

CO₂ from Waste Management

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Introduction

This paper deals with CO₂ Emissions from Waste management which is relevant for the "Non Energy use" problem.

"Non Energy use" is fossil fuel (Solid, liquid and gaseous) which is not used as a fuel directly for combustion for energy production. This fuel is originally included in the national energy balance but is deducted as "Carbon stored" in order to calculate the amount of CO₂ from fuel combustion which is to be reported to UN/FCCC.

Fugitive emissions from fuel

In the IPCC Reporting Instructions "Sector 1B" is said :

"Fugitive Emissions are intentional or unintentional releases of gases from anthropogenic activities. In particular, they may arise from the production, processing, transmission, storage and use of fuels, and include emissions from combustion only where it does not support a productive activity(e.g., flaring of natural gases at oil and gas production facilities). Evaporative emissions from vehicles are included under Road Transport as Subsection 1A3bv."

In the IPCC Reporting Instructions "Sector 1B2" is said :

"Total fugitive emissions from oil and gas activities. Fugitive emissions may arise from equipment exhaust (non-combustion) leakage's, upsets and mishaps at any point in the chain from production through final use. Note also that emissions from flaring are included (the combustion is considered a non-productive activity)."

Non of these fugitive emissions are considered fuel combustion and the involved carbon must therefore be excluded from the calculation of fuel combustion CO₂.

Most of these fugitive emissions take place at the mining, drilling, exploration or production site. They are therefore emitted before the carbon carrier is taken into account in the national energy balance. This is especially the case for imported primary and secondary fuels.

But it is important to notice that some emissions of CH₄, NMVOC and CO₂ originate from national storage, transport, refining, leaking, distribution or flaring of fuels. These emissions are to be reported here and must not be duplicated under "Fuel combustion".

Therefore the carbon emitted here must be deducted as "carbon stored" in the calculation for the RA.

A. Solid Waste disposal on land

The fossil carbon part of the depositions in landfills consists of :

Plastics

Synthetic fibres and materials in textiles and footwear

Synthetic resins, glues, dyes, coatings and ink in materials as chipboard and cardboard

Unburned coke in ashes

Waste oil and chemicals (although normally not allowed)

These materials decompose very slowly in a landfill. Coke and charcoal can be found after thousands of years. The emissions of CO₂ are therefore very small and **not included** in the inventory.

Some biogenic carbon will be stored for very long (archaeological) times. Especially if the deposit is wet and acid. Some wood can be found after thousands of years. Thereby the landfill acts as a sink for carbon.

Such negative CO₂ emissions are **not counted either**.

Any emissions connected with recycling of plastics will be allocated to the relevant chemical industry.

The only exception is mentioned in footnote 3 to CRF table 6.A :

"Under Waste disposal, CO₂ emissions should be reported only when the disposed wastes are combusted at the disposal site which might constitute a management practice. CO₂ emissions from non-biogenic wastes are included in the totals, while the CO₂ emissions from biogenic wastes are not included in the totals."

For this very primitive open incineration on the landfill site which can be intentional or accidental we need to calculate the amount of fossil carbon incinerated.

The analysis reported below for Waste Incineration may be useful.

B. Wastewater Handling

The fossil carbon part in the Wastewater Handling consists of :

Synthetic detergents

Synthetic alcohol's and glycol's (mainly de-icing and frost prevention)

Other synthetic chemicals and pharmaceuticals (mainly from industry)

Some waste oil.

Most of the oil and other non-soluble parts will be removed in the oil-separator prior to the biological treatment and transferred to incineration. Some chemicals may not be decomposed in the treatment and may pollute the rivers and the sea.

The eventually decomposed and oxidised chemicals will emit some CO₂ of fossil origin but the amounts are considered difficult to estimate and very small compared to other sources.

CO₂ is not reported but the emitted CH₄ and N₂O are reported in CRF table 6 and 6.B.

C. Incineration

Incineration of **gaseous waste** from chemical industries (which is different from flaring of fuels) is normally reported in the relevant industrial sector as a process emission.

Incineration of **liquid** fossil waste and waste oil **without** energy recovery. The CO₂ emissions are reported in CRF table 6 and 6.C.

The liquid fossil waste can have different composition and can include water, but the waste oil will mainly be lubricants (motor oil) where we as default can use the figure 20 tC/TJ from IPCC reference manual page 1.13.

If incineration of **liquid** fossil waste and waste oil is **with** energy recovery (waste-to-energy) then the CO₂ emissions must be reported in CRF table 1 and 1.A(a) as a fuel combustion activity.

But these waste fuels are not normally mentioned in the energy balance and therefore not in CRF table 1.A(b). In order to make the comparison in CRF table 1.A(c) it is necessary to add these CO₂ emissions to the RA as coming from "Other Oil".

