CLEAN DEVELOPMENT MECHANISM

CDM-MP76-A08

Draft Small-scale Methodology

AMS-III.AJ: Recovery and recycling of materials from solid wastes

Version 07.0

Sectoral scope(s): 13

DRAFT

United Nations
Framework Convention on
Climate Change

COVER NOTE

1. Procedural background

1. The Executive Board, at its 94th meeting, requested the SSC WG to review and update the global default factors contained in the methodologies "AMS-III.AJ: Recovery and recycling of materials from solid wastes" and "AMS-III.BA: Recovery and recycling of materials from E-waste", taking into account recent publications and scientific information.

2. The Meth Panel, at its 75th meeting, launched a call for public inputs on a revised version of the methodology using updated default values. No comments were received.

2. Purpose

3. The purpose of this revision is to update the default values of the baseline parameters contained in the methodology "AMS-III.AJ: Recovery and recycling of materials from solid wastes", taking into account the outcome of the call for public inputs.

3. Key issues and proposed solutions

4. The methodology includes default values for estimating baseline emissions for recycling and recovery of the following materials:

   (a) Plastic (HDPE, LDPE, PET and PP);

   (b) Aluminium;

   (c) Steel; and

   (d) Glass.

5. The values for aluminium and steel were introduced in version 6.0 AMS-III.AJ in 2017 by the small scale working group at its 53rd meeting, based on values contained in the small-scale methodology "AMS-III.BA: Recovery and recycling of materials from E-waste". It is proposed to use the same methodology/approach used by the small scale working group in the past to derive the default values, but applying updated values based on new sources that have become available. The values for glass were introduced by the small scale working group in 2016 at its 51st meeting and are up to date.

3.1. Update of the default values related to recycling/recovery of Steel and Aluminium:

6. The methodology includes global default specific CO_2e emission factor (*SE*) for the production of aluminium and steel and also default values for the parameter *Bi* which is to adjust the baseline for the share of production of metals, plastics and glass from virgin materials in non-Annex I countries.

7. The updated values of the parameters *SE* for aluminium were sourced from the latest information published by the International Aluminium Institute (IAI), whereas the previous information was sourced from the International Energy Agency (IEA). The updated values

of the parameter *SE* for and steel were sourced from the IPCC and from the IEA, whereas the previous information was sourced from the World Steel Association.

8. The updated values of the parameter *Bi* for both steel and aluminium were sourced from the latest information published by the World Steel Association and IAI, respectively, whereas the data from the previous version of the methodology was sourced from the 2012 USGS (United States Geological Survey)[1].

3.2. Update of the default values parameters related to recycling/recovery of Plastics:

9. The methodology includes global default specific electricity (SEC_{BL}) and specific fuel consumed (SFC_{BL}) emission factor for the production of HDPE, LDPE, PP and PET and also default values for the parameter *Bi* which is to adjust the global CO_2 emission factor based on the share of the production of materials in non-Annex I countries.

10. The original specific fuel consumption (SFC_{BL}) and specific electricity consumption (SEC_{BL}) factors were sourced from the publication "Energy Technology and Transitions for Industry", prepared by the International Energy Agency in 2009. No new publication was identified to update these parameters.

11. The updated values of the parameter *Bi* for plastics were sourced from the latest information available at "Plastics – the Facts 2016", prepared by Plastics Europe - the Association of Plastics Manufacturers in Europe.

3.3. Update of the default values parameters related to recycling/recovery of glass:

12. The recycling/recovery of glass was introduced in version 5.2 of AMS-III.AJ in 2016. Therefore, the values of the parameters *Bi* and $SEC_{BL,glass}$ (Specific electricity consumption for the production of raw materials displaced by the glass recycling) are up-to-date.

13. The table below provides a comparison between the original and updated values for recovery and recycling of materials applicable under AMS-III.AJ:

Table 1. Comparison between the original and updated values of B_i

Product *i*	Original values of B_i (fraction)	Updated values of B_i (fraction)
Aluminium	0.63	0.72
Steel	0.65	0.68
Plastics (PP, PET, HDPE, LDPE)	0.50	0.56
Glass	0.67	No change

[1] For the details on how the values of *SE* and *Bi* were updated, please refer to the Appendix 1, Appendix 2 and Appendix 3 of the draft revised small-scale methodology *"AMS-III.BA: Recovery and recycling of materials from E-waste"*, as contained in Annex 10 of MP76 report.

