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

TYPE III - OTHER PROJECT ACTIVITIES

Project participants shall apply the general guidelines to SSC CDM methodologies, information on additionality and abbreviations 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) and Polyethylene Terephthalate (PET)~~ materials[1] in municipal solid wastes[2] 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~~. In case of recycling of paper and cardboard, if the baseline scenario is the decay in a disposal site, the avoided methane emissions may be claimed.

For the purpose of this methodology the following definitions apply:

Mechanical Recycling: physical/mechanical processes by which recyclable ~~plastic~~ materials e.g. HDPE, LDPE, ~~and~~ PET, paper and cardboard 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. In case of plastics recycling, the process may be accomplished manually and/or using mechanical equipment including one or more of the following measures: washing of the separated LDPE, HDPE and 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[3] 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.

Informal Waste Sector: Individuals or a group of individuals who are involved in waste management activities, but are not formally registered or formally charged with providing the waste management services by the authorities. Newly established formalized organization by such

[1] In this present version, the methodology covers the emissions associated with the production of virgin high density polyethylene (HDPE), low density polyethylene (LDPE), and Polyethylene Terephthalate (PET). Other materials such as glass, ~~paper~~ and metals found in solid wastes that are manufactured in industrial processes can be ~~potentially~~ recycled, however the emissions associated with the production of virgin materials of these categories are not available in the present version. ~~p~~Project proponents are encouraged to submit a revision of this methodology to include additional materials proposing conservative default values for specific energy consumption for the production from virgin raw materials.

[2] Non hazardous waste materials suitable for deposition in a solid waste disposal site (SWDS), paper/cardboard refers to post-consumer wastes.

[3] In case of plastics recycling, washing with hot water to clean the plastics to free it from extraneous materials is an essential part of this activity.

individuals, e.g. cooperative, can also be considered as the informal sector for the purpose of this methodology.

Formal Waste Sector: Solid waste management activities planned, sponsored, financed, carried out or regulated and/or recognised by the formal local authorities or their agents, usually through contracts, licenses or concessions.

The methodology is applicable in the following ~~conditions~~two cases:

Case A: Project activities which target the participation of the informal waste sector

2. In this Case A, the recycling facility is operated by the informal sector. The recycling facility may also receive wastes collected by the formal waste sector (e.g. public collection system). Wastes that were already being recycled in the baseline by enterprises in the formal sector cannot be included in the calculations.

The following applicability conditions shall apply to project activities under this case:

- The recycling facility may be an existing activity, or a newly implemented facility;
- It is possible to directly measure and record the final output of the recycling facility i.e. the weight of ~~LDPE, HDPE and PET~~ materials leaving the recycling facility (on a dry basis) segregated by type, such as LDPE, HDPE, PET, Paper and cardboards;
- ~~The emission reductions under this methodology will accrue either to the recycling facility or to the processing/manufacturing facility. 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 claim emission reductions.~~ Each type of recycled materials is sold directly to processing/manufacturing facilities, or to a chain of intermediary retailers that are able to transfer the materials to final identifiable processing/manufacturing facilities which process the segregated fractions. The Project Design Document (PDD) shall explain how the proposed procedures such as contractual agreements eliminate double counting of emission reductions. Similarly through contractual agreement and other means such as survey/analysis undertaken by a third party, 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 or disposal;
- 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. In case of paper or cardboards, emission reductions due to avoidance of methane formation in anaerobic decay may be claimed, if the baseline scenario is the waste disposal in a disposal site without methane recovery.

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

III.AJ. Recovery and recycling of materials from solid wastes (cont)

Case B: Greenfield facility and/or capacity addition to existing facilities with formal sector participation

3. In this Case B, the recycling facility is owned and operated by the formal waste sector. It may receive recyclable materials from the informal waste sector, but has no participation of the informal sector in its organization or management functions. The following applicability conditions shall apply under this case:

- If the recycling facility is an existing activity, the average data on the amount of recycled materials from the previous three years (a minimum of one year data would be required if the facility is less than three years old) of operation shall be used for the estimation of the baseline recycling activity, and project activity shall consist of the increase of the recycling capacity above this level. If the recycling facility is newly implemented as a Greenfield activity, all recycled materials are eligible for the emission reduction calculation. However, in this case the project participants shall demonstrate that the materials recycled by the project activity are not diverted from other existing recycling facilities belonging to the formal sector, or, alternatively, that it is not a common practice in the region to recover ~~the plastics from solid waste disposal sites (landfills) and process them into recycled pellets~~ and recycle these materials from municipal solid waste streams by means of formal businesses;

- It is possible to directly measure and record the final output of the recycling facility ~~i.e. the weight of LDPE, HDPE and PET~~ and the input to the final processing/manufacturing facilities, i.e. the weight of materials fractions leaving the recycling facility and of material fractions entering the processing/manufacturing facilities (on a dry basis);[4]

- The recycled materials shall be sold directly to a processing/manufacturing facility, or to a chain of intermediary retailers that are able to transfer the recycled materials to a final identifiable processing/manufacturing facility;

- ~~The emission reductions under this methodology will accrue either to the recycling facility or to the processing/manufacturing facility. 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 claim emission reductions.~~ The PDD shall explain how the proposed procedures such as contractual agreements eliminate double counting of emission reductions, for example due to waste pickers, the recycling facility or the processing/manufacturing facility, or other parties possibly claiming credits for emissions reduction. 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 or disposal;

[4] If multiple processes or facilities are involved consider the final weight of the clean and dry material.

