



Methodology

Methodology for the Use of Alternative Materials to Displace the Production of Plastics

Title	Use of Alternative Materials to Displace the Production of Plastics
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1) SUMMARY DESCRIPTION OF THE METHODOLOGY

Additionality and Crediting Method	
Additionality	Activity Method
Crediting Baseline	Project Method

This methodology is globally applicable to project activities that produce an intermediary product that is used in the manufacturing of final plastic products. These intermediary products, contain an alternative material, such as calcium carbonate, which require less fossil fuel to produce compared to conventional plastic materials. Ultimately, these intermediary products displace the production and use of petroleum-based plastics. Alternative materials may be blended with plastic materials to produce an intermediary product that has the same uses and quality as a 100% conventional plastic product but with a lower plastic content and greenhouse gas emissions. This intermediary product is then used to produce final products bought and used by consumers.

2) DEFINITIONS

Alternative materials

Alternative materials are incorporated into intermediary products that in the baseline scenario were made primarily or exclusively from petroleum-based plastic materials. An example of an alternative material is calcium carbonate, which can be blended with conventional plastic material to produce intermediary products. There are potentially other alternative materials that can be manufactured with a lower carbon footprint than conventional plastic. However, alternative materials must be inorganic to avoid the problem of end-of-life organic degradation/decomposition.

Compounder

The company or entity that takes the alternative material and produces an intermediary product.

Converter

The company or entity that takes the intermediary product and produces a useful/final product.

Conventional plastic/plastic materials

Plastic material used in intermediary products that the project activity would be displacing. Conventional plastic is made synthetically from petroleum-based materials and are in no way biologically derived. *There are a number of plastic polymers, such as* polypropylene (PP), polystyrene (PS), polyethylene (PE), thermoplastic urethane (TPU), acrylonitrile butadiene styrene (ABS), polycarbonate (PC) and polyethylene terephthalate (PET), each having their own emissions factor as measured in tCO₂eq emitted per ton of conventional plastic type produced.

Intermediary Products

Intermediary products are made from partially or completely from alternative materials. The compounder takes the alternative material (and conventional plastic if included) and, if necessary, customizes it with various additives to achieve color, property and performance requirements. The material then goes to a converter to

produce the useful/final product.

Plastics market

The plastics market refers to the converters that manufacture useful products sold to consumers.

Useful/final products

Useful/final products refer to products that have a commercial use and are bought by customers who intend to use the products.

3) APPLICABILITY CONDITIONS

This methodology is globally applicable to project activities that use alternative materials for the production of intermediary products, which generate lower GHG emissions in manufacturing than the petroleum-based plastics materials they would replace. These intermediary products could include anything that would, in the baseline scenario, be made from plastic material. The project activities must meet all the following criteria:

1. Production of an intermediary product that can displace one or more of the following conventional plastic materials:
 - Polypropylene (PP)
 - Polystyrene (PS)
 - Polyethylene (PE), including high-density and low-density polyethylene (HDPE, LDPE) and linear low-density polyethylene (LLDPE)
 - Thermoplastic polyurethane (TPU)
 - Acrylonitrile butadiene styrene (ABS)
 - Polycarbonate (PC)
 - Polyethylene terephthalate (PET)
 - Polyvinyl Chloride (PVC)
2. Project proponents shall indicate and keep records of which type of material listed above is being displaced by the output of the project activity (comprised partially or completely of the alternative material), because each material has a different emission factor (EF). Those records shall be provided to the verifier. If no specific displaced conventional plastic material is identified, the project would be ineligible to use this methodology.
3. The intermediary product containing alternative material produced by the project activity must have a lower EF than the conventional plastic product it is displacing. Alternative material content must exceed 30% by weight of the total product content of the final product. Project proponents must be able to obtain this data from the converter.
4. The project proponent shall demonstrate, through sales records, that the intermediary product has been sold to a converter to produce final products.