14. The updated values of the parameter SE_i for aluminium and steel were sourced from the International Aluminium Institute (IAI) and from the World Steel Association. The table below provides a comparison between the original and updated values:

Table 2. Comparison between the original and updated values of SE_i

Product *i*	Original values of SE_i (tCO_2e/t)	Updated values of SE_i (tCO_2e/t)
Aluminium	5.1	8.40
Steel	1.2	1.27

15. The following are the explanations on the increase in the updated specific CO_2 emission factor value for the production of aluminium as shown in the table above:

(a) The previous version considered a global average CO_2 emission factor for the production of electricity that is consumed by the aluminium industry, whereas the proposed revision calculates a non-Annex I average CO_2 emission factor based on information available by the IAI; in addition, the previous version did not include the emissions associated with the consumption of fossil fuels;

(b) The previous version excluded the aluminium produced in Latin America;

(c) China has significantly increased its participation in the global share of production of aluminium whose power generation heavily relies on coal.

3.4. Editorial changes to the default parameters related to the baseline emission for plastic recycling

16. The specific fuel and electricity requirements to produce one ton of the different types of plastics, including the rationale of the selected values, were previously indicated in paragraph 25 of the methodology. In this proposed revision, these values are indicated in Table 3 and the rationale are listed as a footnote to the table.

4. Impacts

17. The update of default factors will result in more accurate and up-to-date calculation of emission reductions.

5. Subsequent work and timelines

18. The methodology is recommended by the MP for consideration by the Board at its one hundredth meeting. No further work is envisaged.

6. Recommendations to the Board

19. The MP recommends that the Board adopt this final draft methodology, to be made effective at the time of the Board’s approval.

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1. Introduction

1. The following table describes the key elements of the methodology.

Table 1. Methodology key elements

Typical projects	The following materials which are recycled from municipal solid wastes (MSW) and processed into intermediate or finished products are covered in the methodology: • Plastics: HDPE, LDPE, PET and PP plastic materials; • Container glass cullet; • Metals – Aluminium and Steel
Type of GHG emissions mitigation action	Energy efficiency: Reduction of production of HDPE, LDPE, PET, PP and container glass from virgin materials, thus reducing related energy consumption

2. Scope, applicability, and entry into force

2.1. Scope

2. This methodology comprises activities for the recovery and recycling of materials in municipal solid waste (MSW)[1] to process them into intermediate or finished products, displacing the production of virgin materials in dedicated facilities, thereby resulting in avoidance of energy use. For paper and cardboard recycling, if the baseline scenario is the decay in a disposal site, the avoided methane emissions may be claimed.

3. The methodology covers the emissions associated with:

   (a) Production of virgin pellets of plastics consisting of either high density polyethylene (HDPE), low density polyethylene (LDPE), Polyethylene Terephthalate (PET) or Polypropylene (PP). For the sake of this methodology, “plastic” means HDPE, LDPE, PET and PP, unless otherwise specified;

   (b) Production of container glass using virgin input (“container glass” hereafter) that is displaced by the recycled container glass (“container glass cullet” hereafter) due to the project activity;

   (c) Production of metals (i.e. aluminium and steel)[2] from mined ore or virgin raw materials that is displaced by the recycled metals due to the project activity.

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

[2] Other metals are not covered under this methodology.

2.2. Applicability

4. The methodology is applicable in the following two cases:

2.2.1. Case A: Project activities that target the participation of the informal waste sector

5. In 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). Waste fractions that were already being recycled in the baseline by enterprises in the formal sector cannot be included in the calculations.

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

   (a) The recycling facility may be an existing facility, or a newly implemented facility;

   (b) It is possible to directly measure and record the final output of the recycling facility, that is the weight of materials leaving the recycling facility (on a dry basis), segregated by type;

   (c) Each type of recycled material is sold directly to a processing/manufacturing facility, or to a chain of intermediary retailers that are able to transfer the materials to final identifiable processing/manufacturing facilities that process the segregated fractions;

   (d) The Project Design Document (PDD) shall explain the procedures such as contractual agreements proposed to eliminate double counting of emission reductions, for example due to the formal waste sector or the processing/manufacturing facility, or other parties possibly claiming credits for emission reductions. Similarly, through contractual agreement and other means such as survey/analysis undertaken by a third party, credible proof shall be 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;

   (e) Emission reductions can be claimed for the difference in energy use for the production of materials from virgin inputs versus production from recycled material. In the case of paper or cardboards, emission reductions due to the 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.

