4	17.5
Soils High Resource	95.9	0.0	0.0	0.0	38.3	57.6	19.4	0.0	-1.3	1.2	18.2	20.6
Soils (mining, quarrying, dredging) Baseline	113.4	0.0	0.0	0.0	0.0	113.4	4.8	0.0	0.0	0.0	4.8	4.8
Minerals Baseline	113.2	0.0	0.0	0.0	81.9	31.3	25.1	0.1	-2.9	2.4	22.3	27.6
Minerals High Resource	113.2	0.0	0.0	0.0	84.6	28.6	25.2	0.0	-2.9	2.5	22.4	27.8
Minerals (mining, quarrying, dredging) Baseline	113.4	0.0	0.0	0.0	0.8	112.6	4.9	0.0	0.0	0.0	4.9	5.0
Misc. Combustibles Baseline	131.9	62.8	9.9	1.7	37.3	20.1	4.5	89.5	-47.0	-22.9	47.0	71.2

C1.1 PAPER AND CARD

Figure C1.1 Baseline Scenario

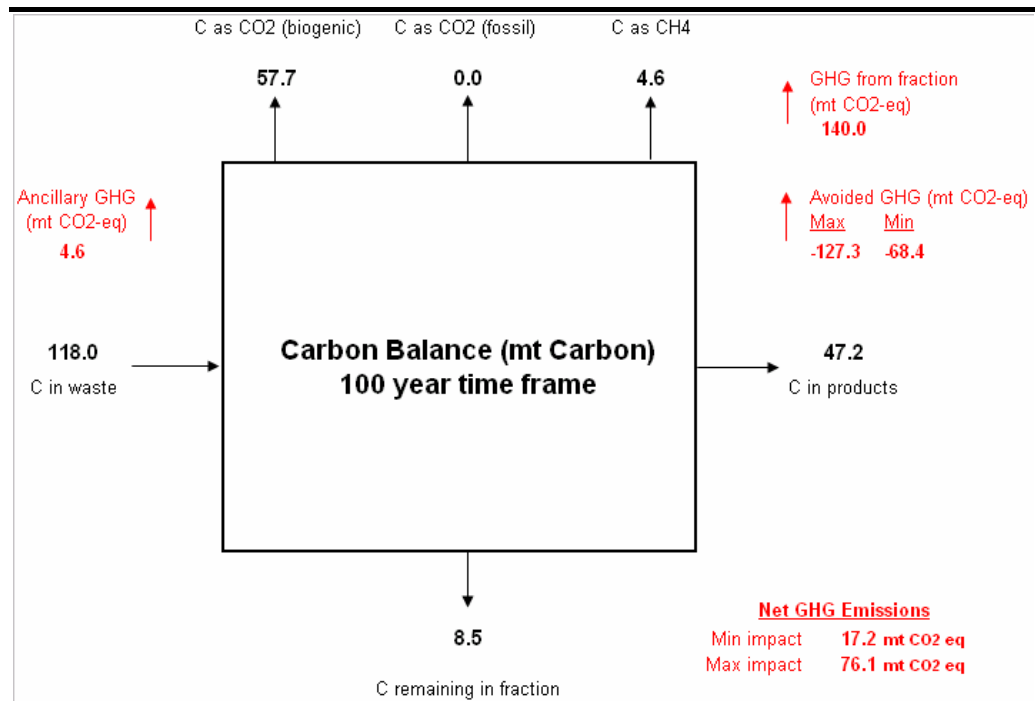


Figure C1.2 High Resource Recovery Scenario

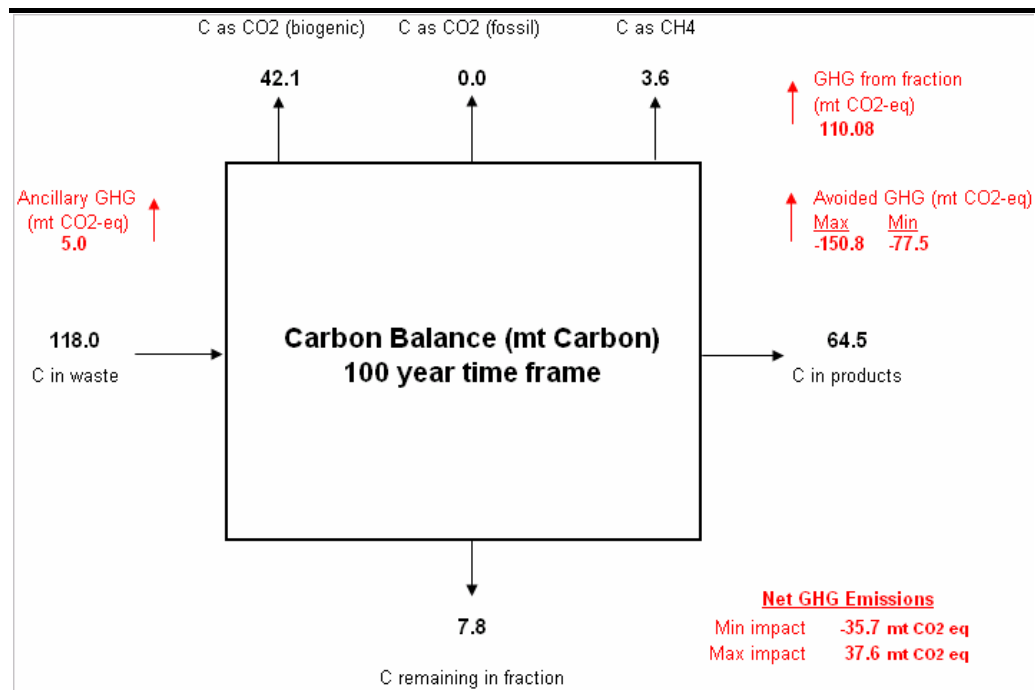