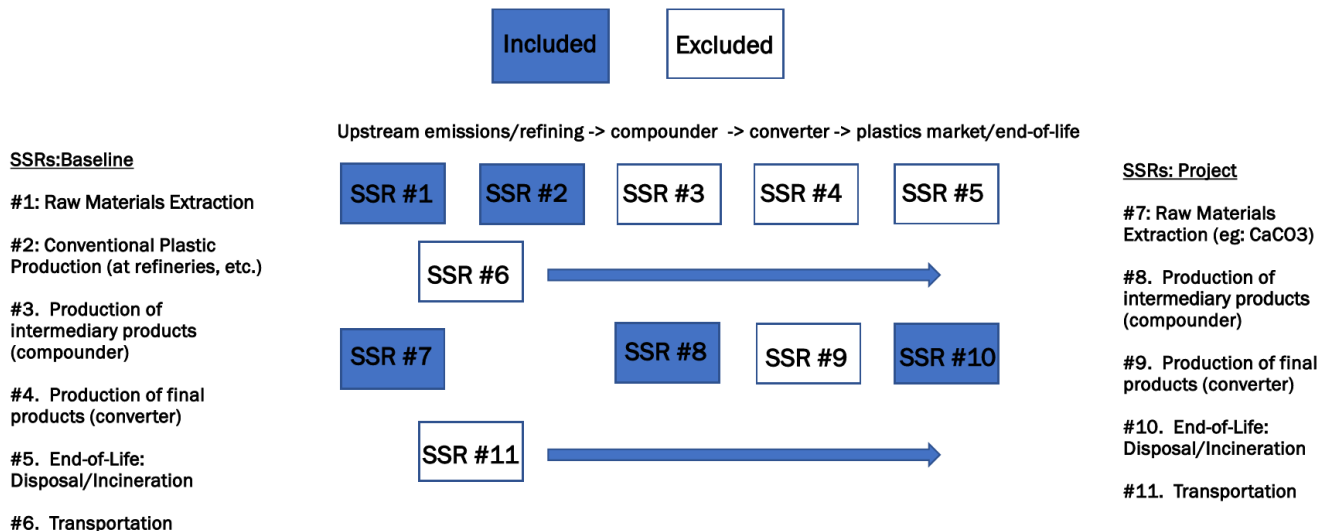
5. Project activities must produce an intermediary product used to manufacture useful products that are sold in the commercial market.
6. The alternative material shall not biologically degrade over time and must therefore be inorganic.
7. Data shall be available in the country where the project activity is taking place that indicate the amount or percentage of plastic material in the overall solid waste stream that is incinerated. Alternatively, a global default, as explained in Appendix II may be used.

4) PROJECT BOUNDARY

As illustrated in Figure 1 below, the spatial extent of the project boundary encompasses:

- The upstream extraction of raw materials and production of alternative materials;
- The project facility (compounder) that uses the alternative materials to manufacture intermediary products, which are then sent to converters or final product producers making useful/final products that enter the plastic material market. Note that the converters are part of the project boundary but are not considered in terms of baseline and project emissions because their activities would take place regardless of whether alternative materials would be used or not.
- Petroleum extraction and the facilities where displaced conventional plastics are produced.

Figure 1. Spatial Boundary of the Project Activity



The greenhouse gases included in or excluded from the project boundary are shown in **Error!** Reference source not found. below.

Table 1: GHG Sources Included In or Excluded From the Project Boundary

Source		Gas	Included?	Justification/Explanation
Baseline	GHGs from traditional production of plastic material, including upstream or raw material extraction emissions sources	CO ₂	Yes	The use and combustion of fossil fuels is the primary source of emissions from the traditional process of manufacturing conventional plastics, including the refining of raw materials and process energy for production of conventional plastics. See Appendix II for further detail, which provides emission factors in <i>tCO₂ equivalent</i> .
		CH ₄	Yes	Appendix II provides emission factors in <i>tCO₂ equivalent</i> .
		N ₂ O	Yes	Appendix II provides emission factors in <i>tCO₂ equivalent</i>
		Other	N/A	Other GHGs (HFCs, PFCs, SF ₆) are not used in this process.
	Baseline production of intermediary products at the compounder and final products at the converter	CO ₂	No	Not considered in the baseline scenario because the intermediary and final products are going to be produced regardless of the project activity. While emissions may decline in the project scenario due to efficiency improvements driven by the project activity, not including this segment as a baseline emission is conservative.
		CH ₄	No	Excluded for same reason that CO ₂ is excluded
		N ₂ O	No	Excluded for same reason that CO ₂ is excluded
		Other	N/A	Excluded for same reason that CO ₂ is excluded
	Emissions from the	CO ₂	No	Incineration emissions are not quantified in the baseline.