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

7. In 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:

   (a) If the recycling facility is an existing activity, the average data on the amount of recycled materials from the previous three years of operation (a minimum of one-year data would be required if the facility is less than three years old) 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 and recycle these materials from municipal solid waste streams by means of formal businesses;

(b) It is possible to directly measure and record the final output of the recycling facility and the input to the final processing/manufacturing facilities, that is the weight of materials leaving the recycling facility and of those entering the processing/manufacturing facilities (on a dry basis),[3] segregated by type;

(c) 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;

(d) The PDD shall explain how procedures, such as contractual agreements, shall be put in place to eliminate double counting of emission reductions, for example potentially resulting from 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 shall be 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;

(e) For recycling of PET/PP, the project participants shall demonstrate the chemical equivalence of the recycled PET/PP to that of PET/PP made from virgin inputs by the comparison of intrinsic viscosities to ensure that the recycled PET/PP replaces virgin inputs;

(f) Emission reductions can only be claimed for the difference in energy use for the production of finished products from virgin inputs versus production from recycled materials. In the case of paper or cardboards, emissions reductions due to avoidance of methane formation in anaerobic decay may be claimed, if the baseline scenario is waste disposal in a disposal site without methane recovery.

2.2.3. Applicability conditions for both cases i.e. Case A and Case B

8. In any of the above cases the project proponent shall be able to demonstrate, using three years[4] historic data (market data, official statistics etc.) prior to the start date[5] of the project activity, that the finished products (HDPE, LDPE, PET, PP, steel aluminium, paper and cardboard and glass) were manufactured in the host country of the CDM project using either virgin raw materials produced in country or virgin raw materials 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, that is those types of products that are expected to be the end products produced from materials recycled as part of the project activity.

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

[4] A minimum of one-year data would be required if the facility is less than three years old.

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

9. As an alternative to the requirement stipulated in paragraph 8 above, the project proponents may choose to adjust the baseline emissions by using the baseline correction factor (Bi) as described under the baseline section below.

10. The recycling facility shall source its materials from MSW; materials from an unknown source are not eligible under this methodology. The project activity consists of separation of the recyclables from bulk MSW by means of manual or magnetic or mechanical separations. If the project activity involves the collection of wastes on a door to door basis, or collection at recipient's containers for the voluntary dispensing of wastes by the local community, all recyclables (paper, plastics, glass, etc.) processed by the recycling plant shall be collected together, selective collection of metals or any other wastes is excluded. As a consequence, wastes not pertaining to the identified baseline waste collection and destination stream that would not be delivered to the baseline disposal site and/or treatment plant (e.g. incineration) are not eligible.

11. In the specific case of metals, the methodology excludes collection of the scraps generated from the production process of primary/secondary/finished metal and materials or in the processing of the finished metal and materials into final products, and it covers only postconsumer obsolete wastes[6]. Project proponents shall provide evidence that the materials recycled under the project activity are recovered only from end-of-life-wastes and project activity does not divert waste from any historically existing informal or formal recycling activity.

12. The amount of fuel and electricity consumed by the recycling facility can be measured and recorded.

13. Project proponents shall demonstrate that the properties of the materials produced from waste recycling are the same as those from virgin materials. For example, if the waste materials such as recycled plastic bottles are converted into building blocks or roof tiles, the emission reductions based on displacement of original virgin materials cannot be claimed under this methodology. For recycled materials, project proponents shall provide documentation proving that the properties of the materials produced are comparable according to standard testing methods for each material.

14. Measures are limited to those that result in aggregate emission reductions of less than or equal to 60ktCO_2 equivalent annually.

2.3. Entry into force

15. The date of entry into force is the date of the publication of the EB ~~94~~XX meeting report on ~~4 May 2017~~DD Month YYYY.