Figure C1.3 High Energy Recovery Scenario

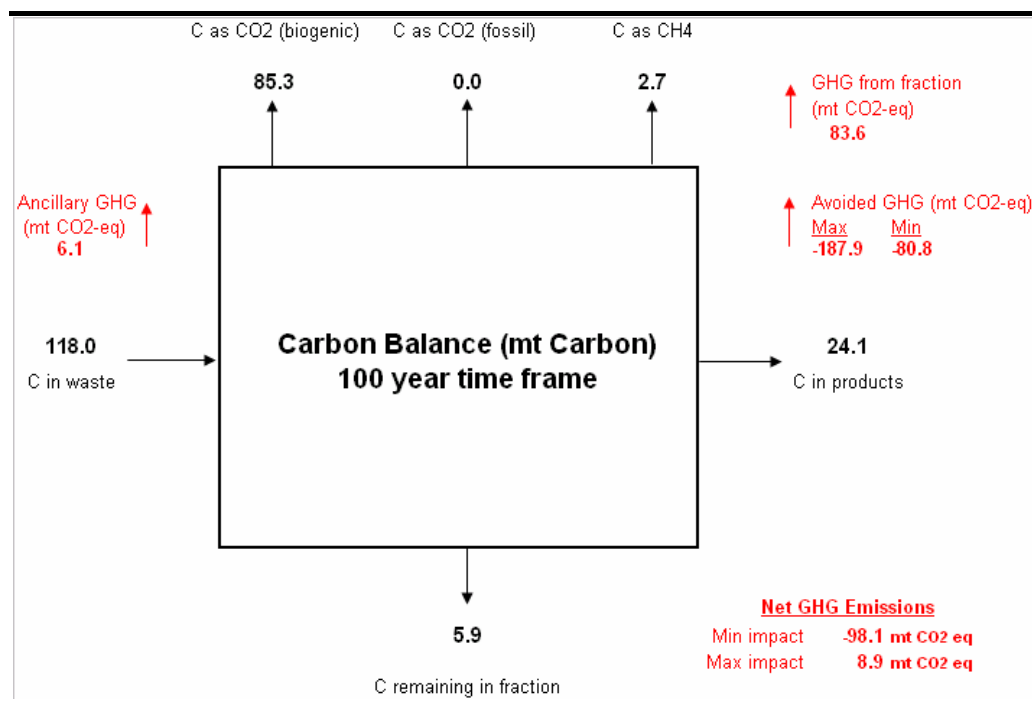


Figure C1.4 Combined Scenario

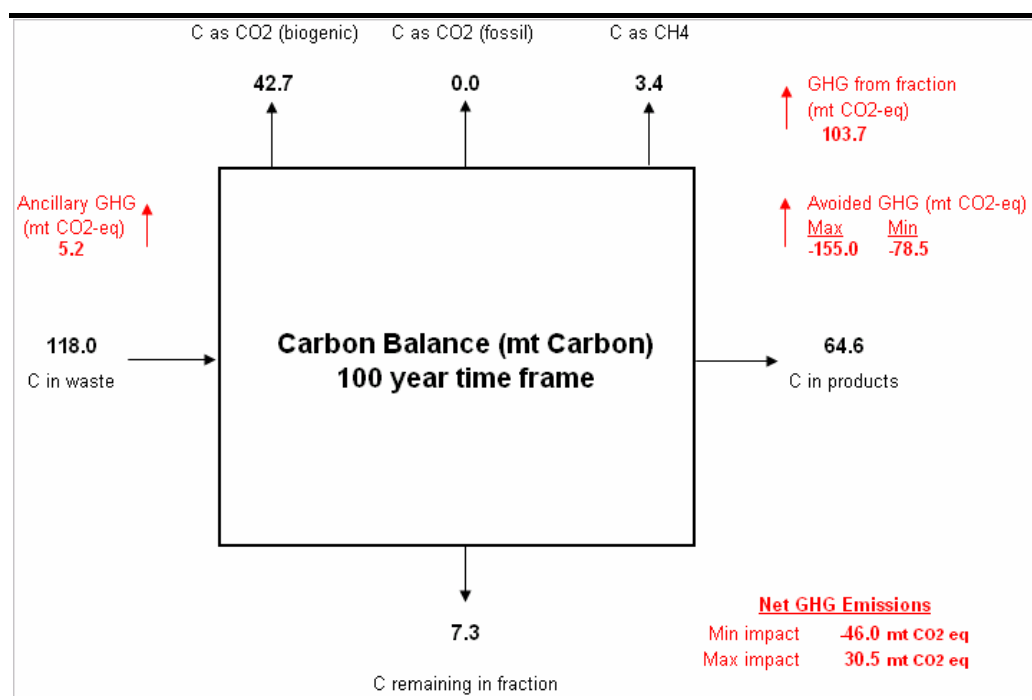


Figure C1.5 Baseline Scenario

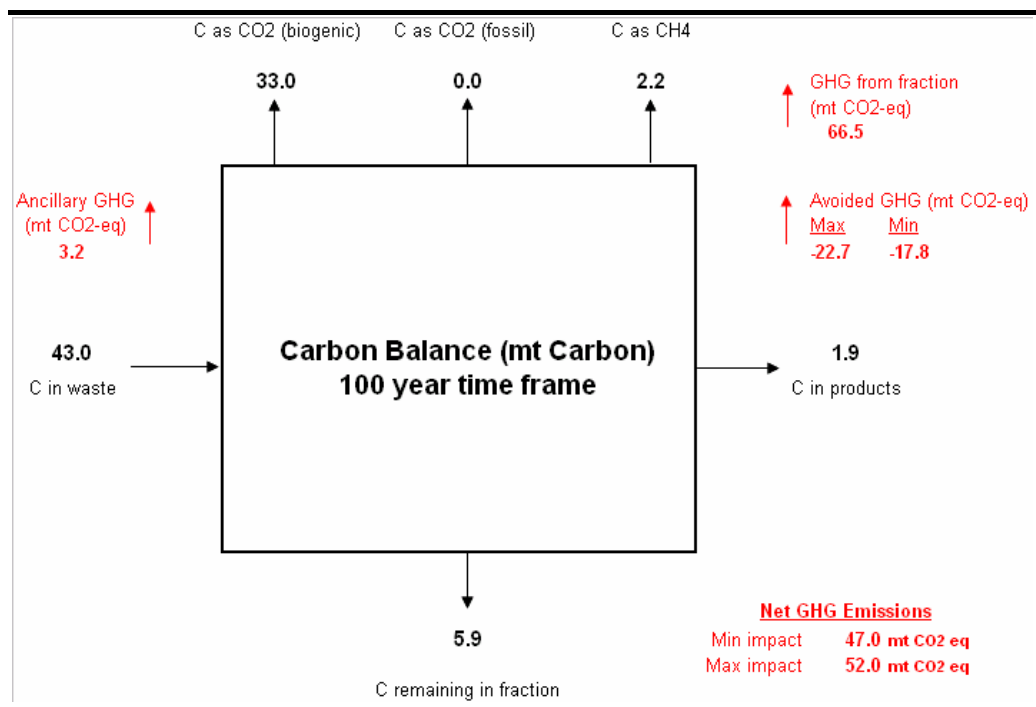


Figure C1.6 High Resource Recovery Scenario

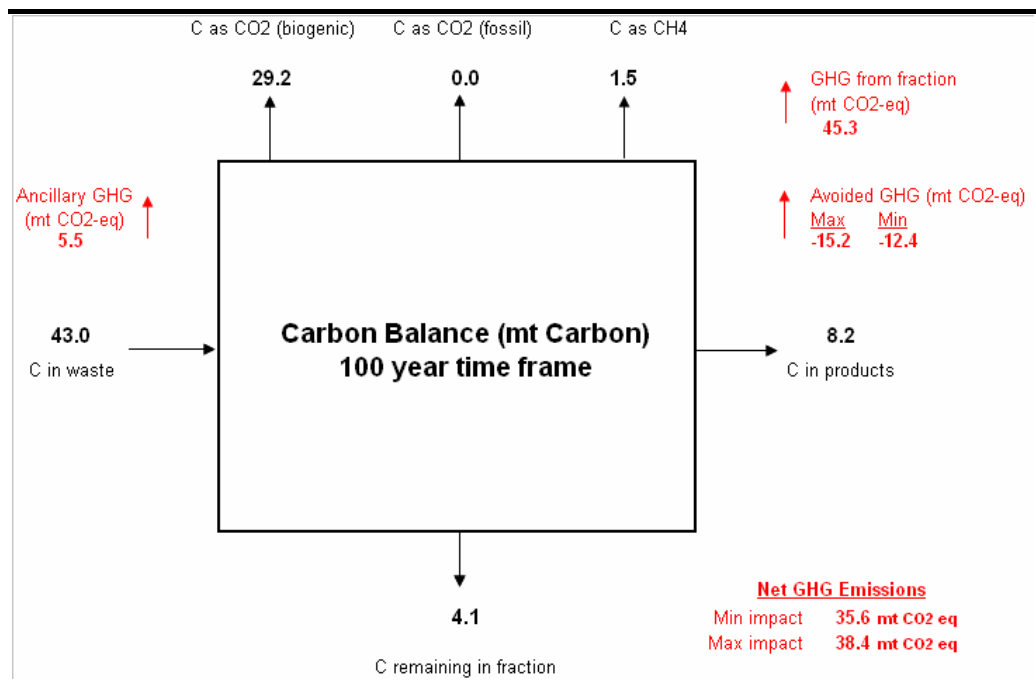


Figure C1.7 High Energy Recovery Scenario

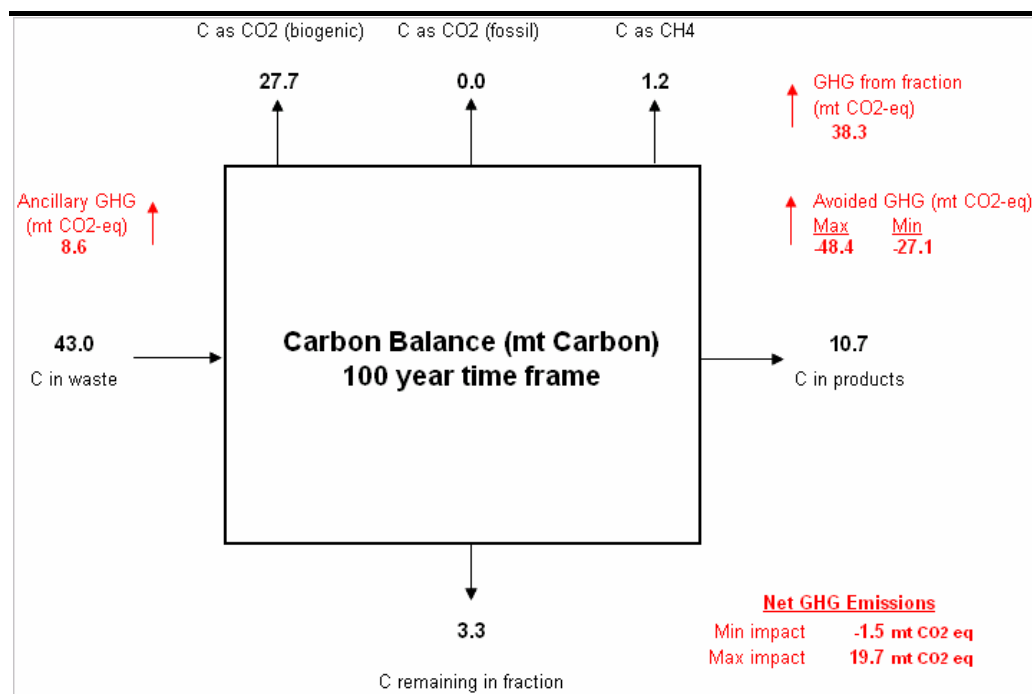


Figure C1.8 Combined Scenario

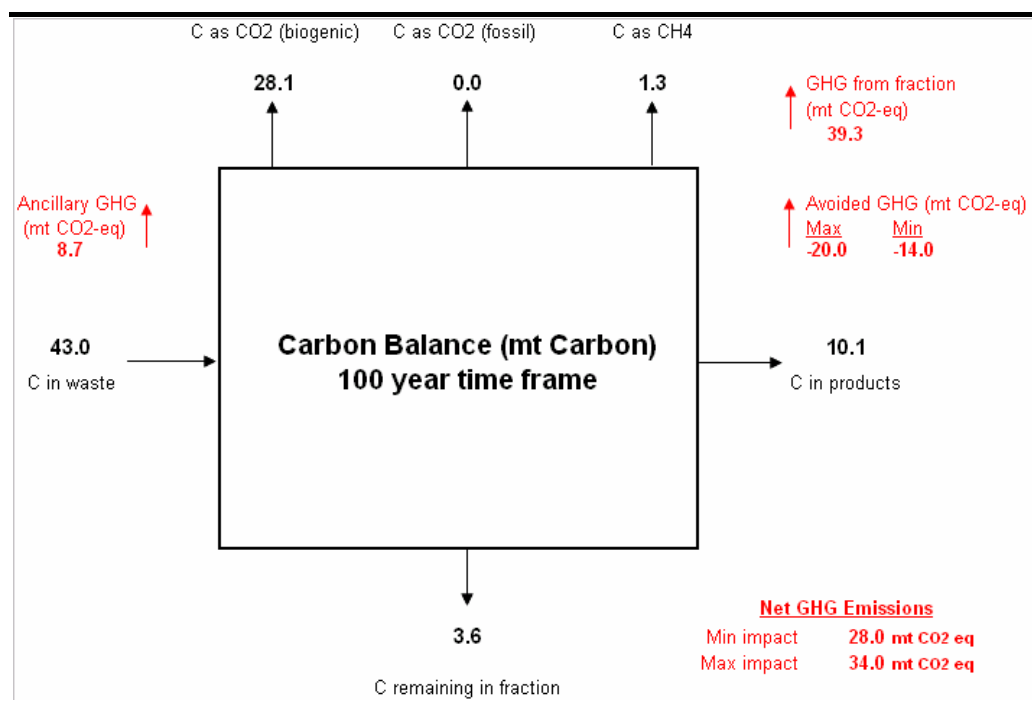


Figure C1.9 Baseline Scenario

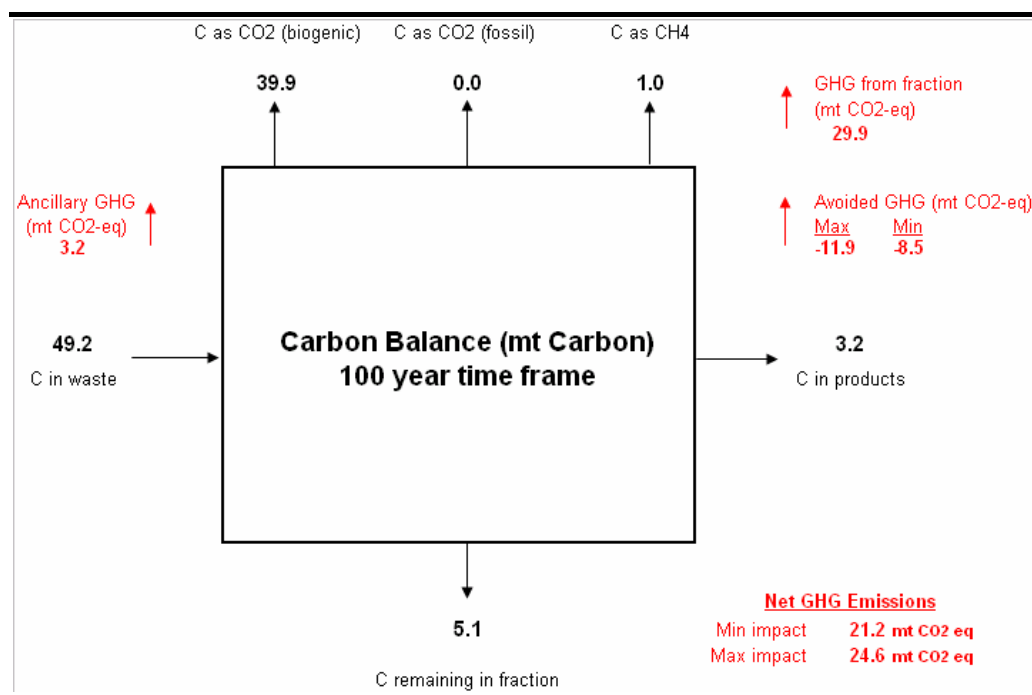


Figure C1.10 High Resource Recovery Scenario

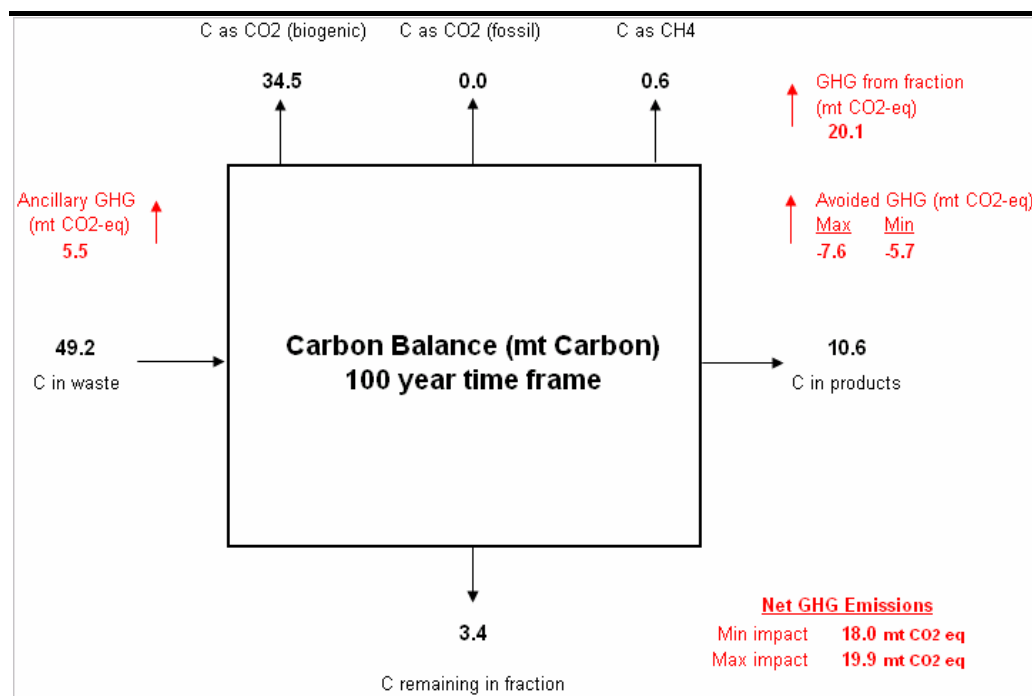
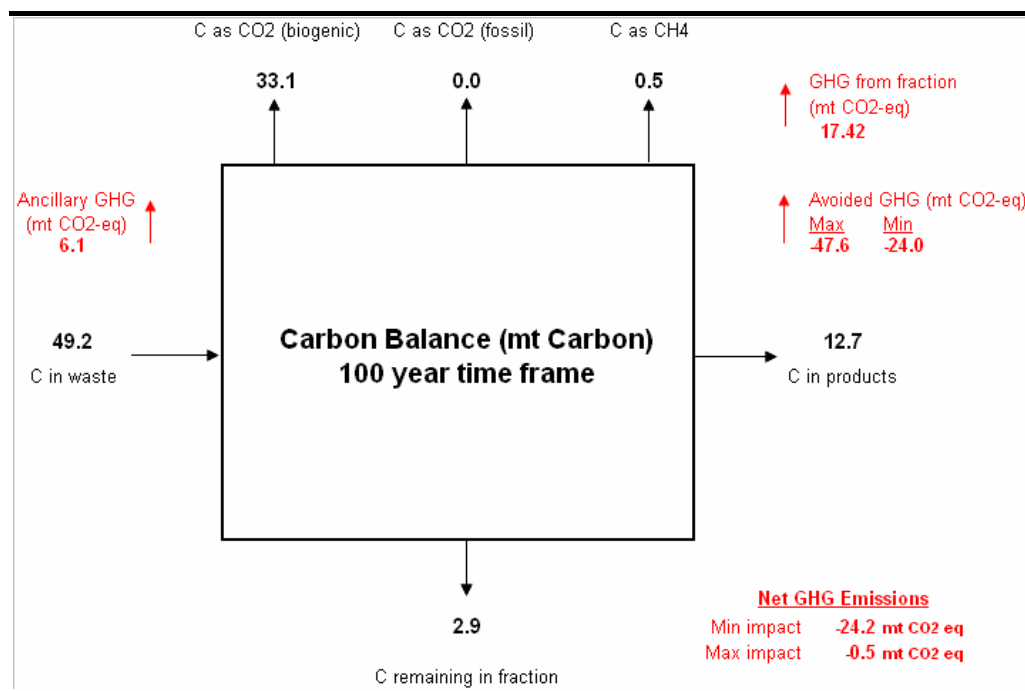