	incineration of plastic materials in the baseline	CH ₄	No	See above	
		N ₂ O	No	See above	
		Other	N/A	Other GHGs (HFCs, PFCs, SF ₆) are not used in this process.	
	Transportation of Plastic Materials	CO ₂	No	Not considered in either the baseline or project scenario because it is assumed that under either scenario, conventional plastics or products containing alternative materials require similar means of transport.	
		CH ₄	No	Excluded for same reason that CO ₂ is excluded	
		N ₂ O	No	Excluded for same reason that CO ₂ is excluded	
		Other	N/A	Excluded for same reason that CO ₂ is excluded	
	Project	GHGs from the compounder	CO ₂	Yes	Use of electricity and combusted natural gas or liquid/solid fuels are the primary energy sources that would be used to power a compounder producing intermediary materials, and thus CO ₂ would be the primary emission from that combustion.
			CH ₄	No	Excluded for simplicity
N ₂ O			No	Excluded for simplicity	
Other			N/A	Other GHGs (HFCs, PFCs, SF ₆) are not used in this process.	
GHGs from incineration of alternative		CO ₂	Yes	Incineration of alternative material releases CO ₂ ,	
		CH ₄	No	Excluded for simplicity	

	materials	N ₂ O	No	Excluded for simplicity
		Other	No	Other GHGs (HFCs, PFCs, SF ₆) are not used in this process.
	GHGs from the production of alternative materials, including upstream or raw material extraction emissions sources	CO ₂	Yes	Production of alternative materials may use fossil fuels and electricity, and CO ₂ is the primary gas emitted
		CH ₄	No	Excluded for simplicity
N ₂ O		No	Excluded for simplicity	
	GHGs from the converter	Other	No	Other GHGs (HFCs, PFCs, SF ₆) are not used in this process.
		CO ₂	No	<i>Converters are not considered in terms of baseline and project emissions because their activities would take place regardless of whether alternative materials would be used or not.</i>
		CH ₄	No	Excluded for same reason that CO ₂ is excluded
		N ₂ O	No	Excluded for same reason that CO ₂ is excluded
	Transportation of Plastic Materials	Other	No	Other GHGs (HFCs, PFCs, SF ₆) are not used in this process.
		CO ₂	No	Not considered in either the baseline or project scenario because it is assumed that under either scenario, conventional plastics or products containing alternative materials require similar means of transport.
		CH ₄	No	Excluded for same reason that CO ₂ is excluded

		N ₂ O	No	Excluded for same reason that CO ₂ is excluded
		Other	N/A	Excluded for same reason that CO ₂ is excluded

5) BASELINE SCENARIO

The baseline scenario is the continuation of manufacturing intermediary and useful/final products through traditional processes (i.e., not through the use of alternative materials that can displace petroleum-based plastic materials). This methodology uses a project method to determine the crediting baseline. More information is provided in Appendix I.

6) ADDITIONALITY

This methodology uses an activity method for the demonstration of additionality for project activities that use alternative materials made from calcium carbonate, and a project method for projects that produce alternative materials made from materials other than calcium carbonate.

Project proponents applying this methodology must demonstrate additionality using the procedures described below:

Step 1: Regulatory Surplus

Project proponents must demonstrate regulatory surplus in accordance with the rules and requirements

Step 2: Positive List

Projects that use calcium carbonate to produce alternative materials, located anywhere in the world, and that meet all applicability conditions of this methodology, are deemed as complying with the positive list and as being additional.