[6] Post-consumer obsolete wastes cover for example small domestic appliances in the daily waste collection system, and it excludes collection of large devices such as refrigerators, vehicles. This is because these devices are usually scrapped and not treated and disposed together with MSW as assumed by this methodology; further recycling/recovery of metals from such devices would potentially involve emissions due to physical leakage of refrigerants and accounting such emissions are not under the scope of this methodology.

2.4. Applicability of Sectoral Scopes

16. For validation and verification of CDM projects and programme of activities by a designated operational entity (DOE) using this methodology, application of sectoral scope 13 is mandatory.

3. Normative references

17. Project participants shall apply the "General guidelines for SSC CDM methodologies", "Guidelines on the demonstration of additionality of small-scale project activities" provided at <http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html>.

18. This methodology also refers to the latest approved version of the following approved methodology:

    ~~(a) AMS-I.D.: "Grid connected renewable electricity generation~~

    (a) "AMS-III.BA.: Recovery and recycling of materials from E-waste";

    (b) "TOOL05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation";

    (c) "TOOL03: Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion".

4. Definitions

19. The definitions contained in the Glossary of CDM terms shall apply.

20. For the purpose of this methodology the following definitions apply:

    (a) **Mechanical Recycling** - physical/mechanical processes by which recyclable materials are obtained from municipal solid waste by way of separation, cleaning and compaction/packing (for plastics and paper) or grinding (for container glass) 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 materials with hot water, drying, compacting, shredding or pelletizing;

    (b) **Recycling facility** - facility(ies) where the recyclable fraction of the collected municipal solid waste is sorted, classified and prepared into marketable commodities for processing/manufacturing in single or multiple locations.[7] In the case of plastics recycling, washing with hot water to clean the plastic to free it from extraneous materials is an essential part of this activity and associated emissions shall be monitored and accounted as project emissions. Similarly, the recycling of container glass cullet is an essential part of the project activity and associated emissions shall be accounted as project emissions. For steel and aluminium, the separation of these metals from extraneous non-metallic pieces present in the recycled wastes (e.g. plastics or glass) shall also take part at the recycling facility;

[7] The recycling facility includes final segregation of the waste types and no further segregation occurs in the Processing/Manufacturing facility.

(c) **Processing/Manufacturing facility** - includes industrial processes to transform recyclable materials obtained from the recycling facility into intermediate or finished products that is plastic resin, i.e. production of recycled plastic resin or pellets and/or the glass manufacturing facility where the container glass cullet is melted;

(d) **Informal Waste Sector** - individuals or a group of individuals who are involved in waste management activities, but are not formally registered or formally responsible for providing the waste management services. Newly established formalized organizations of such individuals, that is cooperatives, can also be considered as the informal sector for the purpose of this methodology;

(e) **Formal Waste Sector** - solid waste management activities planned, sponsored, financed, carried out or regulated and/or recognized by the local authorities or their agents, usually through contracts, licenses or concessions.

5. Baseline methodology

5.1. Project boundary

21. The project boundary includes the physical geographical sites of:

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

(b) The recycling facility;

(c) Processing/manufacturing facility;

(d) Virgin material production;[8]

(e) MSW disposal site or treatment plant in the baseline scenario.

5.2. Baseline emissions

22. Baseline emissions include~~ emissions include~~:

(a) For the production of plastic, the emissions associated with energy consumption for the production of plastic pellets from virgin plastic materials;

(b) For paper and cardboard, the emissions associated with the anaerobic decay within a disposal site may be claimed;

(c) For the production of glass, emissions associated with the energy consumption for the production of virgin container glass corresponding to the preparation and mixing of raw materials before the melting stage;[9]

(d) For the production of metals, emissions associated with energy consumption for the production from virgin materials.

[8] 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.

[9] Project proponent is encouraged to submit proposals to revise the methodology to include emissions avoided associated with the acquisition of raw materials and CO2 emissions avoided from the use of carbonated materials (such as limestone and soda) in the glass manufacturing process.

