Indicative simplified baseline and monitoring methodologies
for selected small-scale CDM project activity categories

TYPE III - OTHER PROJECT ACTIVITIES

Project participants shall take into account the general guidance to the methodologies, information on additionality, abbreviations and general guidance on leakage provided at http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html.

III.AJ. Recovery and recycling of materials from solid wastes

Technology/measure

1. This methodology comprises activities for recovery and recycling of high density polyethylene (HDPE), low density polyethylene(LDPE), Polyethylene Terephthalate(PET) in municipal solid wastes[1] to process them into intermediate or finished products e.g., plastic resin to displace production of virgin plastic materials. in dedicated facilities thereby resulting energy savings and emission reduction.

For the purpose of this methodology the following definitions apply:

Plastic materials/resin: Those derived from high density polyethylene (HDPE), low density polyethylene (LDPE) and polyethylene terephthalate (PET).

Mechanical Recycling: Physical/mechanical processes by which recyclable plastic materials e.g., HDPE, LDPE, PET are obtained from municipal solid waste by way of separation, cleaning and compaction/packing for further processing in order to produce intermediate/finished products to substitute virgin raw materials in an industrial production chain. The process may be accomplished manually and/or using mechanical equipment including one or more of the following measures: washing of the separated HDPE, LDPE, PET plastic materials with hot water, drying, compaction, shredding and pelletizing.

Recycling facility: Facility (ies) where the recyclables in the municipal solid waste collected are sorted, classified and prepared[2] into marketable commodities for processing/manufacturing in single or multiple locations.

Processing/Manufacturing facility: includes industrial processes to transform recyclable materials obtained from recycling facility into intermediate or finished products e.g., plastic resin.

The methodology is applicable under the following conditions:

- It is possible to directly measure and record the final output of the recycling facility i.e., the weight of HDPE, LDPE, PET materials leaving the recycling facility (on a dry basis)[3];
- Chemical equivalence of the recycled PET to that of PET made from virgin inputs can be proved by the comparison of intrinsic viscosity so as to prove that the

[1] Non hazardous waste materials suitable for deposition in a solid waste disposal site (SWDS).
[2] Washing with hot water to clean the plastics to free it from extraneous materials is an essential part of this activity.
[3] If multiple processes or facilities are involved consider the final weight of the clean and dry material.

recycled PET replaces virgin inputs. This parameter has to be monitored in accordance with monitoring section below.

- Emission reductions can only be claimed for the difference in energy use for the production of HDPE/LDPE/PET plastic product/s from virgin inputs versus production from recycled plastic material;
- The emission reductions under this methodology will accrue either to the recycling facility or the manufacturing facility[4]. In order to avoid double counting of emission reductions, a contractual agreement between the recycling facility and processing/manufacturing facility shall indicate that only one of them will ~~the latter shall not~~ claim emission reductions. Similarly through contractual agreement and other means, credible proof is provided to show that the materials supplied from the recycling facility are used for Processing/Manufacturing and not for other purposes such as a source of fuel;
- Using three years historic data (market data, official statistics etc.) prior to the start date of the project activity, it is possible to demonstrate that the HDPE/LDPE/PET finished products in the host country of the CDM project were manufactured using either in country HDPE/LDPE/PET resin manufacturing facility or HDPE/LDPE/PET resin imported from another non-annex I country. Optionally analysis may be limited to HDPE/LDPE/PET products where recycled materials have proven to be technically viable option;
- The solid wastes containing recyclable materials are procured locally from sources located within 200 km of the recycling facilities[5]. Plastics already segregated from the rest of the waste ~~and transported over 200 km distance~~ are not eligible under this methodology;
- For the material procured locally and transported over a distance of more than 200 km within the host country boundary the project emissions source attributed to transportation shall be considered.
- Processing/Manufacturing facility is located within 200 km from the Recycling facility

2. Measures are limited to those that result in aggregate emission reductions of less than or equal to 60 kt CO_2 equivalent annually.

Boundary

3. The project boundary is the physical geographical sites of:

- The recycling facility;

[4] Manufacturing facilities can only claim emission reductions in cases where there is an integrated recycling/manufacturing unit.

[5] Emissions related to transportation of solid wastes are ignored as they are likely to be small for short distances. For plastics sourced from outside the host country this methodology is not applicable ~~When the wastes are transported over larger distances consideration of this source may be necessary and a request for revision of this methodology would be required~~.

- Processing/manufacturing facility;
- Virgin material production.

Baseline

4. Baseline emissions include emissions associated with energy consumption for the production of HDPE/LDPE/PET pellets from virgin plastic materials.