Figure C1.11 High Energy Recovery Scenario



C1.4 AGRICULTURAL CROP WASTE

Figure C1.12 Baseline Scenario

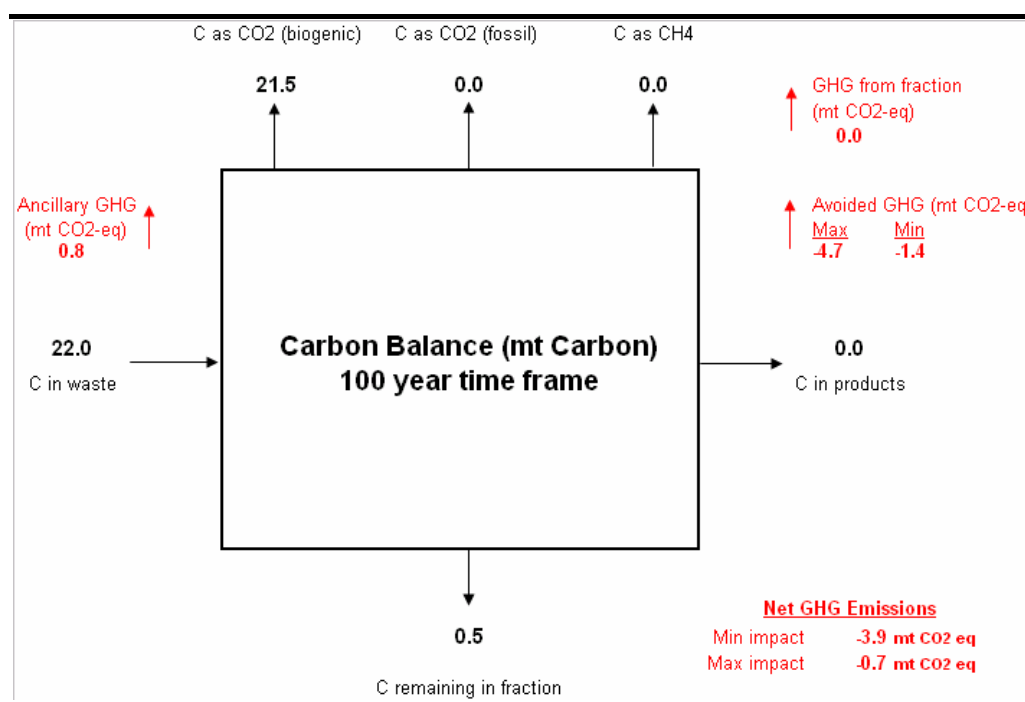


Figure C1.13 High Resource Recovery Scenario

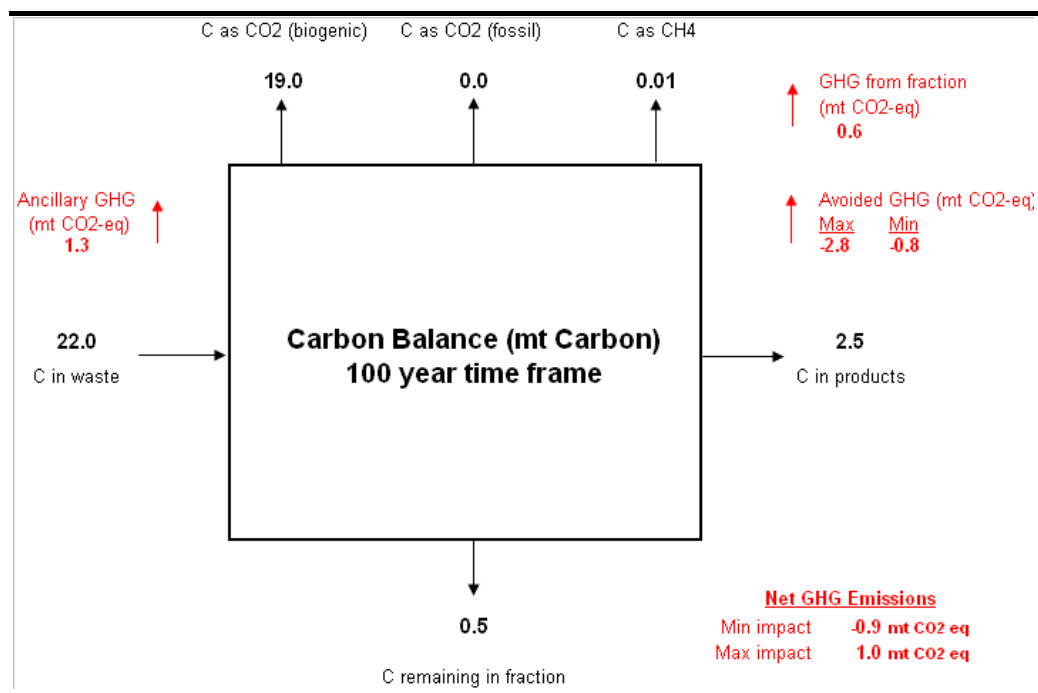


Figure C1.14 High Energy Recovery Scenario

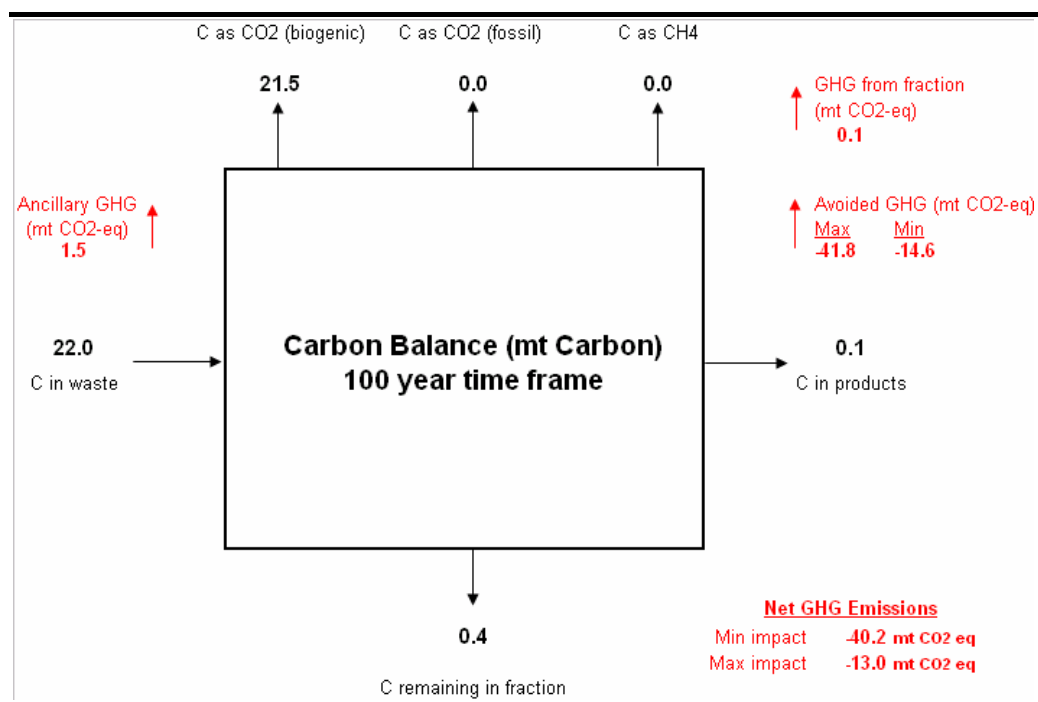


Figure C1.15 Baseline Scenario

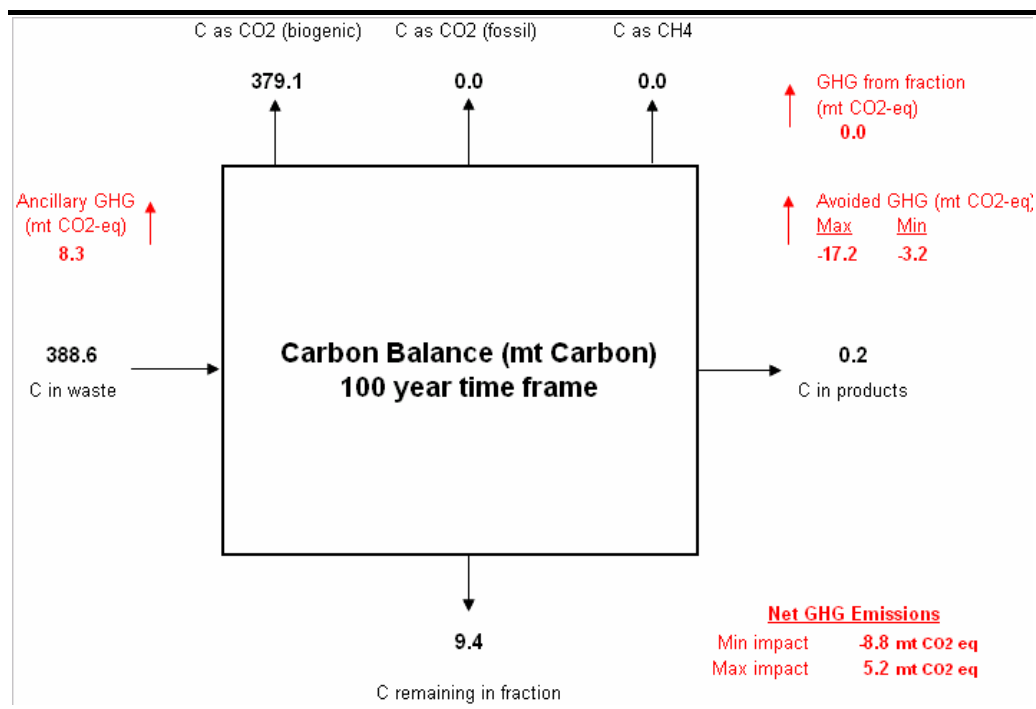


Figure C1.16 High Resource Recovery Scenario

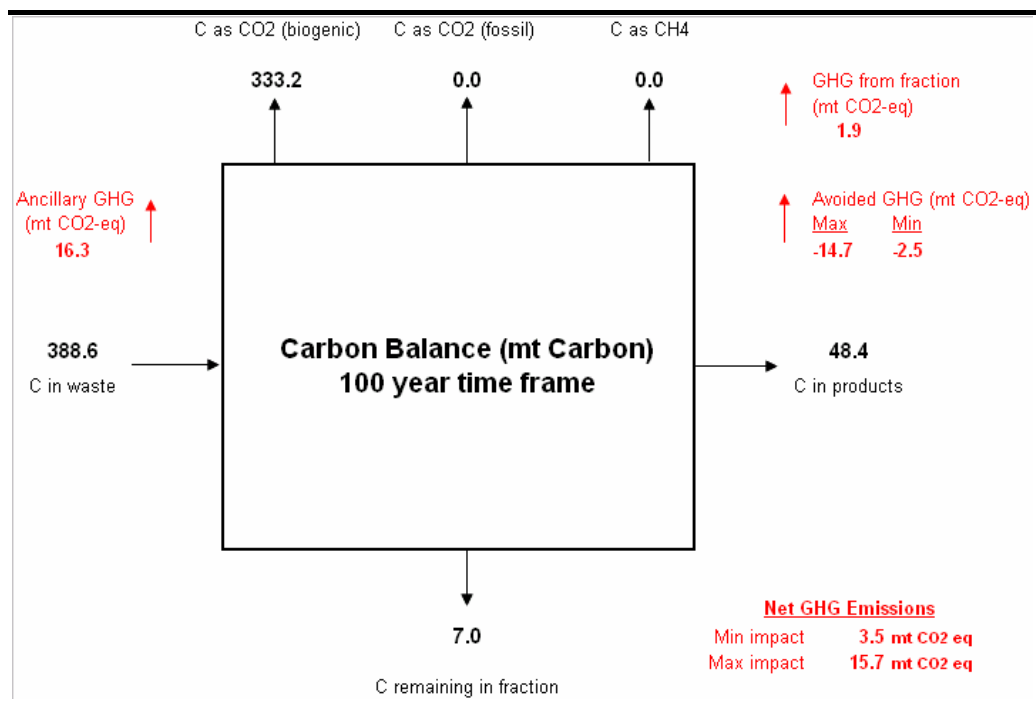
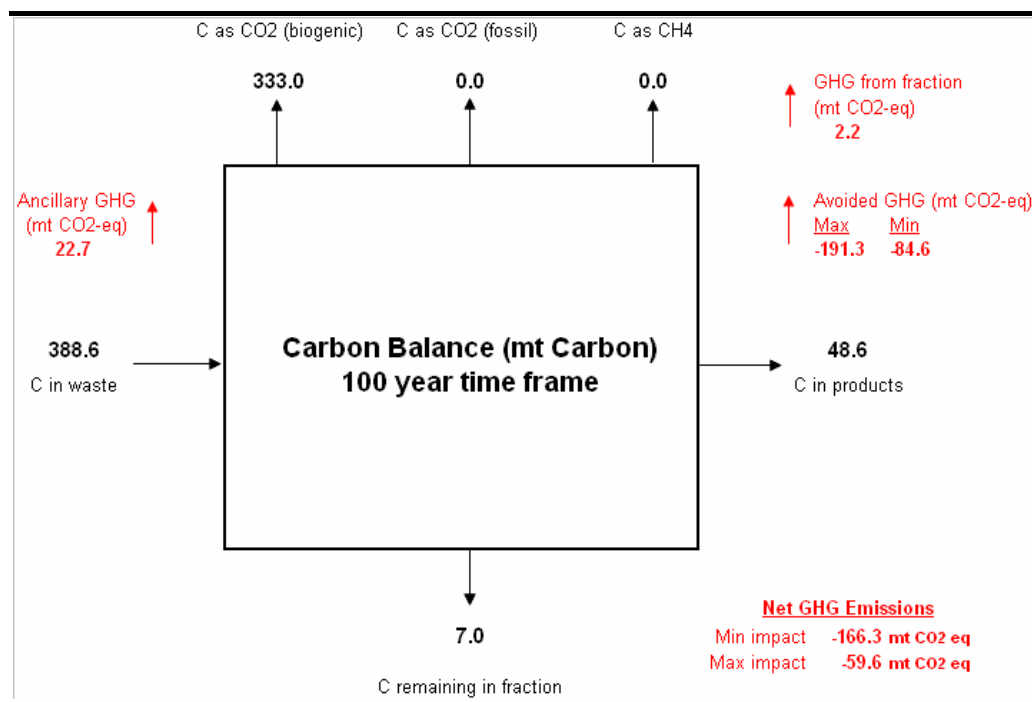