23. Baseline emissions shall be determined as:

$$\boldsymbol{BE_y = BE_{plastic,y} + BE_{glass,y} + BE_{paper,y} + BE_{Metal,y}} \quad \text{Equation (1)}$$

Where:

BE_y	=	Baseline emissions in year *y* (t CO_2e)
$BE_{plastic,y}$	=	Baseline emissions in year *y* associated with the recycling of plastic (tCO_2e)
$BE_{glass,y}$	=	Baseline emissions in year *y* associated with the recycling of glass (tCO_2e)
$BE_{paper,y}$	=	Baseline emissions in year *y* associated with the recycling of paper (tCO_2e)
$BE_{Metal,i,y}$	=	Baseline emissions in year *y* associated with the recycling of metal *i*, i.e. Steel and/or Aluminum (tCO_2e)

24. Only the baseline emissions which would take place in non-Annex I countries shall be credited. Therefore, in the case where requirements stipulated under paragraph 8 cannot be met, the baseline emissions calculated for the total amount of recycled materials obtained in the project activity are adjusted by a correction factor *"Bi"*, calculated as the ratio of the production of the material *"i"* in non-Annex I countries and the total production of this material in the world. See the Table 2 below. These correction factors shall be updated at each renewal of the crediting period, and project participants shall use the values from the latest version of the methodology at renewal of the crediting period.

Table 2. Baseline correction factor for metals, plastics and glass from virgin materials

Metal/Plastic	Bi adjustment factor based on the share of the production in non-Annex I countries[(a)]
Aluminium	~~0.63~~0.72
Steel	~~0.65~~0.68
PET	~~0.54~~0.56
HDPE	~~0.54~~0.56
LDPE	~~0.54~~0.56
PP	~~0.54~~0.56
Glass	0.67

(a) ~~Source: For metals, U.S. Geological Survey, 2012. For plastics, Plastics Europe, 2015. For Glass <http://www.glassforeurope.com/en/industry/global-market-structure.php>~~For details on how the values of Bi were determined, please refer to Appendix 1 of "AMS-III.BA.: Recovery and recycling of materials from E-waste".

5.2.1. Baseline emissions for plastics recycling

~~25. Baseline emissions for the production of pellet i from virgin inputs are calculated as follows making conservative assumptions:~~

~~(a) It is assumed that natural gas supplies the process energy required for the thermal cracking; a default specific energy consumption of 15 GJ/t shall be used for HDPE and LDPE or 11.6GJ/t for PP respectively;~~

~~(b) For manufacturing of a 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;~~

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

~~(i) 0.83 MWh/t (3 GJ/t) and 1.67 MWh/t (6 GJ/t) for HDPE and LDPE;~~

~~(ii) 1.11 MWh/t (4.0 GJ/t) for PET;~~

~~(iii) 0.56 MWh/t (2.0 GJ/t) for PP;~~

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

26. Baseline emissions for the production of pellet *i* from virgin inputs are calculated using the equation below:

$$BE_{plastic,y} = \sum_{i} \left[Q_{i,y} \times L_i \times B_i \times \left(SEC_{Bl,i} \times EF_{el,y} + SFC_{Bl,i} \times EF_{FF,CO2} \right) \right] \quad \text{Equation (2)}$$

Where:

$BE_{plastic,y}$	=	Baseline emissions for plastics recycling in year y (tCO_2/year)
i	=	Indices for material type *i* (i = 1,2,3,4 for HDPE, LDPE, PET and PP)
$Q_{i,y}$	=	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 Table 3
$EF_{el,y}$	=	Emission factor for grid electricity (tCO_2/MWh), determined in accordance with the provisions in the most recent version of the methodological tool "Tool to calculate the emission factor for an electricity system"
B_i	=	Correction factor based on share of production in non-Annex I countries, as specified in Table 2. Apply a value of 1.0 when requirement stipulated under para 24 is met
$SFC_{Bl,i}$	=	Specific fuel consumption for the production of virgin material type *i* (GJ/t), take value as specified in Table 3
$EF_{FF,CO2}$	=	CO_2 emission factor for fossil fuel (tCO_2/GJ)

27. The values of the parameters $SEC_{Bl,i}$ and $SFC_{Bl,i}$ are illustrated in the table below:

Table 3. Values of specific energy and fuel consumptions for the production of different types of plastics from virgin materials

Plastic	$SEC_{Bl,i}$ (MWh/t)[(a)]	$SFC_{Bl,i}$ (GJ/t)[(a)]
PET	1.11	15
HDPE	0.83	15
LDPE	1.67	15
PP	0.56	11.6

[(a)] The following conservative assumptions were made to derive the default values contained in the table above:

1. For the production of HDPE, LDPE and PP, it was assumed that natural gas supplies the process energy required for the thermal cracking;
2. For the production of PET, the baseline emissions for production of the monomers Mono Ethylene Glycol (MEG) and Purified Terephthalic Acid (PTA) are conservatively estimated as the energy demand for the production of the same mass of ethylene through thermal cracking;
3. The remaining steps of virgin pellet production (melting and shaping, pelletizing, compounding) require relatively negligible amounts of energy and hence are ignored.