Incineration of waste containing **solid** fossil carbon is dominated by plastics. If it takes place **without** energy recovery then the CO₂ emissions are reported in CRF table 6 and 6.C. Any CO₂ emission from associated incineration of biogenic carbon must be reported in CRF table 6.C as biogenic and not included in the totals but transferred to CRF table 1 as "Memo Items, CO₂ Emissions from Biomass"

If the incineration (combustion) is **with** energy recovery (waste-to-energy) then the CO₂ emissions must be reported in CRF table 1 and 1.A(a) as a fuel combustion activity. But like waste oil this plastic waste fuel is not normally mentioned in the energy balance and therefore not in CRF table 1.A(b). In order to make the comparison in CRF table 1.A(c) it is necessary to add these CO₂ emissions to the RA as coming from "Other Oil" (although Plastic is solid it originates from Oil and it is therefore a "secondary liquid fossil fuel"). Any CO₂ emission from associated incineration (combustion) of biogenic carbon must be reported in CRF table 1.A(a) as biomass combustion. It will then be excluded from the totals but be transferred to CRF table 1 as "Memo Items, CO₂ Emissions from Biomass"

The total EU amount of 17 505 000 tons of Plastic Waste will come from six different sources (Ref.1):

Automotive	5.3%
Agriculture	3.8%
Construction/demolition	5.5%
Distribution/Industrial	21.7%
Electrical/Electronic waste	3.3%
Municipal Solid Waste	60.4%

The part of Plastic Waste which is recycled, landfilled or incinerated/combusted varies very much between sources in the different countries.

The Plastic content in MSW has been investigated in some countries as shown in the table.

Estimated MSW composition (% of total by type of material/component)

Source: Ref.2 and 3

Material / component	Country												
	USA	Belgium	Denmark	Germany	France	Greece	Ireland	Italy	Luxembourg	Netherlands	Portugal	Spain	UK
Year of data	1995	1993	1993	1993	1992	1990	1993	1991	1990	1993	1990	1992	1991
Organics	28.1	43.2	37	31.6	21	49.0	41.6	31.5	40.2	38.8	38.5	44.1	20
Paper/board	39.2	27.5	30	24.0	27	20.0	15.3	27.0	15.4	25.3	20.4	21.2	33
Glass	6.2	9.3	6	8.0	7	4.5	6.3	8.0	4.4	7.9	3.5	6.9	9
Metals	7.6	3.6	3	5.6	4	4.0	3.6	3.5	2.8	5.2	2.4	4.1	8
Plastics	9.1	6.8	7	8.8	11	9.0	11.5	7.5	8.0	8.0	9.1	10.6	6
Textiles	9.8	9.6	18		2	13.5	7.8	3.5	2.6	14.8	4.7	4.8	4
Other				22.0	28		13.9	19.0	24.8		21.4	8.3	20
Total	100	100	100	100	100	100	100	100	100	100	100	100	100

Sources:

USA: US EPA Ref. 3.

Belgium: OVAM, Institut Wallon des Déchets

Denmark: Danish Environmental Protection Agency

Germany: Innovation Beratungs Institut (together with the federal governments)

France: MODECOM (ADEME)

Greece: Ministry of Environment

Ireland: Department of the Environment

Italy: Ministero dell' Ambiente

Luxembourg: Administration de L'Environnement, Division des Déchets

Netherlands: National Waste Planning Institute

Portugal: OECD

Spain: Ministerio de Obras Publicas y Urbanismo

UK: Warren Spring Laboratory

The geographic and social variations of MSW composition within a country has been investigated in Denmark. Ref. 4.

	Plastic packaging %	Other Plastics %	Total Plastics %
Detached houses in Large towns	6	3	9
Detached houses in Small towns	5	2	7
Detached houses in Rural areas	4	3	7
Detached houses Total average	5	3	8
Multi-storey Flats Total average	6	3	9
Private Households Total average	6	3	9

As can be seen from the tables there are differences in the plastic content of MSW as well between as inside countries. But as the uncertainties probably are larger than the differences a general Tier 1 default plastic content in MSW of 9% could be used if more detailed recent studies are not available.

References.

- (1) Elements for a Cost-effective Plastic waste management in the European Union. European Commission, March 1996
- (2) Cost-benefit Analysis of the different Municipal Solid Waste Management Systems. European Commission, March 1996
- (3) Characterisation of Municipal Solid Waste in the United States. US EPA Report No. EPA 530-R-97-015, June 1997.
<http://www.epa.gov/epaoswer/non-hw/muncpl/mswrpt96/msw96rpt.pdf>
- (4) Dagrenovation fra private husholdninger. Miljøprojekt nr.264, Miljøstyrelsen Denmark 1994. In Danish, English summary.