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

III.AJ. Recovery and recycling of materials from solid wastes (cont)

- For recycling of PET, the project participants shall prove the chemical equivalence of the recycled PET to that of PET made from virgin inputs by the comparison of intrinsic viscosities to ensure that the recycled PET replaces virgin inputs;

- ~~For recycling of PET, the project participants shall demonstrate that pellets obtained from recycled PET are used to produce the same final product (e.g. bottles) as the one with the virgin pellets.~~

- In case of recycling of plastics, 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 solid wastes containing recyclable materials are procured locally from sources located within 200 km of the recycling facilities.[5] However this restriction on transport distance shall not apply to segregated plastics transported within the host country;~~

Applicability conditions for both cases

4. In any of the above cases ~~it is possible~~ the project proponent shall be able to demonstrate, using three years (a minimum of one year data would be required if the facility is less than three years old) historic data (market data, official statistics etc.) prior to the start date[6] of the project activity, 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. This analysis may be limited to only those finished products where recycled materials have proven to be a technically viable option, i.e. those types of products that are expected to be the end products produced from materials recycled as part of the project activity;

5. The recycling facility shall source its materials from municipal solid waste; materials from an unknown source are not eligible under this methodology. ~~where a system for municipal solid waste collection, management and disposal is in place~~. As a consequence, wastes not pertaining to the same identified baseline waste collection and destination stream and that would not be delivered to the baseline disposal site and/or treatment plant (e.g. incineration) are not eligible;

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

Boundary

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

- Waste collection sites (e.g. door-to-door collection);

[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.~~

[6] As per the definition of start date provided in the EB 41 report, paragraph 67.

- The recycling facility;
- Processing/manufacturing facility;
- Virgin material production;[7]
- Municipal solid waste disposal site or treatment plant in the baseline scenario.

Baseline

8. Baseline emissions include emissions associated with energy consumption for the production of HDPE/LDPE/PET pellets from virgin plastic materials. In case of paper and cardboard the emissions associated with the anaerobic decay within a disposal site may be claimed.

9. 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 for HDPE and LDPE manufacturing; a default specific energy consumption of 15 GJ/t shall be used;

(ii) For manufacturing of an unit mass of PET, the baseline emissions for production of the monomers Mono Ethylene Glycol (MEG) and Purified Terepthalic Acid (PTA) are conservatively estimated as the energy demand for the production of the same mass of ethylene through thermal cracking; a default specific energy consumption of 15 GJ/t may be used;

(iii) It is assumed process energy for polymerization is supplied with electricity. The following default values shall be used:

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

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

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

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

[7] Virgin material production is included in the project boundary, even if it is not an identifiable site, because the emission factor for virgin material production for baseline calculation is based on the assumptions on the typical conditions for the virgin material production in the host country or in a non-Annex I country.

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

III.AJ. Recovery and recycling of materials from solid wastes (cont)

Where:

BE_y	Baseline emissions in year *y* (tCO_2/y)
i	Indices for material type *i (i = 1,2,3* for HDPE, LDPE and PET)
$Q_{i,y}$	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 9 (iii)
$EF_{el,y}$	Emission factor for grid electricity generation, as per the most recent version of the "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 9 (i) and (ii)
$EF_{FF,CO2}$	CO_2 emission factor for fossil fuel (tCO_2/GJ)

11. Baseline emissions for the anaerobic decay of paper and cardboard in the solid waste disposal site are calculated using the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site".

Leakage

12. If it is demonstrated that organic biogenic waste segregated in the recycling facility would have been deposited in a landfill without methane recovery in the baseline scenario, or if the baseline scenario is the incineration of the wastes, then no leakage calculation is required.

Project activity emissions

13. Project emissions include emissions for energy use at recycling facility[8] ~~and processing/manufacturing facility~~. No project emissions need to be considered in case of paper and cardboard. In case of project activities of Case B, project emissions are calculated using equation (2). The electricity and fuel energy consumption (EC_y, FC_y) shall be directly monitored.

[8] Emissions associated with transportation of recyclable materials and ~~transportation for further~~ processing/manufacturing under the project activity are considered as equivalent to the corresponding emissions for the virgin materials and therefore ignored in this methodology.