Figure C1.17 High Energy Recovery Scenario



C1.6 'OTHER ORGANICS'

Figure C1.18 Baseline Scenario

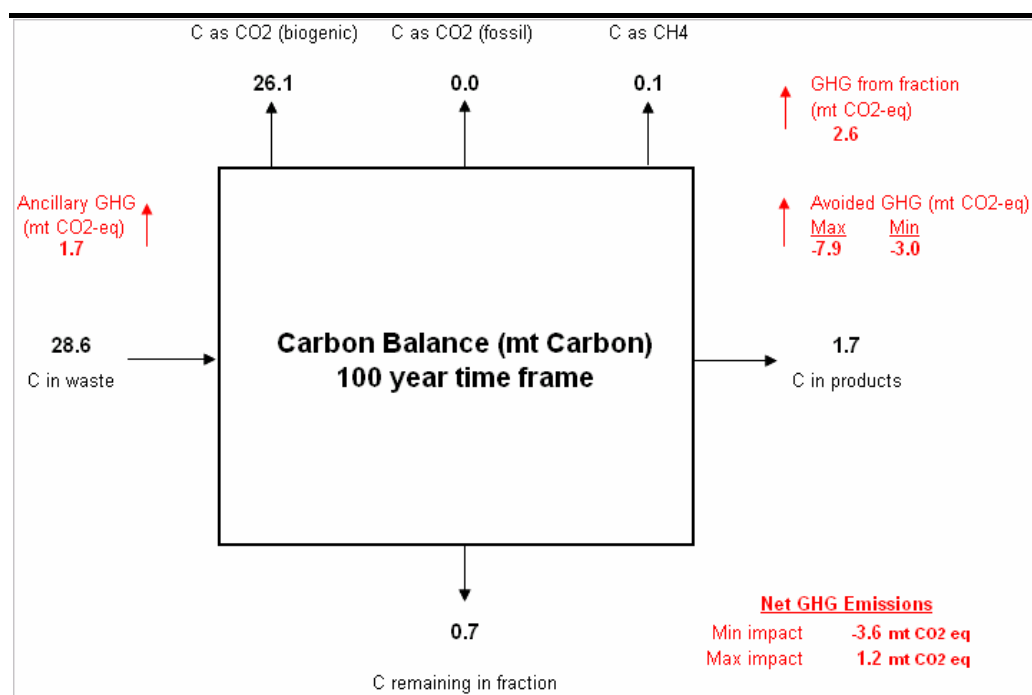


Figure C1.19 High Resource Recovery Scenario

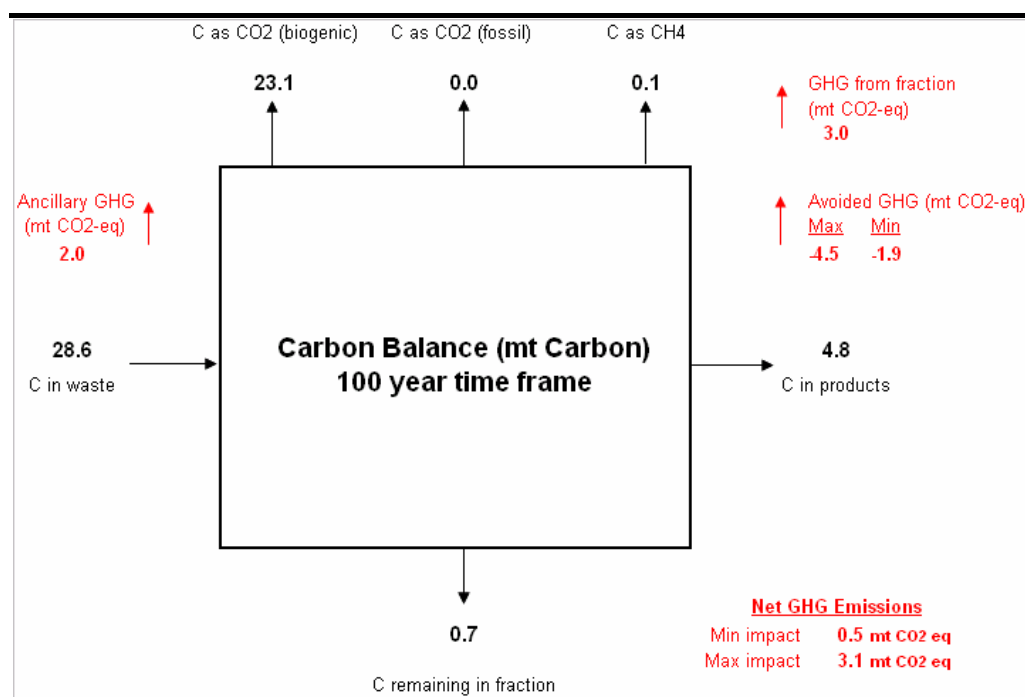


Figure C1.20 High Energy Recovery Scenario

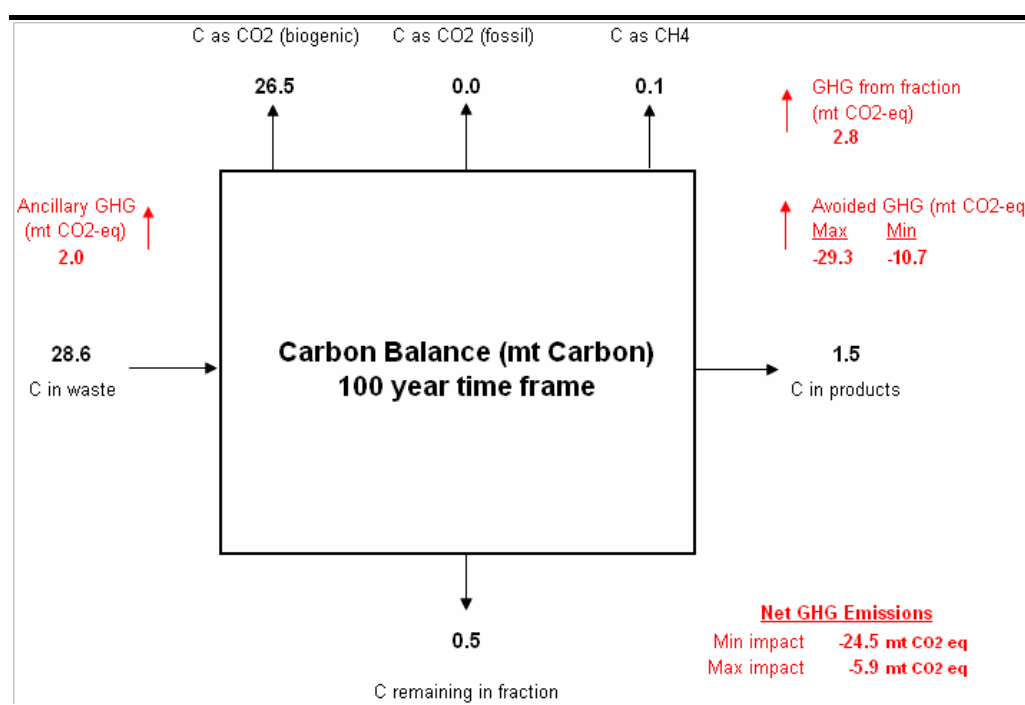
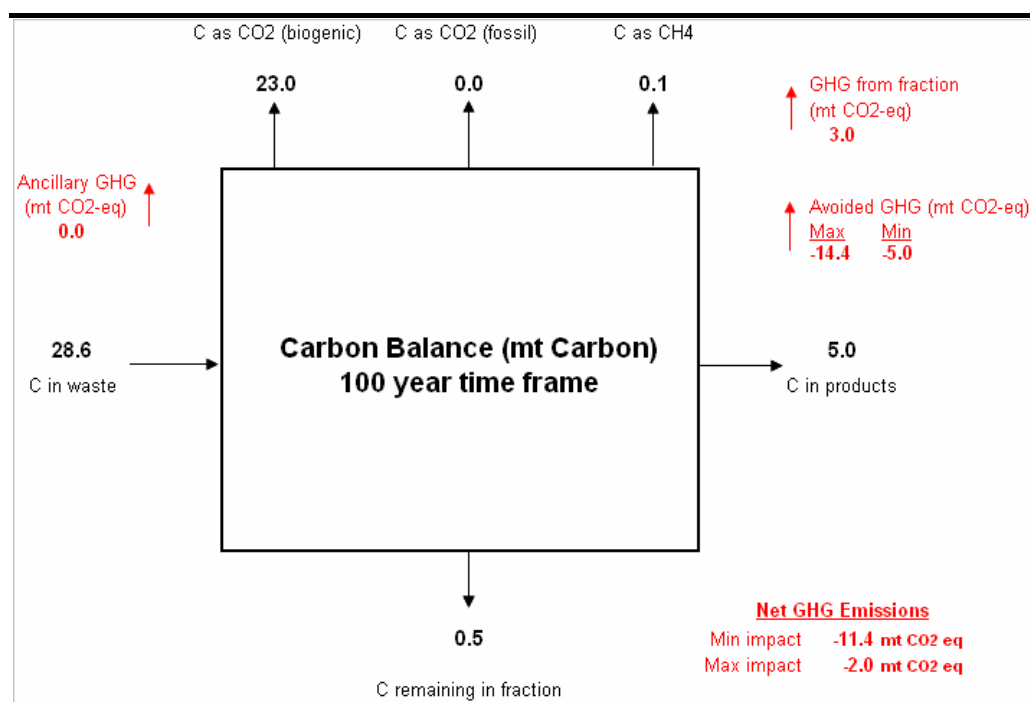