5.2.2. Baseline emissions for paper and cardboard recycling

28. Baseline emissions for the anaerobic decay of paper and cardboard in the solid waste disposal site are calculated using the methodological tool "Emissions from solid waste disposal sites".

5.2.3. Baseline emissions for glass recycling

29. Baseline emissions for the production of container glass from virgin inputs are calculated using following equation:

$$BE_{glass,y} = \sum_{i} [Q_{glass,y} \times L_{glass} \times B_i \times SEC_{Bl,glass} \times EF_{el,y}] \quad \text{Equation (3)}$$

Where:

$BE_{glass,y}$	=	Baseline emissions in year *y* (tCO_2/y)
$Q_{glass,y}$	=	Quantity of glass cullet recycled by the project activity in year *y* (t/y)
L_{glass}	=	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 0.88)
$SEC_{Bl,glass}$	=	Specific electricity consumption for the production of raw materials displaced by the glass recycling (MWh/t), take value specified in paragraph 30(c)

30. ~~Baseline emissions for the production of container glass from virgin inputs are calculated through.~~ The following conservative assumptions were made to determine the baseline emissions for the production of container glass from virgin inputs:

(a) Container glass cullet will displace only the preparation and mixing of raw materials before the melting stage;

(b) The only source of energy consumed by the preparation and mixing of raw materials is electricity – no fossil-fuels are used;

(c) The default value for SEC (specific electricity consumption) of 0.026 MWh/t_{glass} shall be used[10];

(d) The remaining steps of container glass production are not considered because the use of container glass cullet does not avoid melting and the subsequent steps of the glass manufacturing process (i.e. forming and post-forming).

[10] Source: *"Revision of AMS-III.AJ methodology to cover glass – Conservativeness study for the baseline calculation"*, prepared by ALLCOT Group, aavailable at http://cdm.unfccc.int/UserManagement/FileStorage/NC0TF6YEJU8GMVIK49D1LBSWP3HRO2

5.2.4. Baseline emissions for metals recycling

31. Baseline emissions for the production of metal type *i* from virgin inputs are calculated using equation (4):

$$BE_{metal,y} = \sum_{i} [Q_{i,y} \times B_i \times SE_i] \quad \text{Equation (4)}$$

Where:

$BE_{metal,y}$	=	Baseline emissions for metals recycling in year *y* (tCO_2/year)
i	=	Metal type *i* (i.e. Steel or Aluminium)
$Q_{i,y}$	=	Quantity of metal type *i* (Steel or Aluminium) recycled and sent to a processing or manufacturing facility in year *y* (t/y)
SE_i	=	Specific CO_2e emission factor for production of metal i (tCO_2/t), take value specified in Table 4 below

32. The specific CO_2 emission factors are indicated in below. These values shall be updated at each renewal of the crediting period, in accordance with the latest version of the methodology.

Table 4. Specific CO_2 emission factor for production of metals

Metal	Specific CO_2e emission factor for production of metals (tCO_2/t)
Aluminium	8.40[(a)] ~~5.1~~
Steel	1.27[(b)] ~~1.2~~

[(a)] For details on how the emission factor for the production of aluminium was determined, please refer to Appendix 2 of the methodology "AMS-III.BA: Recovery and Recycling of E-waste".