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

III.AJ. Recovery and recycling of materials from solid wastes (cont)

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

Where:

PE_y	Project emissions in year y (tCO_2/y)
i	Indices for plastic type i (i = 1,2,3 for HDPE, LDPE and PET)
$EC_{i,y}$	Electricity consumption of the recycling facility apportioned to the plastic type i (MWh/t) in year y
$FC_{i,y}$	Fuel consumption of the recycling facility apportioned to the plastic type i (unit mass or volume/t) in year y
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 of plastic type i, use 0.5 MWh/t (1.8 GJ/t) for HDPE or LDPE.~~ ~~For PET, use 0.65 MWh/t (2.34 GJ/t). PET melts at relatively higher temperature. However, for the project activity where the processing/manufacturing facility is under the control of the project proponent, electricity consumption shall be monitored and the higher of the monitored value and 0.65 MWh/t shall be used~~

~~14. The electricity and fuel energy consumption of the recycling facility (EC_y, FC_y) shall be based on energy consumption of the recycling facility.~~

In case of project activities of Case A, when project emissions are calculated using equation (2), the project emissions for electricity and fuel energy consumption (EC_y, FC_y) may be estimated based on the nameplate specific energy consumption of the equipment used and the average time of operation and level of service delivered,[9] or based in measurement campaigns of the energy consumption under typical operation conditions. Alternatively, the project emissions may be calculated using equation (3).

$$PE_y = \sum_i (Q_{i,y} * SEC_{rec} * EF_{el,y}) \quad \textbf{(3)}$$

Where:

SEC_{rec}	Specific electricity consumption for the recycling of plastic type i, use 0.83 MWh/t (3 GJ/t) for HDPE/LDPE/PET

[9] In case the nameplate energy consumption and/or service provided by the equipments used in the recycling facility in Case A are unknown, they may be estimated by a local expert in order to define a locally applicable emission factor for the recycling plant.

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

III.AJ. Recovery and recycling of materials from solid wastes (cont)

15. ~~The~~ The project emissions ~~shall~~ may 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 and 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

$$EC_{i,y} = EC_y \times \frac{Q_{i,y} * \$_{i,y}}{\sum_s [Q_{s,y} * \$_{s,y}]} \quad \textbf{(4)}$$

$$FC_{i,y} = FC_y \times \frac{Q_{i,y} * \$_{i,y}}{\sum_s [Q_{s,y} * \$_{s,y}]} \quad \textbf{(5)}$$

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 and 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

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

$$ER_y = BE_y - PE_y - LE_y \quad \textbf{(6)}$$

Where:

ER_y	Emission reductions in year *y* (tCO_2e)
BE_y	Baseline emissions in year *y* (tCO_2e)

PE_y Project emissions in year y (tCO_2e)

LE_y Leakage emissions in year y (tCO_2e)

Monitoring

17. The following parameters shall be monitored and recorded during the crediting period. The applicable requirements specified in the "General guidelines to SSC CDM methodologies" are also an integral part of the monitoring guidelines specified below and therefore shall be referred by the project participants:

No.	Parameter	Description	Unit	Monitoring/recording Frequency	Measurement Methods and Procedures
1		Municipal solid waste	t/y	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/y	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[10]
3	EC_y	Electricity consumption of the recycling facility in year *y*	MWh	Continuous	Metering with calibrated equipment. As alternative option, for the project activity where the monitoring is not possible, default values based on specification of equipments may be conservatively considered

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

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

III.AJ. Recovery and recycling of materials from solid wastes (cont)

No.	Parameter	Description	Unit	Monitoring/recording Frequency	Measurement Methods and Procedures
~~4~~		~~Electricity consumption of the processing/manufacturing facility in year y~~	~~MWh~~	~~Continuous~~	~~Applicable only for the project activity where the processing/manufacturing facility is under the control of the project proponent. Metering with calibrated equipment. Electricity consumption shall be monitored and the higher of the monitored value and default 0.65 MWh/t shall be used for PET~~
~~4~~ 5	FC_y	Fossil fuel consumption of the recycling facility in year *y*	MJ		Weight or volume & density and calorific value
~~5~~ 6	$\$_{i,y}$ 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~~ 7		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

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

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

III.AJ. Recovery and recycling of materials from solid wastes (cont)

History of the document

Version	Date	Nature of revision
03	EB 62, Annex 10 15 July 2011	The revision includes: • Inclusion of accounting avoided methane emissions for recycling of paper and cardboard; • Inclusion of simplified requirements such as the use of default values for project emissions for the informal waste sector; and • Elimination of project emissions associated with energy use at processing/manufacturing facility.
02	EB 59, Annex 3 18 February 2011	Inclusion of Polyethylene Terephthalate (PET).
01	EB 53, Annex 15 26 March 2010	Initial adoption.
Decision Class: Regulatory **Document Type**: Standard **Business Function**: Methodology		