Figure C1.21 Combined Scenario



C1.7 WOOD

Figure C1.22 Baseline Scenario

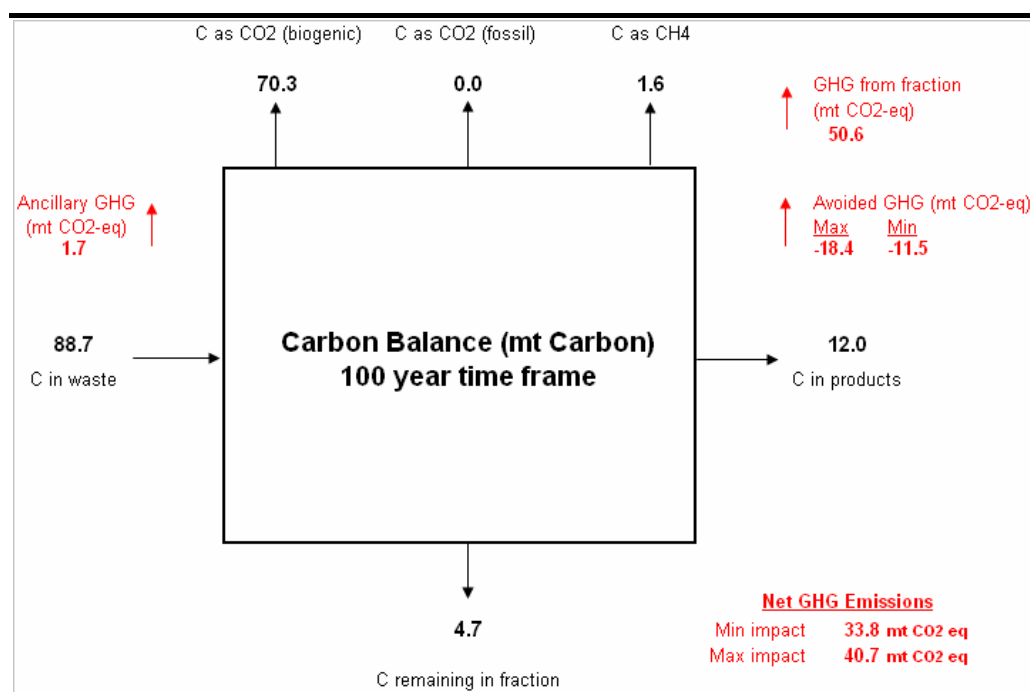


Figure C1.23 High Resource Recovery Scenario

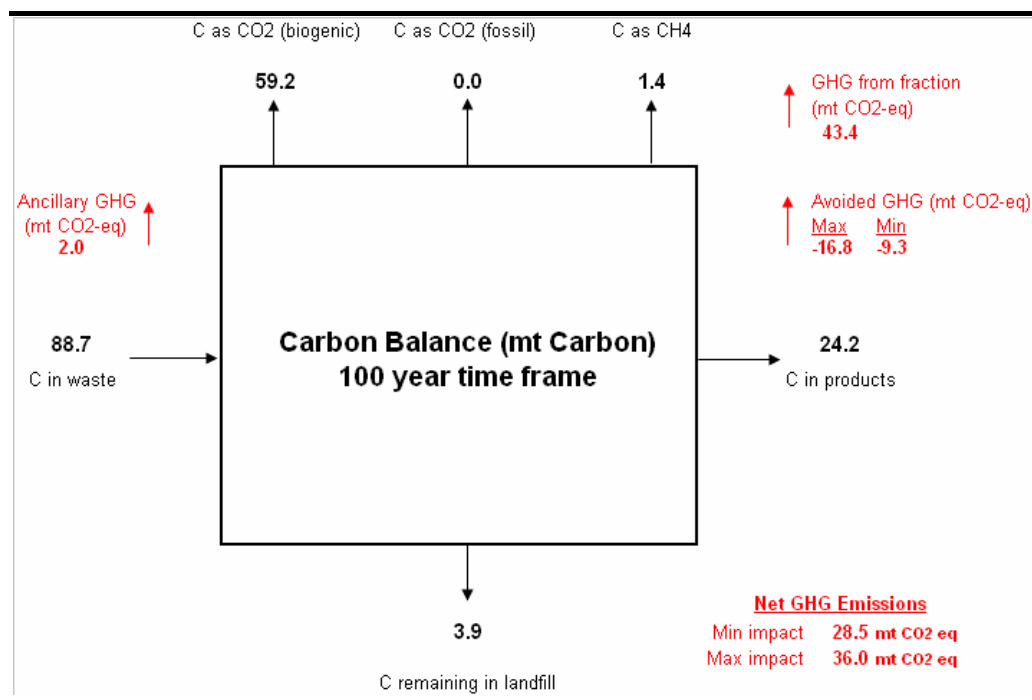


Figure C1.24 High Energy Recovery Scenario

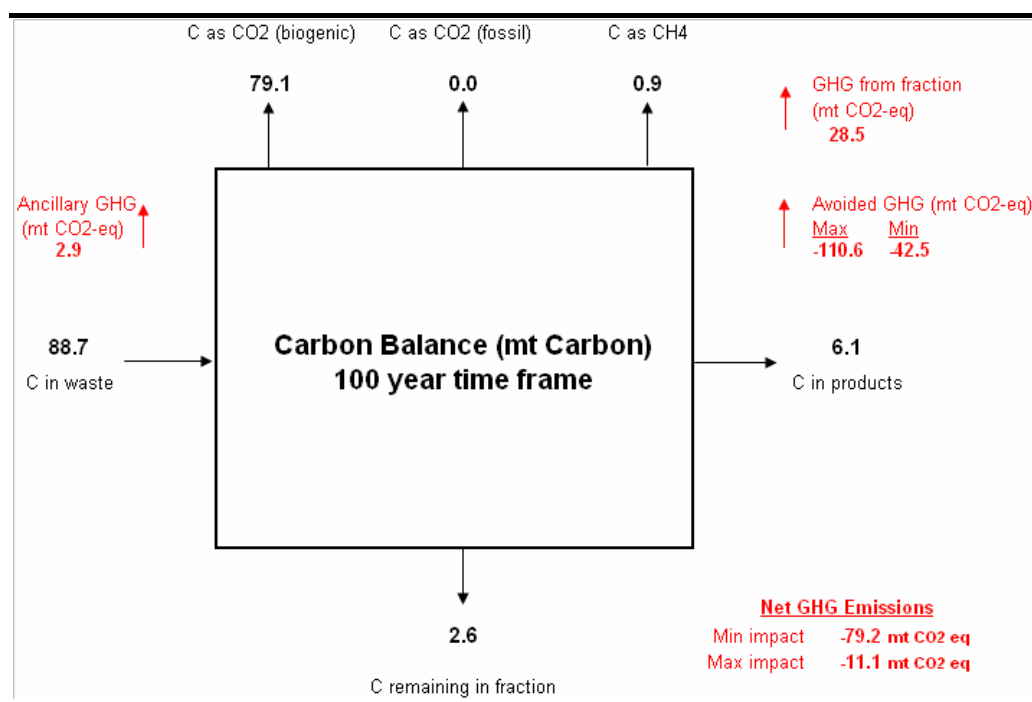
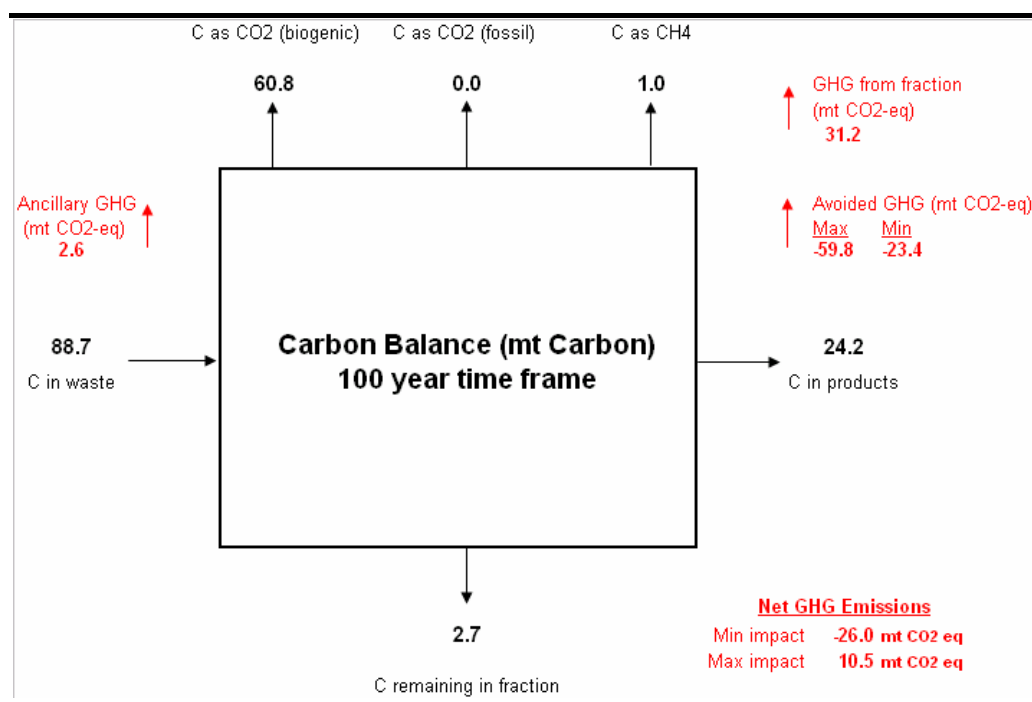


Figure C1.25 Combined Scenario



C1.8 TEXTILES

Figure C1.26 Baseline Scenario

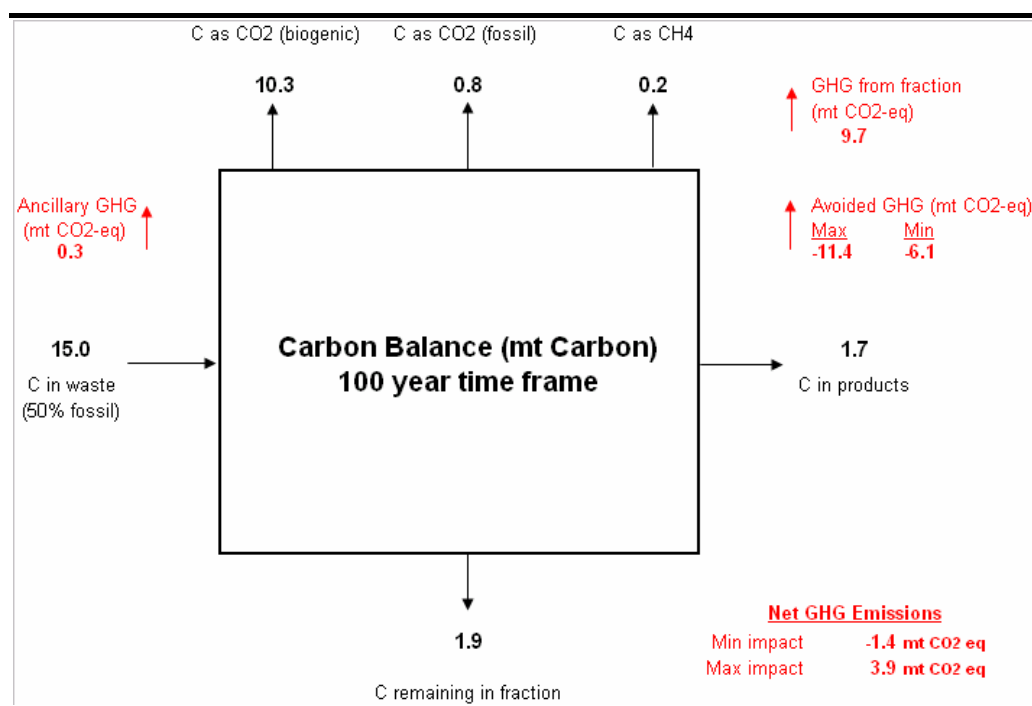


Figure C1.27 High Resource Recovery Scenario

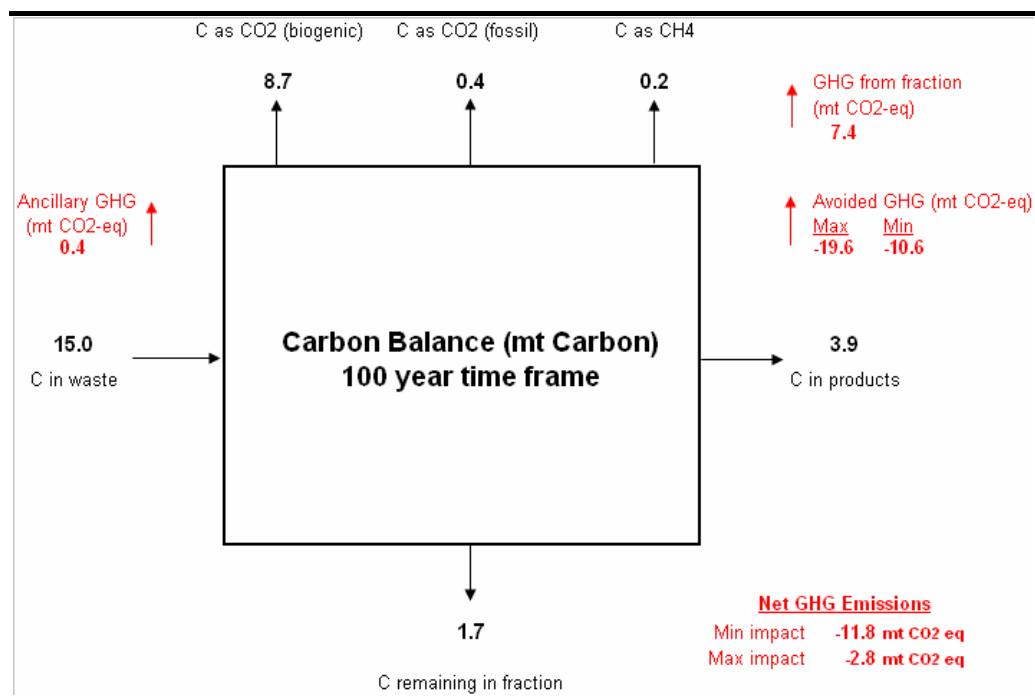


Figure C1.28 High Energy Recovery Scenario

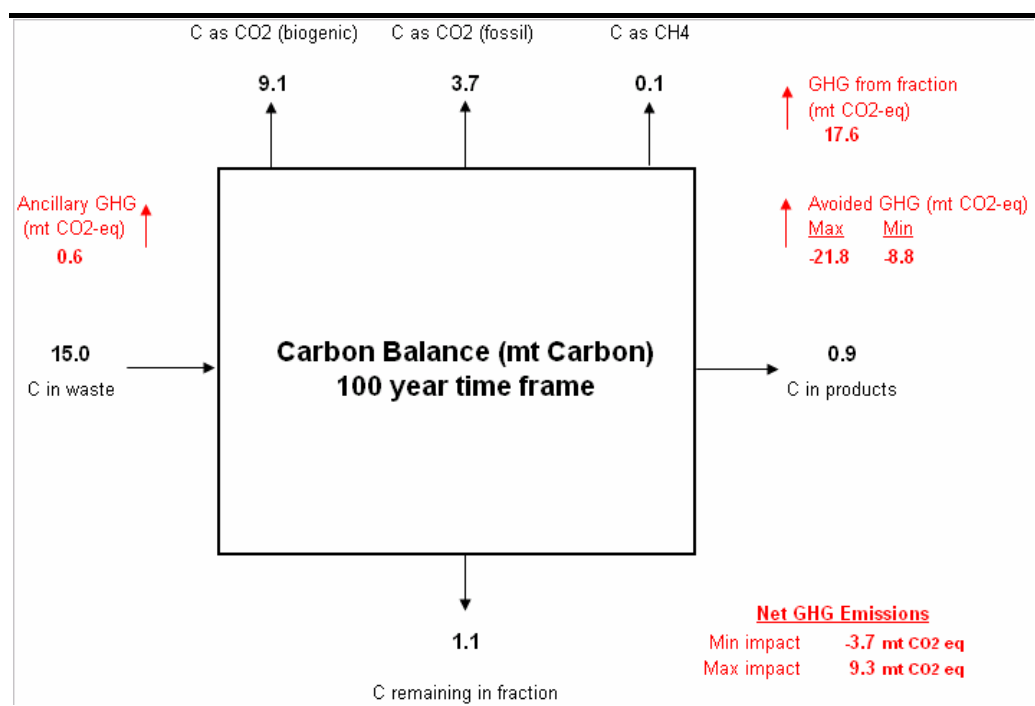
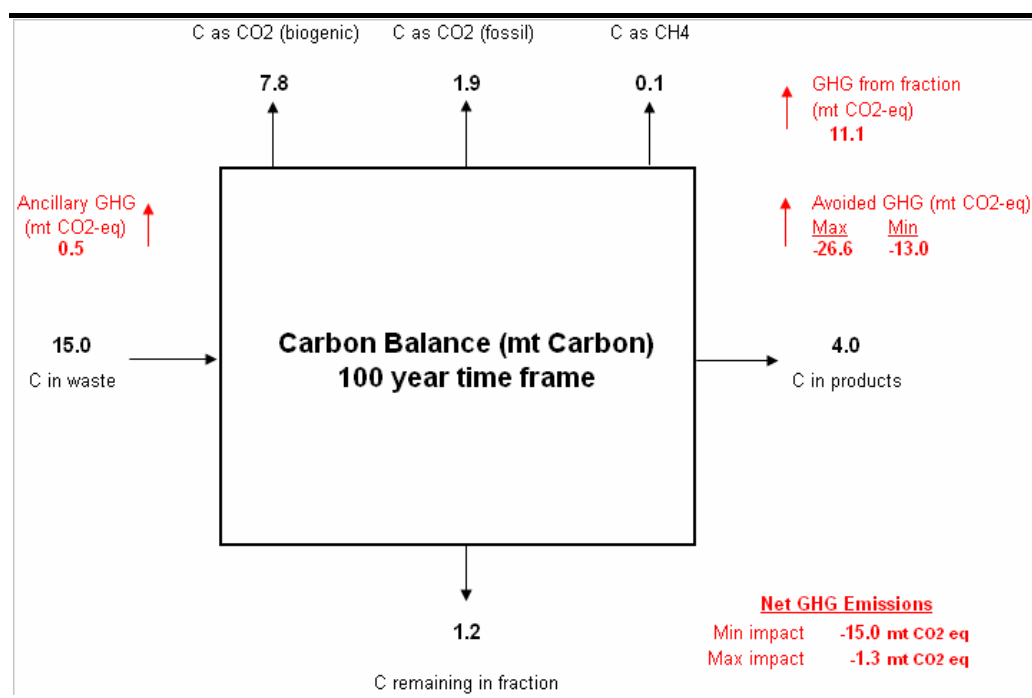