5. Baseline emissions for the production of pellet *i* from virgin inputs are calculated as below making conservative assumptions:

(i) It is assumed that natural gas supplies the process energy required for the thermal cracking to produce ethylene and for manufacturing of MEG and PTA[6] in the case of PET production; a default specific energy consumption of 15 GJ/t shall be used;

(ii) It is assumed process energy for polymerization is supplied with electricity; The following default values[7] shall be used:

- 0.83 MWh/t (3 GJ/t) and 1.67 MWh/t (6 GJ/t) of HDPE and LDPE
- 1.11 MWh/t (4.0 GJ/t) for PET

~~(ii)~~(iii) The remaining steps of virgin pellet production (melting and shaping, pelletizing, compounding) require relatively negligible amounts of energy and hence ignored.

6. Baseline emissions for the production of pellet type *i* from virgin inputs are calculated using equation (1).

$$BE_y = \sum_i [Q_{i,y} * L_i * (SEC_{Bl,i} * EF_{el,y} + SFC_{Bl,i} * EF_{FF,CO2})] \quad \textbf{(1)}$$

Where:

BE_y	Baseline emissions in year *y* (tCO_2/y)
i	Indices for material type *i (i = 1,2)*
$Q_{i,y}$	Quantity of plastic type *i* recycled in year *y* (t/y)
L_i	Net to gross adjustment factor to cover degradation in material quality and material loss in the production process of the final product using the recycled material (use *0.75)*
$SEC_{Bl,i}$	Specific electricity consumption for the production of virgin material type *i* (MWh/t), *take value specified in paragraph 5 (ii)*

[6] Mono Ethylene Glycol and Purified Terepthalic Acid

[7] For HDPE and LDPE, values are referred from IEA (2007), Tracking Industrial Energy Efficiency and CO2 Emissions, Table 4.9, pp75, International Energy Agency. For PET values are referred from, IEA (2009), Potential of best practice technology and other measures for improving energy efficiency, Chemical and Petrochemical Sector, Table 1(pp.14-17), International Energy Agency,

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$EF_{el,y}$	Emission factor for grid electricity generation, as per the most recent version of "Tool to calculate emission factor for an electricity system" (tCO_2/MWh). If the virgin material is sourced from more than one non-Annex 1 countries, the weighted average of the grid emission factors shall be used, using market data from the last three years prior to the project start date
$SFC_{Bl,i}$	Specific fuel consumption for the production of virgin material type *i* (GJ/t), *take value as specified in paragraph 5 (i)*
$EF_{FF,CO2}$	CO_2 emission factor for fossil fuel (tCO_2/GJ)

Leakage

7. If it is demonstrated that organic waste segregated in the recycling facility would have been deposited in a landfill in the baseline without methane recovery, then no leakage calculation is required.

Project activity emissions

8. Project emissions include emissions at recycling facility and processing/manufacturing facility.

$$PE_y = \sum_i [(EC_{i,y} * EF_{el} + FC_{i,y} * NCV_{FF} * EF_{FF,CO2}) + (Q_{i,y} * SEC_{proc} * EF_{el,y})] \quad \textbf{(2)}$$

Where:

PE_y	Project emissions in year *y* (tCO_2/y)
I	Indices for plastic type *i (i = 1,2)*
$EC_{i,,y}$	Electricity consumption of the recycling facility apportioned to the plastic type *i* (MWh/t) in year *y, see below*
$FC_{i,,y}$	Fuel consumption of the recycling facility apportioned to the plastic type *i* (unit mass or volume/t) in year *y, see below*
NCV_{FF}	Net calorific value of the fossil fuel consumed in the recycling facility in year *y* (GJ/unit mass or volume)
$EF_{FF,CO2}$	CO_2 emission factor of the fossil fuel consumed at the recycling facility (tCO_2/GJ), use local or national values, or IPCC default values
SEC_{proc}	Specific electricity consumption for the processing/manufacturing, use 0.5 MWh/t (1.8 GJ/t). For PET, use 0.65 MWh/t (2.34 GJ/t) PET melts relatively at higher temperature

9. Project emissions related to transport of solid waste to recycling facility are calculated on the basis of distance and number of trips (or the average truck load)

$$PET_{i,y} = \frac{\sum_{k} Q_{T,y}}{TL_y} \cdot AVD_y \cdot EF_{km,CO2,y} \quad \textbf{(4)}$$

Where:

PET_{iy}	CO_2 emissions during the year *y* due to transport of the segregated plastic type i to the project plant (tCO_2/yr)
AVD_y	Average round trip distance (from and to) between the recyclable plastic supply sites and the site of the project plant during the year *y* (km) per truck
$EF_{km,CO2,y}$	Average CO_2 emission factor for the trucks measured during the year *y* (tCO_2/km)
$Q_{T,y}$	Quantity of plastic that has been transported to the project site during the year *y* (tons of dry matter)
TL_y	Average truck load of the trucks used (tons) during the year *y*
I	Types of plastic used in the project plant and that have been transported to the project plant in year *y*

10. The electricity and fuel energy consumption of the recycling facility (EC_y, FC_y) shall be based on monitoring of energy consumption of the recycling facility. The project emissions shall be allocated to each mass unit of segregated material by market prices, i.e., apportioning the emissions proportional to the market prices of plastics, metals, organics, glass, paper etc. The market prices may be either monitored *ex post* or be determined once for the crediting period. This rule can be applied only if transparent and reliable information on market prices is available. Alternatively, as a conservative approach, all project emissions shall be allocated to recycled plastic.