The positive list was established using the activity penetration option. Justification for the activity method is provided in Appendix I.

Where Step 2 does not apply, project proponents must proceed to Step 3.

Step 3: Project Method

Projects that produce an inorganic alternative material not made from calcium carbonate shall apply a project method to demonstrate additionality using the latest version of the *CDM Tool for the demonstration and assessment for additionality*.¹

¹ Project proponents using alternative materials made from a material other than calcium carbonate may also choose to revise the methodology and include a separate appendix establishing that the activity penetration for the production of that material is less than five percent (5%).

7) QUANTIFICATION OF GHG EMISSION REDUCTION AND REMOVALS

7.1) Baseline Emissions

Baseline emissions account for GHGs from conventional plastics production, including upstream or raw material extraction emissions sources. Baseline emissions are determined by quantifying the amount of conventional plastic that was used in an intermediary product, which has been avoided through the manufacture and use of alternative materials. In the quantification description below, the project developer would determine the quantity of the alternative material (e.g., CaCO₃) only and assume that it displaces a specific conventional plastic, such as polyethylene.

Baseline emissions are calculated as follows:

$$BE_{tp,y} = \sum_i (Q_{AM,i,y} * DAF_i * EF_i) \quad (1)$$

Where:

$BE_{tp,y}$ = Baseline emissions from manufacturing plastic material through traditional processes (tCO₂e) in time period y .

$Q_{AM,i,y}$ = Net quantity of alternative material produced by the project in year y (metric tonne) that is used to displace plastic material type i . This would not include any conventional plastics that are blended with the alternative material (metric tonnes).

DAF_i = Density Adjustment Factor for plastic material type i

EF_i = Emission factor associated with the production of conventional plastic materials (tCO₂e/metric tonne of conventional plastic type i). See Appendix II.

Determining EF: There may be some potential for ambiguity in determining exactly which type of conventional plastic is being displaced by the project activity, which is important given that different plastic materials have different emission factors. When determining the specific type of plastic material that is being displaced by the project activity, the project proponent can consider one of the following options:

1. In many cases, the project proponent may start with a specific intermediary product and a formulation is developed that results in a reduction in that conventional plastic type, which is replaced by the alternative material. For example, a previous product may be 100% polypropylene. That is replaced by a product that is 35% polypropylene and 65% CaCO₃. In this case, it is clear which conventional plastic type is being displaced.
2. In cases where the precise type of conventional plastic displacement cannot be identified -- or where there are potentially multiple conventional plastic types in a useful product -- project proponents shall use the lowest EF figure in Appendix II.

Density Adjustment Factor (DAF)

In some cases, the useful/final product may be heavier or more dense (or conversely, less dense), compared to the type of final product material it is displacing. If the useful/final product containing the intermediary product with the alternative material is heavier than the original conventional plastic, then the level of CO₂ savings is lowered. The DAF can be determined using the equation below (note this data will come from the converter, not the compounder):

$$DAF_i = \frac{WO_i}{WAP_i} \quad (2)$$

Where:

WO_i = Weight in grams of a representative sample of the original final/useful product that used plastic material type i . For the purposes of this methodology a “representative sample” is an example of the final product itself (eg: a bottle, package, container, etc.).

WAP_i = Weight in grams of a representative sample of the useful/final product made by the project activity, replacing plastic material type i

7.2) Project Emissions

Project emissions occur in the following scenarios:

- GHGs from the production of alternative materials, including upstream or raw material extraction emissions sources².
- GHG emissions from the compounder facility – fuel and electricity usage at the facility where the alternative materials are processed into intermediary products, before being sent to a converter or final product manufacturer and made into final products. *Note that this emissions source only has to be considered if there are incremental increases in emissions associated with the project activity at the compounder facility. If the use of alternative materials at an existing compounder leads to the same level of energy requirements as would take place if the compounder used petroleum-based plastic materials, this source does not need to be considered.*
- GHGs from the incineration of useful/final products containing intermediary products with alternative materials – incineration of materials at end-of-life when, for example, solid waste is sent to an incinerator, releasing the CO₂ in the alternative materials.³

² This provides an “apples to apples” comparison when considering upstream emissions displacement from conventional plastics.