Figure C1.29 Combined Scenario



C1.9 PLASTIC (DENSE)

Figure C1.30 Baseline Scenario

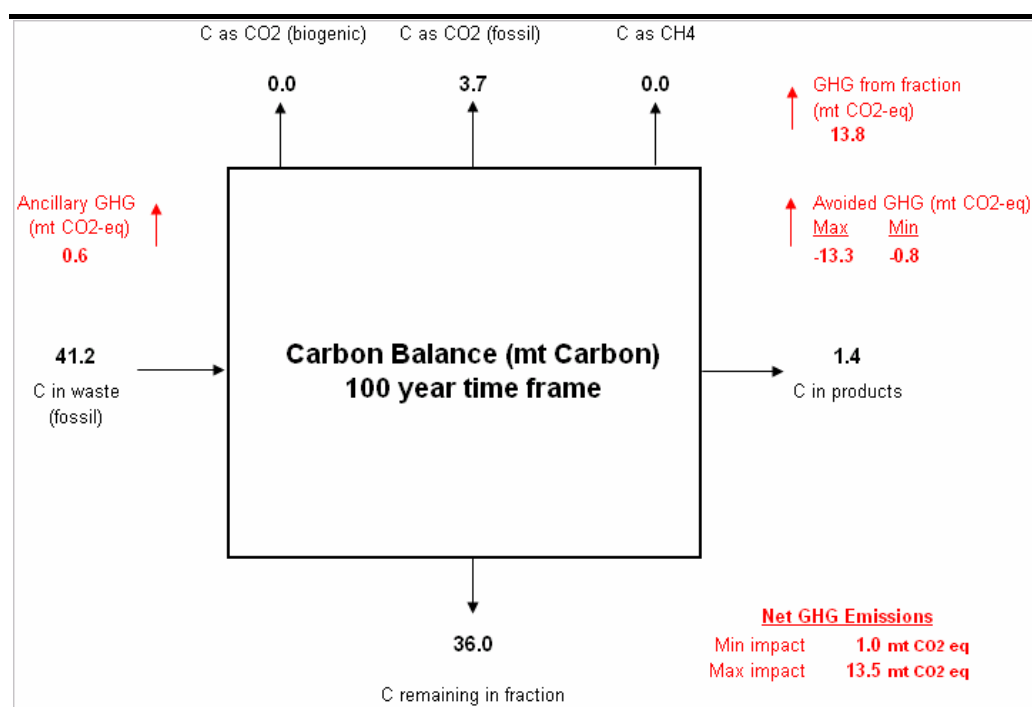


Figure C1.31 High Resource Recovery Scenario

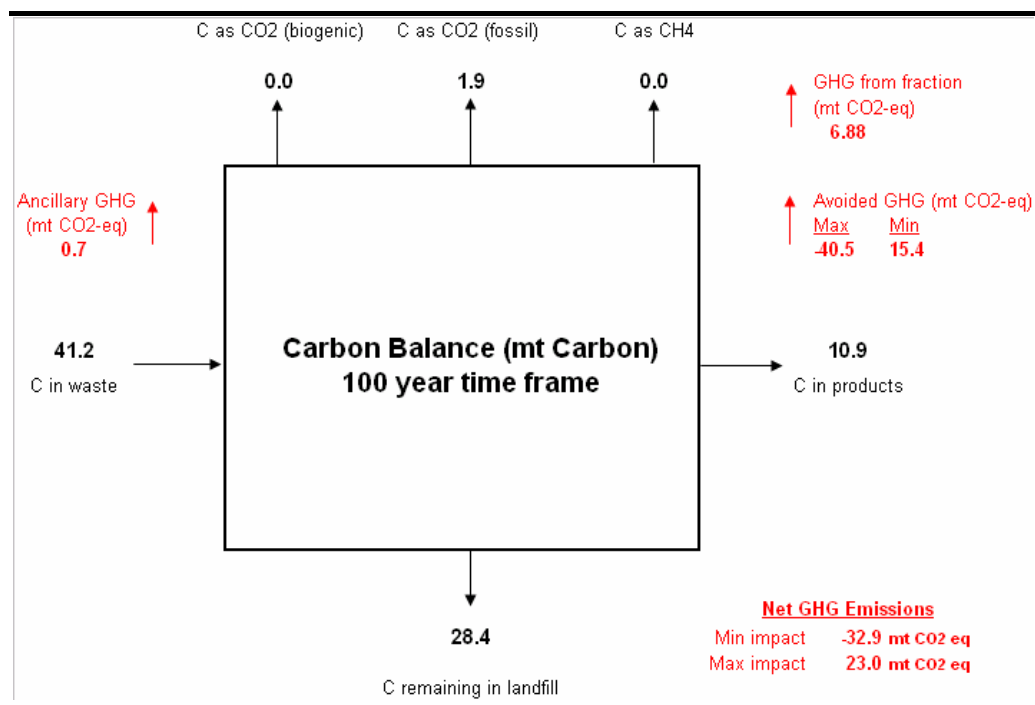


Figure C1.32 High Energy Recovery Scenario

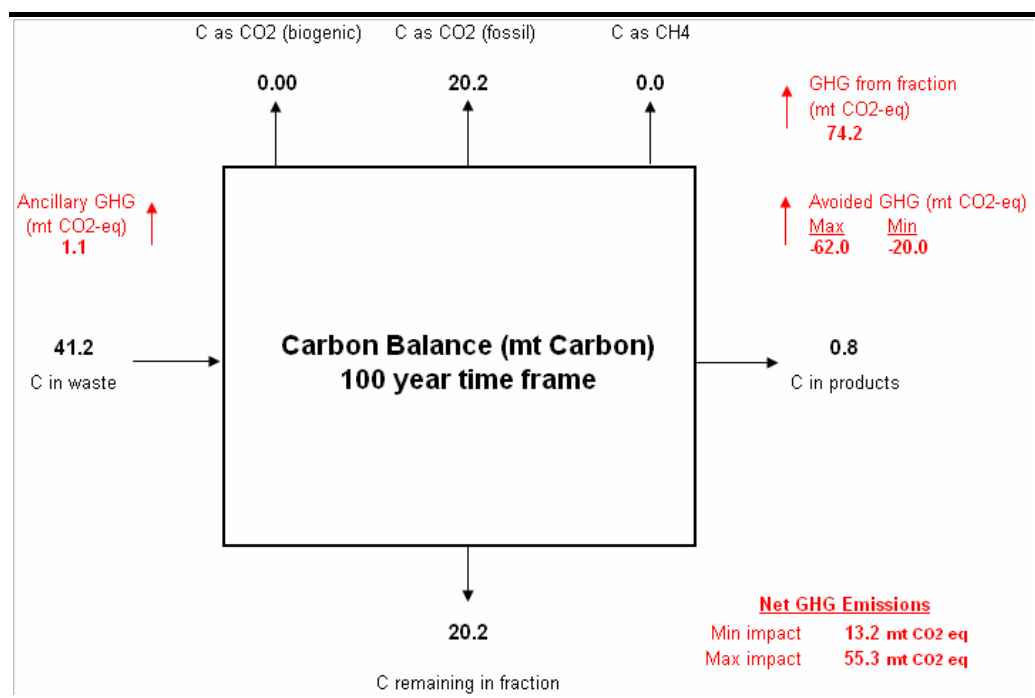
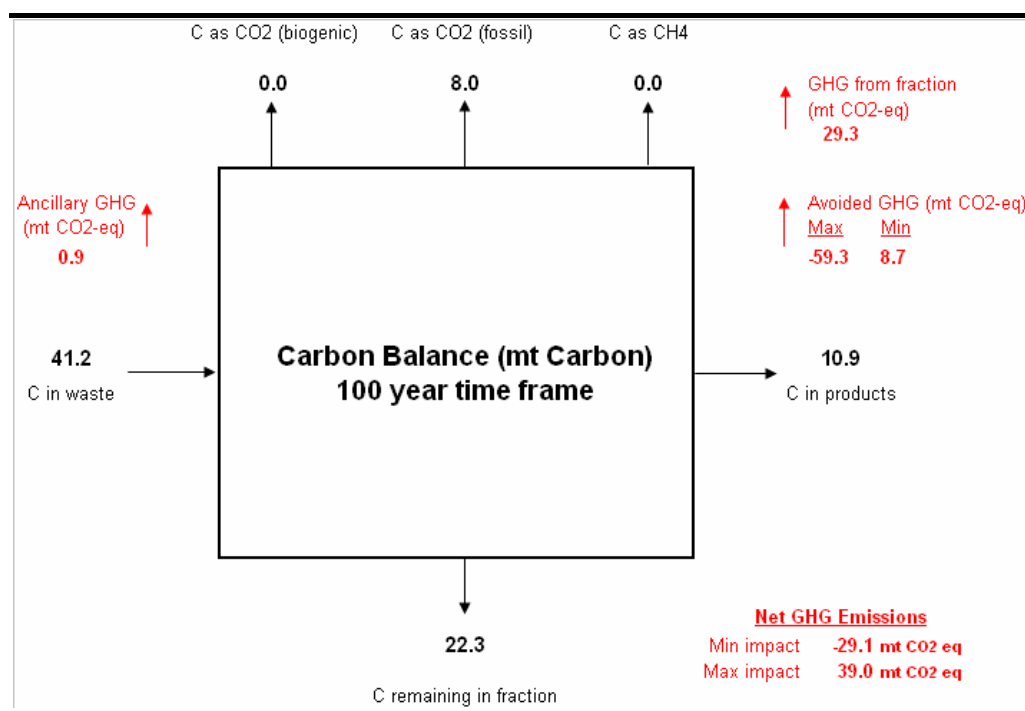


Figure C1.33 Combined Scenario



C1.10 PLASTIC (FILM)