[(b)] For details on how the emission factor for the production of steel was determined, please refer to Appendix 3 of the methodology "AMS-III.BA: Recovery and Recycling of E-waste"

5.3. Project emissions

33. Project emissions include emissions for energy use at recycling facility and emissions associated with the use of the recycled material in the manufacturing facility. No project emissions need to be considered in the case of paper and cardboard. For project activities of Case B, project emissions are calculated using equation (5). The electricity and fuel energy consumption (EC_y, FC_y) shall be directly monitored.

$$PE_y = \sum_{i} \{Q_{i,y} \times [(EC_{i,y} + SEC_{P,i}) \times EF_{el,y} + (FC_{i,y} \times NCV_{FF} \times EF_{FF,CO2})]\} \quad \text{Equation (5)}$$

Where:

PE_y	=	Project emissions in year *y* (t CO_2/y)

i	=	Material type – plastics (HDPE, LDPE, PET and PP), container glass cullet, aluminium or steel
$Q_{i,y}$	=	Quantity of material type recycled in year *y* (t/y)
$EC_{i,y}$	=	Electricity consumption of the recycling facility apportioned to material type *i* (MWh/t) in year *y*
$SEC_{P,i}$	=	Energy consumption factor for processing of recycled material i in the processing/manufacturing facility (MWh/t) Use 0.66 for aluminium Use 0.9 for steel Use 0 for plastics and glass[11]
$FC_{i,y}$	=	Fuel consumption of the recycling facility apportioned to material 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) in year y

34. For Case A project activities, when project emissions are calculated using equation (5), 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[12], or based on measurement campaigns of the energy consumption under typical operation conditions. Alternatively, the project emissions from plastic recycling may be calculated using equation (6).

$$PE_y = \sum_i \left(Q_{i,y} \times SEC_{rec} \times EF_{el,y}\right) \qquad \text{Equation (6)}$$

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/PP

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

[12] In case the nameplate energy consumption and/or service provided by the equipment 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.

35. If the recycling plant is claiming emission reductions for only part of recycled materials (e.g. only for plastics and not for metals), project emissions may be allocated to each mass unit of segregated material by gross sales revenues, that is apportioning the emissions proportional to the market prices of plastics, metals, organics, glass and paper etc. and their respective throughput. The market prices are the average prices of recycled materials paid by processing units/retailers to the recycling plants, 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 material.

36. The following formulas may be used to allocate project emissions to each mass unit of segregated material *s* by market prices:

$$EC_y = EC_y \times \frac{Q_{i,y} \times \$_{i,y}}{\sum_s \left(Q_{s,y} \times \$_{s,y}\right)} \qquad \text{Equation (7)}$$

$$FC_y = FC_y \times \frac{Q_{i,y} \times \$_{i,y}}{\sum_s \left(Q_{s,y} \times \$_{s,y}\right)} \qquad \text{Equation (8)}$$

Where:

S	=	Material segregated at the recycling facility with a market price, including plastic and other marketable items such as organics
EC_y	=	Total electricity consumption of the recycling facility in year *y* (MWh/y)
EC_{yi}	=	Total electricity consumption of the recycling facility in year *y* (MWh/y) apportioned to product *i*
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 plastic type *i* or container glass in year *y*
$\$_{s,y}$	=	Sale price of the segregated material type *s* in year *y*

5.4. Leakage

37. If it is demonstrated that organic biogenic waste segregated in the recycling facility would otherwise 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.

5.5. Emission reductions

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

$$ER_y = BE_y - PE_y - L_y \quad \text{Equation (9)}$$

Where:

ER_y	=	Emission reductions in year *y* (t CO_2e)
L_y	=	Leakage emissions in year *y* (t CO_2e)

6. Monitoring methodology

39. The following parameters as indicated in section 6.1 below shall be monitored and recorded during the crediting period. The applicable requirements specified in the "General guidelines for SSC CDM methodologies" are also an integral part of the monitoring guidelines specified below and therefore shall be referred to by the project participants.

6.1. Data and parameters monitored

Data / Parameter table 1.

Data / Parameter:	**Municipal solid waste**
Data unit:	t/y
Description:	Quantity of municipal solid waste collected at the recycling facility
Source of data:	-
Measurement procedures (if any):	Quantity
Monitoring frequency:	Yearly
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 2.

Data / Parameter:	***$Q_{s,y}$, $Q_{i,y}$ and Q_{glass}***
Data unit:	t/y
Description:	Quantity of each of the segregated materials leaving the recycling facility with a market price, including plastic type *i* and other marketable items such as organics, container glass cullet, metals etc.
Source of data:	-
Measurement procedures (if any):	Direct weighing and recording of the weight, cross checked with company's records that is invoiced and backed by receipt of payments. For the case of plastic type *i* in Case B, cross-check with the mass of product(s) used at the processing/ manufacturing facility using production records[13]

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

Monitoring frequency:	Recorded at the time of sending each consignment from recycling facility to processing/ manufacturing facility or other customers
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 3.