³ For example, if the alternative material is calcium carbonate (CaCO₃), and the end-use products are incinerated with other solid waste, that CaCO₃ would release CO₂

Project emissions are calculated as follows:

$$PE_y = PE_{inc,y} + PE_{elec,y} + PE_{ffc,y} + PE_{AM,Production,y} \quad (3)$$

Where:

PE_y = Project emissions for year y of the project crediting period (tCO₂)

$PE_{inc,y}$ = Project emissions from the eventual incineration of a portion of the alternative materials in the useful/final products (tCO₂)

$PE_{elec,y}$ = Project emissions from the incremental increase in electricity use at the compounder facility as a result of the project activity (tCO₂)

$PE_{ffc,y}$ = Project emissions from the incremental increase in fossil fuel combustion at the compounder facility as a result of the project activity. (tCO₂)

$PE_{AM,Production,y}$ = Project emissions from the production of the alternative materials (tCO₂)

Project emissions from incineration are calculated as follows:

$$PE_{inc,y} = \sum_i (Q_{AM,i,y} * CO2_{released,i,y} * DF_{EL}) \quad (4)$$

$PE_{inc,y}$ = Project emissions from the eventual incineration of a portion of alternative materials which are then re-emitted (tCO₂).

$Q_{AM,i,y}$ = Net quantity of alternative material produced by the project in year y (metric tonne) that is used to displace conventional plastic type i

$CO2_{released,i,y}$ = Amount of CO₂ released when one metric tonne of alternative material is incinerated in year y (tonne CO₂/tonne of alternative material) ONLY when the amount of CO₂ released by the alternative material would be greater than the amount of CO₂ that would be released from baseline conventional plastic content.⁴

DF_{EL} = Discount factor applied for volume of end-of-life plastic material that can be expected to be incinerated (in VM0040 for the US, this figure is 15%, meaning that it is expected that 15% of all plastic material will be incinerated. This figure came from detailed analysis of

⁴ See guidance provided in the relevant monitoring table.

the EPA Waste Reduction Model). More details are provided in Appendix II.

Project emissions from the use of electricity at the compounder facility are calculated as follows:

$$PE_{elec,y} = Q_{elec,y} * EF_{elec} \quad (5)$$

Where:

$PE_{elec,y}$ = Project emissions from the incremental increase in electricity use at the compounder facility as a result of the project activity in year y (tCO₂)

$Q_{elec,y}$ = Quantity of incremental electricity usage from the grid in year y used at the project compounder facility in year y (MWH)

EF_{elec} = Emissions intensity of the electricity in tCO₂/MWH.

Project emissions from the combustion of fossil fuels at the project compounder facility are calculated as follows:

$$PE_{ffc,y} = \sum a (Q_{ff,a,y} * FC_a * EF_a) \quad (6)$$

Where:

$PE_{ffc,y}$ = Project emissions from the incremental increase in fossil fuel combustion at the compounder facility as a result of the project activity in year y (tCO₂e)

$Q_{ff,a,y}$ = Quantity of fossil fuel a used in year y (volume of liquid fuel, mass of solid fuel or cubic meters of natural gas)

FC_a = Energy content of fuel type a (TJ/unit of fuel)

EF_a = Emission factor of fuel a (tCO₂e/TJ)

Project emissions from the production of the alternative material are calculated as follows:

$$PE_{AM,Production,y} = \sum i (Q_{AM,i,y} * EF_{AM,i}) \quad (7)$$

Where:

$Q_{AM,i,y}$ = Net quantity of alternative material produced by the project activity in year y (metric tonne) that displaces conventional plastic type j .

$EF_{AM,i}$ = Emissions factor for producing one tonne of alternative material displacing conventional plastic type i in tCO₂/tonne of material produced. This can be based on data from the supplier or through a third-party lifecycle analysis (see monitoring table).