Figure C1.34 Baseline Scenario

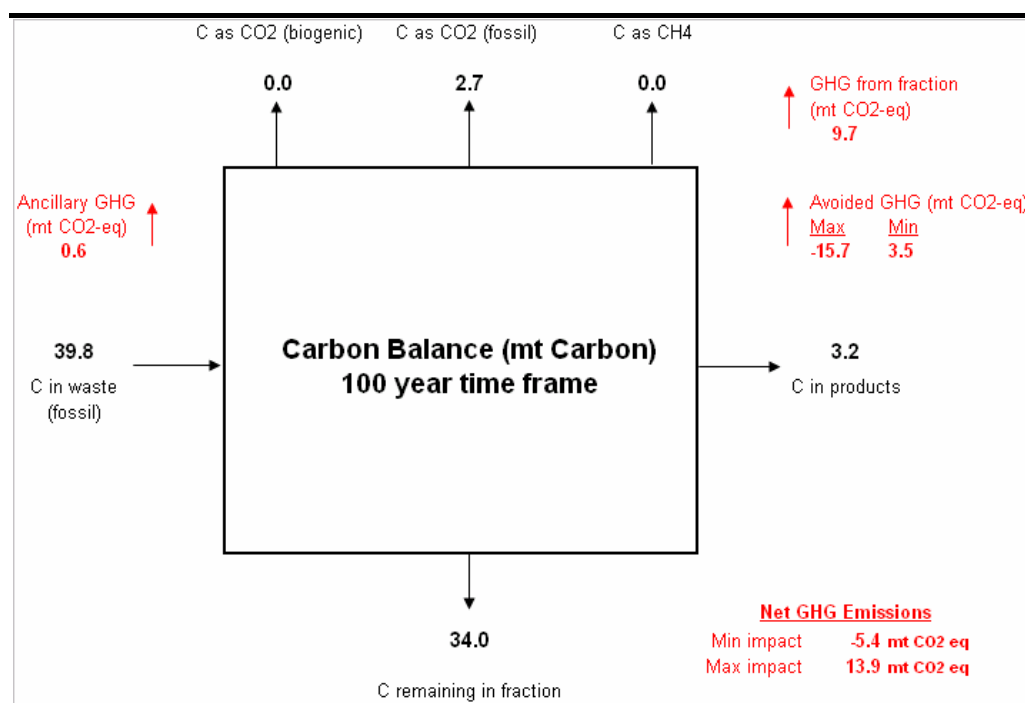


Figure C1.35 High Resource Recovery Scenario

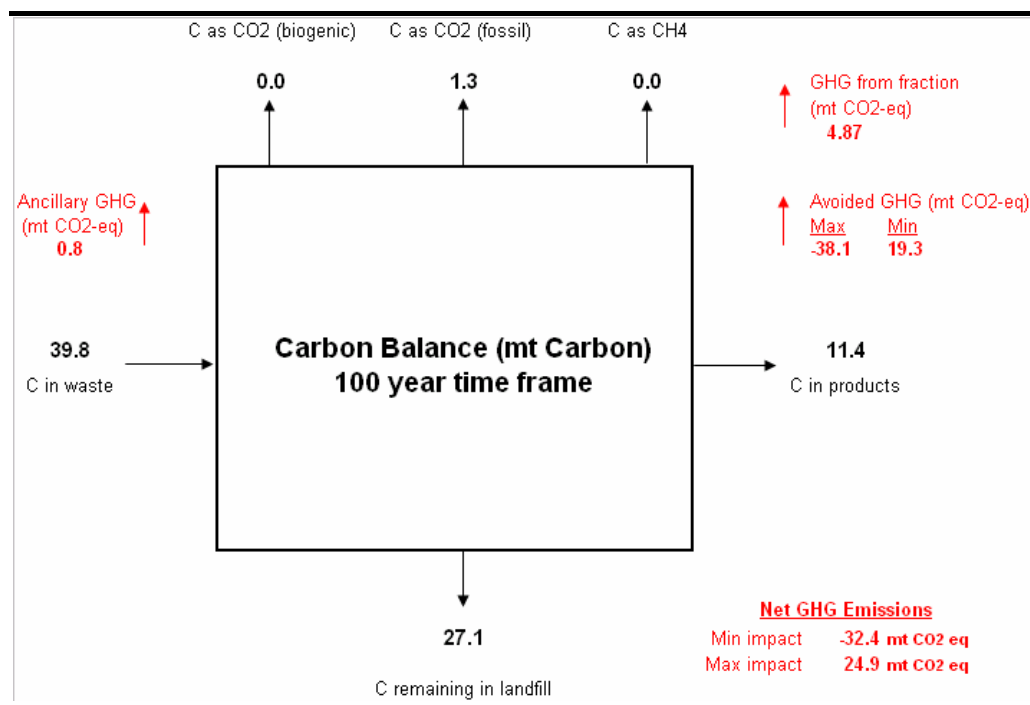


Figure C1.36 High Energy Recovery Scenario

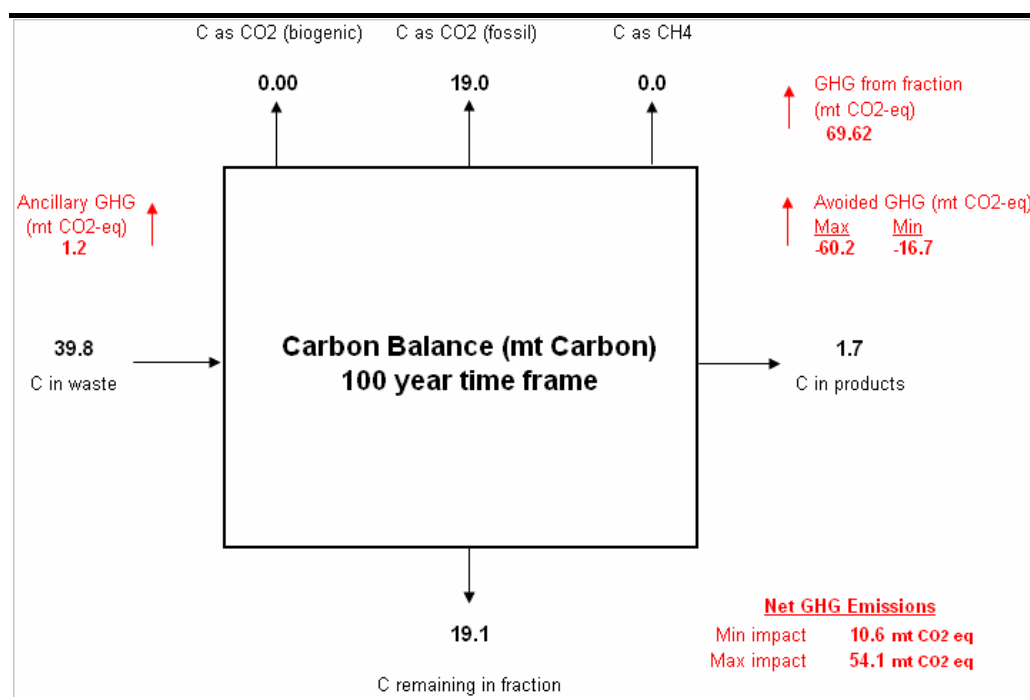
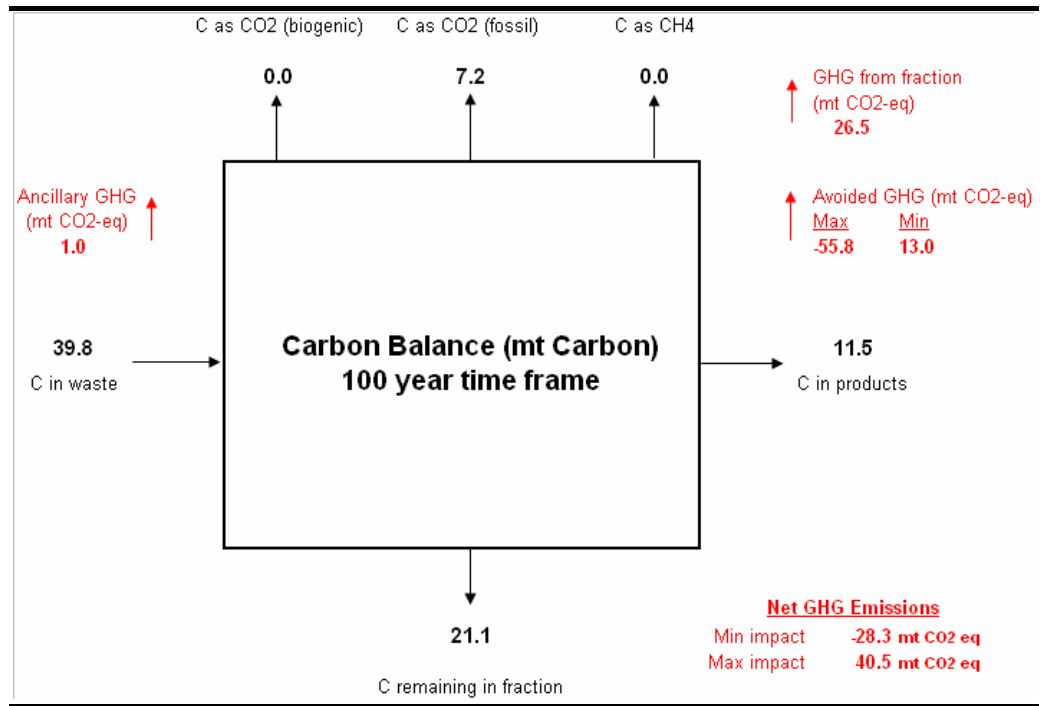


Figure C1.37 Combined Scenario



C1.11 FERROUS METALS

Figure C1.38 Baseline Scenario

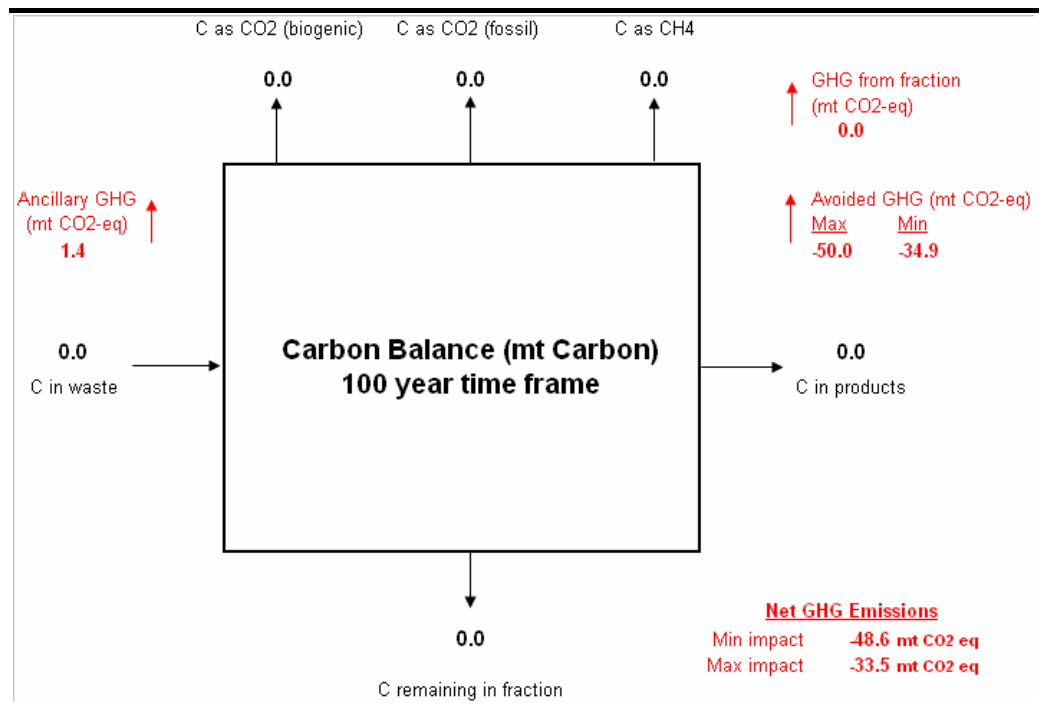
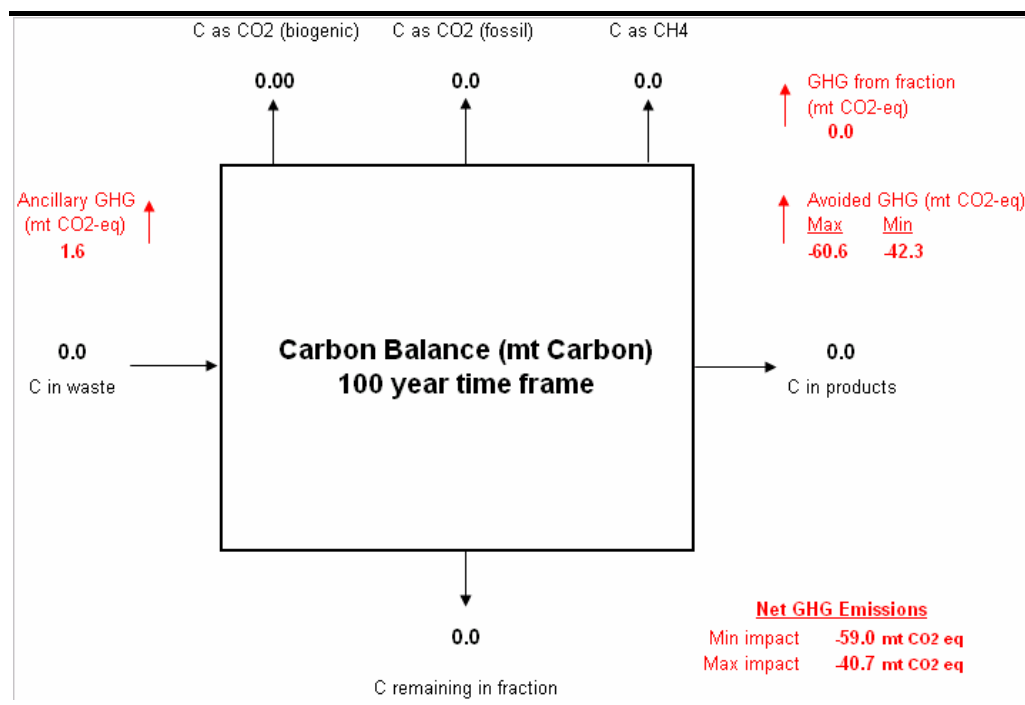