Following formulas may be used to allocate project emissions to each mass unit of segregated material *s* by market prices

$$EC_{i,y} = EC_y \times \frac{Q_{i,y} * \$_{i,y}}{\sum_{s}[Q_{s,y} * \$_{s,y}]} \quad \textbf{(3)}$$

$$FC_{i,y} = FC_y \times \frac{Q_{i,y} * \$_{i,y}}{\sum_{s}[Q_{s,y} * \$_{s,y}]} \quad \textbf{(4)}$$

Where:

S	Indices for each of the segregated materials at the recycling facility with a market price including plastics type *i* and other marketable items such as organics, glass
EC_y	Total electricity consumption of the recycling facility in year *y* (MWh/y)
FC_y	Total fossil fuel consumption of the recycling facility in year *y* (unit mass or volume/y)

$Q_{s,y}$ Quantity of material type *s* segregated in the recycling facility in year *y* (t/y)

$\$_{i,y}$ Sale price of the plastic type *i* in year *y*

$\$_{s,y}$ Sale price of the segregated material type *s* in year *y*

Emission reductions

11. The emission reductions achieved by the project activity shall be determined as the difference between the baseline emissions and the project emissions and leakage.

$$ER_y = BE_y - PE_y - LE_y \quad \textbf{(5)}$$

Where:

ERy Emission reductions in year *y* (tCO_2e)

BEy Baseline emissions in year *y* (tCO_2e)

PEy Project emissions in year *y* (tCO_2e)

LEy Leakage emissions in year *y* (tCO_2e)

Monitoring

12. The following parameters shall be monitored and recorded during the crediting period.

No.	Parameter	Description	Unit	Monitoring/recording Frequency	Measurement Methods and Procedures
1		Municipal solid waste	T	Yearly	Quantity and distance of transportation
2	$Q_{s,y}$ and $Q_{i,y}$	Quantity of each of the segregated materials leaving the recycling facility with a market price including plastics type *i* and other marketable items such as organics, glass etc.	T	Recording at the time of sending each consignment from recycling facility to processing/manufacturing facility or other customers	-Direct weighing and recording of the weight, cross check with company records e.g., invoices - For the case of plastics type *i*, cross-check with the mass of product(s) used at Processing/Manufacturing facility using production records[8]
3	EC_y	Electricity	MWh	Continuous	Metering with calibrated

[8] This is to ensure that the recycled HDPE, LDPE, PET are further utilized and substitute virgin raw materials.

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No.	Parameter	Description	Unit	Monitoring/recording Frequency	Measurement Methods and Procedures
		consumption of the recycling facility in year *y*			equipment. Considering the scattered nature of recycling operation, design values may be conservatively considered for some small drives, for which monitoring is not practically possible.
4	FC_y	Fossil fuel consumption of the recycling facility in year *y*	MJ		Weight or volume & density and calorific value
5	$\$_{i,y}$ and $\$_{s,y}$	Sale price of plastic type *i* or material *s* in year *y*	$	As per paragraph 9	Cross check with sale invoices/receipts.
6	$Q_{T,y}$	Quantity of plastic that has been transported to the project site during the year *y*	T	Continuous	Direct weighing and recording of the weight, cross check with company records e.g., invoices
7	AVD_y	Average round trip distance (from and to) between plastic supply sites and the project site	Km	Continuous	Records by project participants on the origin of the supply of plastics
8	TL_y	Average truck load of the trucks used for transportation of segregated Plastics type	T	Continuously, aggregated annually	Determined by averaging the weights of each truck carrying plastics to the project plant

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No.	Parameter	Description	Unit	Monitoring/recording Frequency	Measurement Methods and Procedures
		i			
9	$EF_{km,CO2,y}$	Average CO_2 emission factor for the trucks during the year *y*	tCO_2/km	Annually	Calculate CO_2 emissions from fuel consumption by multiplying with appropriate net calorific values and CO_2 emission factors. For net calorific values and CO_2 emission factors, use reliable national default values or, if not available, (country-specific) IPCC default values.
10		Intrinsic Viscosity of PET	decilitres/gram (dl/g)	Every batch of Polymerisation	Test method for determining Intrinsic viscosity is as per ASTM D 4603 'Standard test method for determining Viscosity of Polyethylene Terephthalate

Project activity under a programme of activities

13. Further guidance on leakage would be required to adapt this methodology for application to project activities under programme of activities.

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History of the document

Version	Date	Nature of revision
01	EB 53, Annex 15 26 March 2010	Initial adoption.
Decision Class: Regulatory **Document Type**: Standard **Business Function**: Methodology		