Data / Parameter:	***EC_y***
Data unit:	MWh
Description:	Electricity consumption of the recycling facility in year *y*
Source of data:	-
Measurement procedures (if any):	~~Metering with calibrated equipment. As an alternative option, for the project activity where monitoring is not possible, default values based on specification of equipment may be conservatively considered.~~ As per the latest version of the methodological tool "TOOL05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation". When applying the tool, requirements for $EG_{PJ,grid,y}$ and/or $EG_{PJ,j,y}$ specified in the tool should apply to electricity consumed form the grid and electricity consumed from the captive power plant.
Monitoring frequency:	~~Continuous.~~ As per the tool "TOOL05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation".
QA/QC procedures:	~~-~~ As per the tool "TOOL05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation".
Any comment:	-

Data / Parameter table 4.

Data / Parameter:	***FC_y, / NCV_{FF} / $EF_{FF,CO2}$***
Data unit:	~~MJ~~ As per "TOOL03: Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion".
Description:	FC_y: Fossil fuel consumption of the recycling facility in year *y* NCV_{FF}: Net calorific value of the fossil fuel consumed in the recycling facility in year y $EF_{FF,CO2}$: CO_2 emission factor of the fossil fuel consumed at the recycling facility in year *y*
Source of data:	-
Measurement procedures (if any):	~~Weight or volume & density and calorific value~~ As per the latest version of "TOOL03: Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion". When applying the tool, requirements for $FC_{i,j,y}$ should apply to the total fossil fuel consumption, requirements for $NCV_{i,y}$ should apply for the net calorific value of the fossil fuel consumed in the recycling facility and requirements for $EF_{CO2,i,y}$ should apply for the CO_2 emission factor of the fossil fuel consumed at the recycling facility.

Monitoring frequency:	- As per the latest version of "TOOL03: Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion".
QA/QC procedures:	- As per the latest version of "TOOL03: Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion".
Any comment:	-

Data / Parameter table 5.

Data / Parameter:	***$\$_{i,y}$ and $\$_{s,y}$***
Data unit:	Local currency or USD
Description:	Sale price of plastic type *i* or material *s* in year *y*
Source of data:	-
Measurement procedures (if any):	Cross check with sale invoices/receipts
Monitoring frequency:	As per paragraph 35
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 6.

Data / Parameter:	***Intrinsic Viscosity***
Data unit:	decilitres/gram (dL/g)
Description:	Intrinsic Viscosity of PET/PP
Source of data:	-
Measurement procedures (if any):	Test method for determining Intrinsic viscosity is as per ASTM D 4603 "Standard test method for determining Viscosity of Polyethylene Terephthalate" for PET and as per "Plastics - Determination of the viscosity of polymers in dilute solution using capillary viscometers; EN ISO 1628-3:2010)" for PP
Monitoring frequency:	Every batch of Polymerisation
QA/QC procedures:	-
Any comment:	-

6.2. Project activity under a programme of activities

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

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Document information

Version	*Date*	*Description*
07. 0	20 June 2018	MP 76, Annex 8 To be considered by the Board at EB100. The draft version of this document (CDM-MP75-A05) was available for public input from 6 April to 20 April 2018. It received no inputs. Revision to update the default values.
06.0	4 May 2017	EB 94, Annex 10 Revision to broaden the applicability to cover recovery and recycling of metals (aluminium and steel) from waste collection systems.
05.2	12 August 2016	Editorial revision to correct the year in paragraph 11.
05.1	5 August 2016	Editorial revision to include information on mandatory and conditional sectoral scopes under section 2.4, paragraph 12.
05.0	22 July 2016	EB 90, Annex 14 Revision to broaden the applicability of container glass.
04.0	23 November 2012	EB 70, Annex 28 The revision includes inclusion of Polypropylene (PP).
03.0	15 July 2011	EB 62, Annex 10 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.
02.0	18 February 2011	EB 59, Annex 3 Inclusion of Polyethylene Terephthalate (PET).
01.0	26 March 2010	EB 53, Annex 15 Initial adoption.

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