7.3) Leakage

Leakage is defined as GHG emissions that occur not as a result of the project activity itself, but which take place outside the project boundary. In this case, the project activity is the production of alternative materials in intermediary products to displace conventional plastic products. A potential source of leakage could be the extraction of raw materials to make the alternative materials and other upstream emissions; however, this is considered in the project emissions calculation (Eq. 7). It is assumed that the end-of-life process is similar to any other plastic material (e.g., landfill, incineration), and those potential emissions are also considered.

7.4) Net GHG Emission Reductions and Removals

Net GHG emission reductions and removals are calculated as follows:

$$ER_y = BE_y - PE_y \tag{8}$$

Where:

ER_y = Net GHG emissions reductions and removals in year y (tCO₂e)

BE_y = Baseline emissions in year y (tCO₂e)

PE_y = Project emissions in year y (tCO₂e)

8) MONITORING

8.1) Data and Parameters Available at Validation

Data / Parameter	EF_i
Data unit	tCO ₂ /metric tonne of plastic material type i produced
Description	Emission factor for GHGs caused by the production of plastic materials in tCO ₂ /metric tonne of plastic material
Equation	1
Source of data	Use values from credible international or national government sources, such as the U.S. EPA (see Appendix II for more information on the data used to calculate this variable in the U.S.). If national data are not available or if international data does not reflect the practice of conventional plastic

	production in the country where the project is being implemented, proponents may follow approaches from standards developed by other market-based mechanisms provided they apply conservative assumptions.
Value applied	See Appendix II
Justification of choice of data or description of measurement methods and procedures applied	National environmental agencies or similar government and research institutions have accurate data on energy requirements for each segment of the conventional plastic production process, including raw materials extraction and the production process itself. To be updated at crediting period renewal if new data is available.
Purpose of Data	Calculation of baseline emissions
Comments	In cases where the precise type of plastic displacement cannot be identified -- or where there are potentially multiple conventional plastic materials in a useful product -- project proponents shall use the lowest figure in Appendix II (1.47).

Data / Parameter	DF_{EL}
Data unit	Unitless
Description	Discount factor applied to account for the end of life of plastic material that is incinerated, releasing CO ₂
Equation	4
Source of data	U.S. EPA or similar source in other countries (see Appendix II)
Value applied	<u>For projects located in the U.S.:</u> 0.15 <u>For projects located outside of the U.S.:</u> Determine value from credible national government sources (see Appendix II) Global default value: 0.40
Justification of choice of data or description of measurement methods and procedures applied	National environmental agencies or similar government and research institutions have accurate data on the percentage of plastic materials in conventional waste streams and what percentage of those waste stream that is incinerated.
Purpose of Data	Calculation of project emissions -- where conventional plastic is incinerated, and reductions cannot be credited for this portion of the baseline emissions.
Comments	Discount factor applied to account for the end of life of conventional plastic material that is expected to be

incinerated, thereby releasing CO₂. For example, where 20% of conventional plastics in a particular country can be expected to be incinerated, instead of recycled or landfilled, then the discount factor is 0.20. To be updated at crediting period renewal if new data is available.

It will be assumed that the final products containing alternative materials are incinerated at the same percentage as conventional plastic materials, in which case any CO₂ content would be released. For example, if discount factor is 20% and the alternative material is calcium carbonate (CaCO₃), it will be assumed that 20% of the alternative material used in the project activity is incinerated and CO₂ would be released (CaCO₃ → CaO + CO₂). Additional Guidance: Projects must apply a discount factor, DF_{EL}, to account for conventional plastics that are destroyed (e.g., through incineration if they enter municipal waste streams), thus releasing the captured CO₂ prior to the end of their lifetime. Accurate data as to the amount of plastic material that is incinerated versus landfilled is well documented in many countries. In the U.S., the Environmental Protection Agency (EPA) estimates that 15% of plastic materials, regardless of type, will eventually be incinerated, with the rest being landfilled or recycled (see Appendix II for further detail). This percentage must be discounted from the calculations of emission reductions, to account for the volume of CO₂ that can be expected to be re-emitted.