Figure C1.39 High Resource Recovery Scenario



C1.12 NON-FERROUS METALS

Figure C1.40 Baseline Scenario

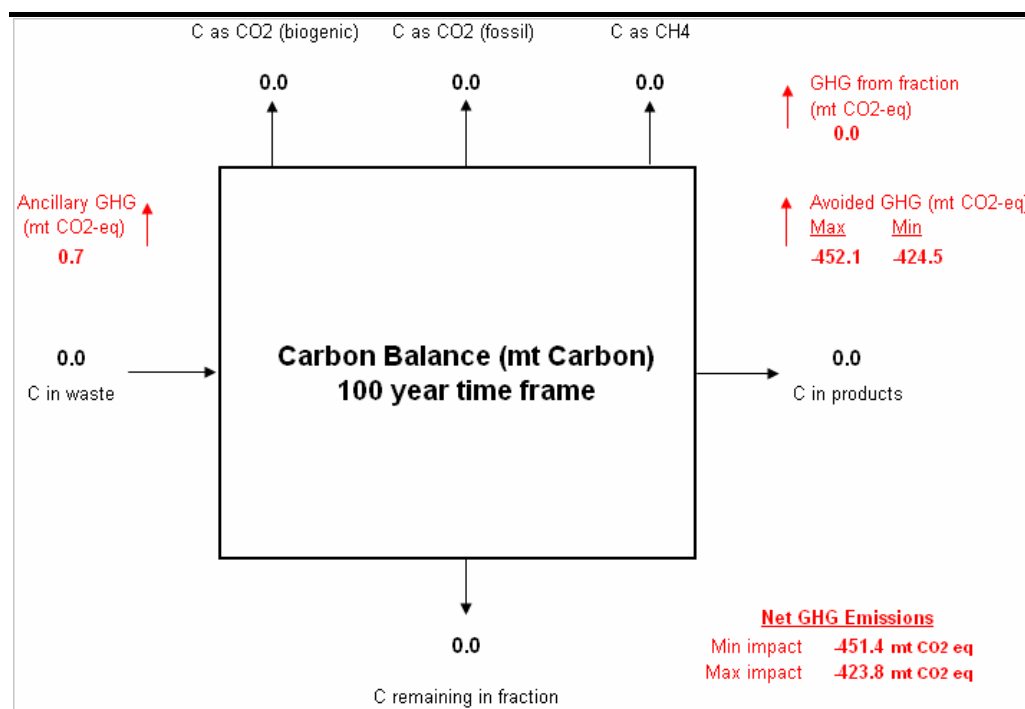
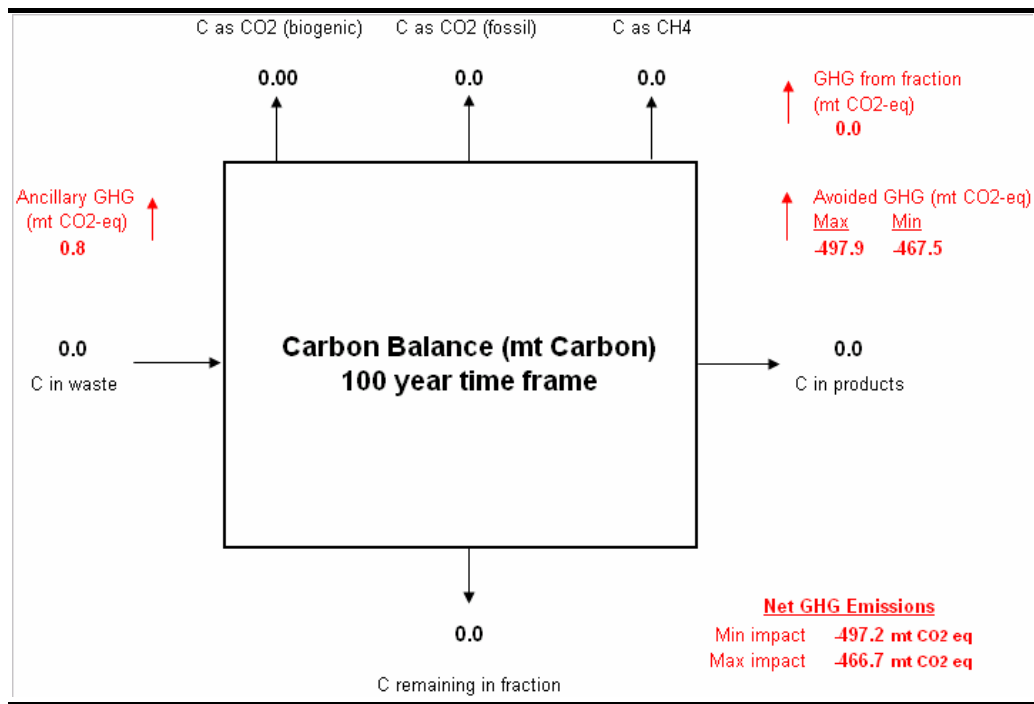


Figure C1.41 High Resource Recovery Scenario



C1.13 SOILS

Figure C1.42 Baseline Scenario

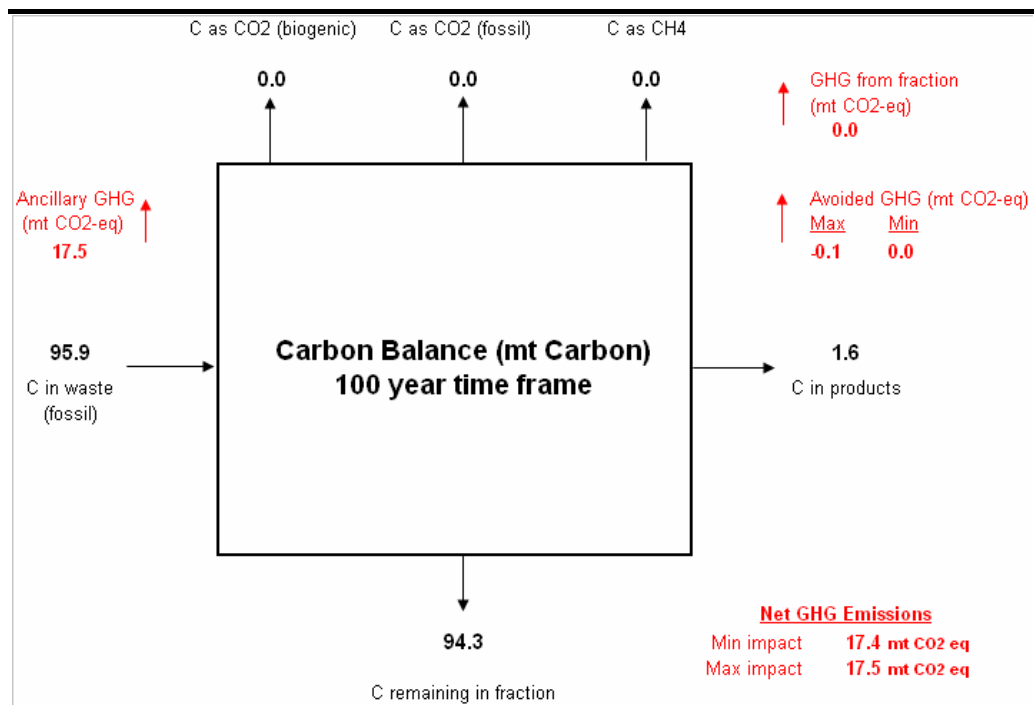
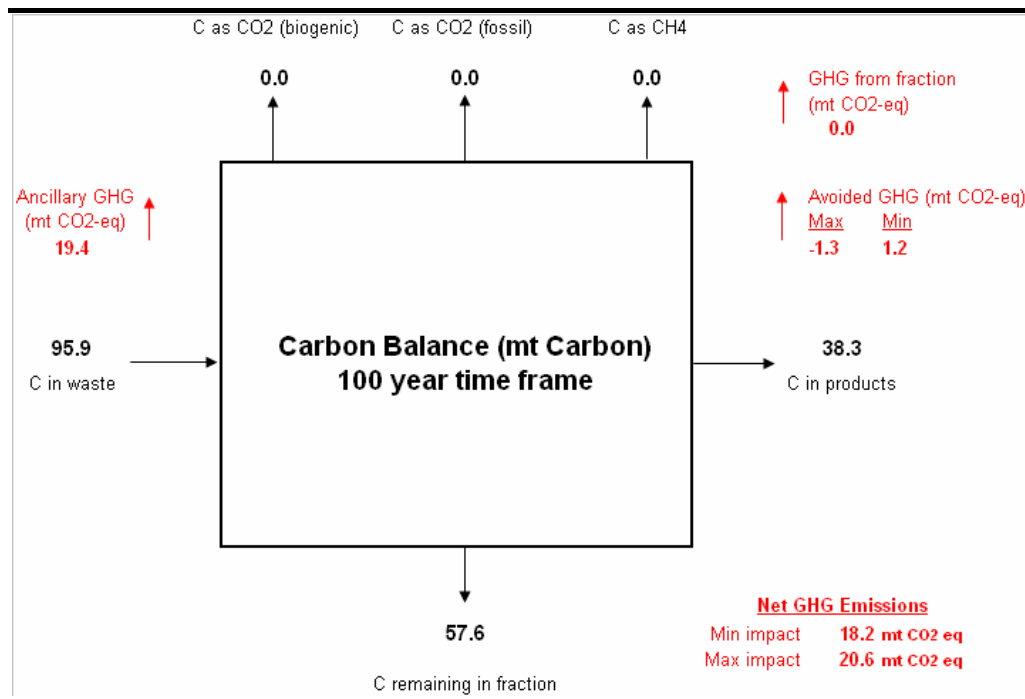


Figure C1.43 High Resource Recovery Scenario



C1.14 SOILS (MINING, QUARRYING, MARINE DERIVED)

Figure C1.44 Baseline Scenario

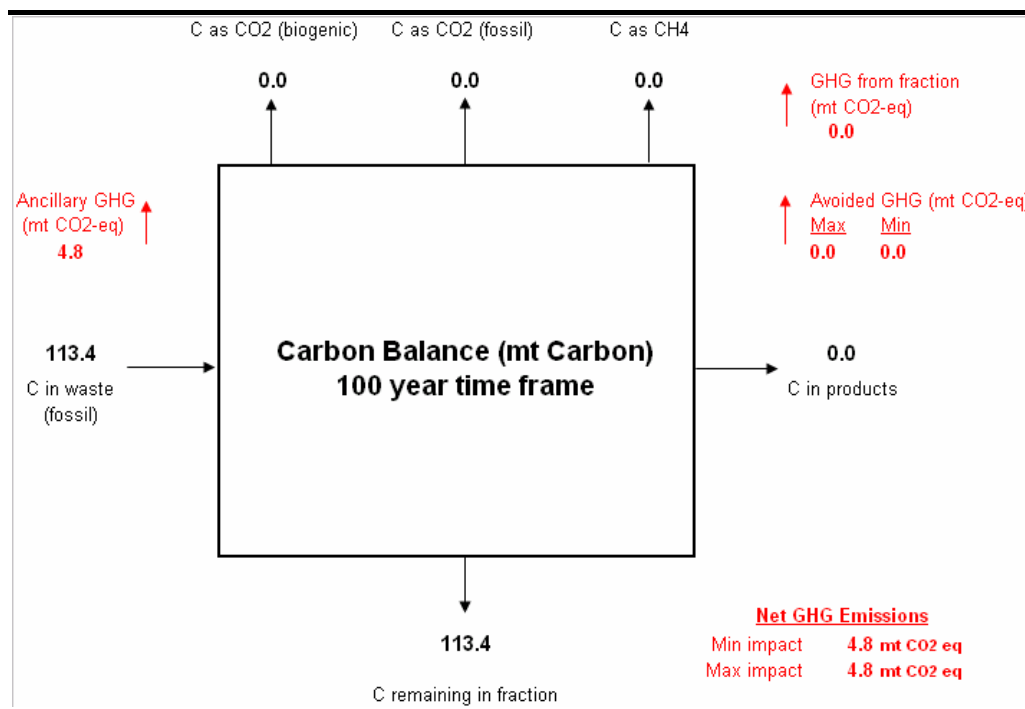


Figure C1.45 Baseline Scenario

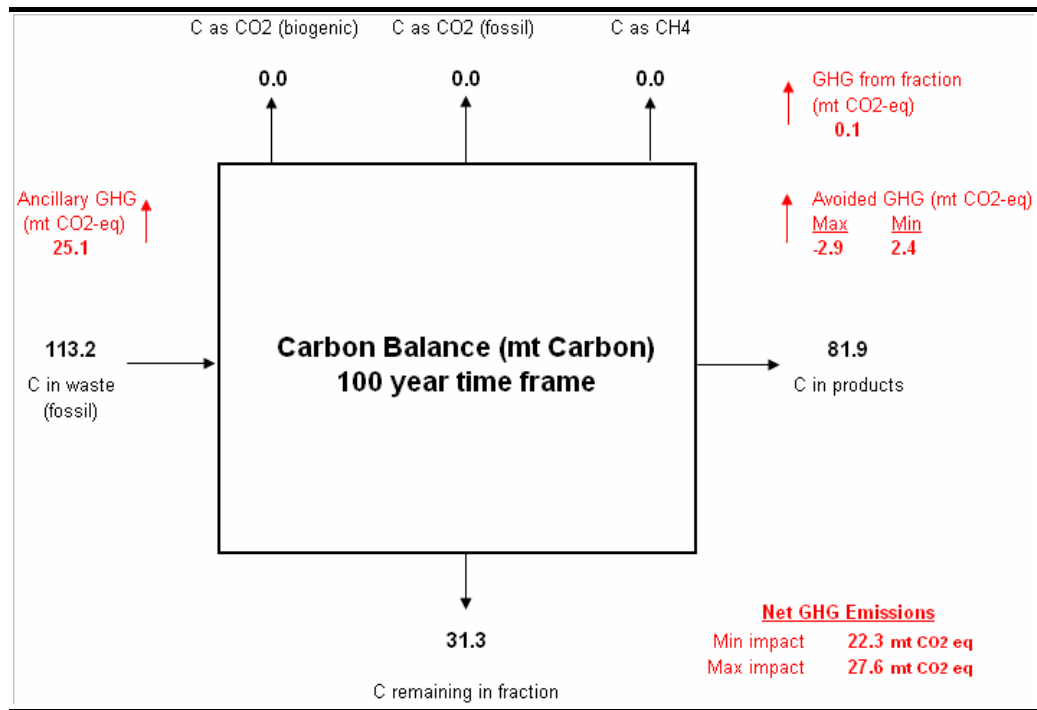


Figure C1.46 High Resource Recovery Scenario