Where similar data exists in the country where the project is located, this data may be used to inform the discount factor. Appropriate data and data sources include host country officially published data, research studies or industry data. Any data or analysis used to inform the discount factor must be explained in the project documentation and assessed by the validation/verification body. The discount factor must distinguish between different types of conventional plastics and/or be conservative for the type of conventional plastic(s) that the project is producing.

Where no similar data exists in the country where the project is located, a conservative global default factor may be used, as set out in Appendix II.

Data / Parameter	$CO_{2,released,i,y}$
Data unit	Tonne CO ₂ /tonne of alternative material
Description	Amount of CO ₂ released when one metric tonne of alternative material is incinerated in year y.
Equation	4
Source of data	Project proponent
Value applied	N/A
Justification of choice of data or description of measurement methods and procedures applied	<p>Ratio of CO₂ released when the alternative material is incinerated in year y to the production of conventional plastic material i by the project (metric tonnes per year). For example, for CaCO₃, one CO₂ molecule would be released when one CaCO₃ molecule is destroyed through incineration: $CaCO_3 \rightarrow CaO + CO_2$. The project developer shall provide the molecular formula. In this example, one tonne of CaCO₃ incinerated would release one tonne of CO₂, and the ratio is 1:1 on a molar basis, but this will need to be converted to mass.</p> <p>In the case of the reaction $CaCO_3 \rightarrow CaO + CO_2$, 1 kmol of CaCO₃ produces 1 kmol of CO₂; therefore the 1:1 ratio is in kmol and needs to be converted to tonnes.</p> <p>To convert to mass units, project proponents can take into account the mass of 1 kmol of CaCO₃ and 1 kmol of CO₂, equal to 100 kg/kmol and 44 kg/kmol respectively. Therefore, the ratio in mass units should be 1 to 0.44. Thus, one tonne of CaCO₃ incinerated will generate 0.44 tCO₂ emitted.</p>
Purpose of Data	Calculation of project emissions
Comments	Note that this variable needs to be considered only when the amount of CO ₂ released by the alternative material would be greater than the amount of CO ₂ that would be released from baseline conventional plastic content. Thus, the project proponent should know the CO ₂ that would be released from the baseline conventional plastic material. If that information is unknown, then the project proponent must count the project emissions. Other government or industry sources may be used. Just as example, a 2019 report on conventional plastics ⁵ states that for every ton of plastic incinerated, 2.9 tCO ₂ eq. is released.

⁵ <https://www.ciel.org/wp-content/uploads/2019/05/Plastic-and-Climate-FINAL-2019.pdf>

Data / Parameter	EF_a
Data unit	tCO ₂ e/TJ
Description	Emission factor of fuel type a
Equation	6
Source of data	IPCC
Value applied	Will vary
Justification of choice of data or description of measurement methods and procedures applied	The IPCC Guidelines for National Greenhouse Gas Inventories is internationally recognized and the data provided in the guidelines is peer reviewed.
Purpose of Data	Calculation of project emissions
Comments	N/A

Data / Parameter	FC_a
Data unit	TJ/unit of fuel
Description	Energy content per unit of fuel type a
Equation	6
Source of data	IPCC
Value applied	Will vary
Justification of choice of data or description of measurement methods and procedures applied	The IPCC Guidelines for National Greenhouse Gas Inventories is internationally recognized and the data provided in the guidelines is peer reviewed.
Purpose of Data	Calculation of project emissions
Comments	N/A

Data / Parameter	EF_{AM}
Data unit	tCO ₂ /tonne of alternative material produced
Description	Emission factor for producing one tonne of alternative material.
Equation	7

Source of data	Project proponent shall provide evidence either through data from the supplier of the alternative material and/or through an independent life cycle analysis.
Value applied	N/A
Justification of choice of data or description of measurement methods and procedures applied	Data should be transparent and the sources of the data – the alternative material supplier(s) for example – should be available for assessment and/or an interview by the auditor. If a third-party life cycle analysis of the upstream emissions associated with the processing of alternative materials is used to justify the EF_{AM} , then that third party should be available to the auditor as well. Note that the transportation of alternative materials does not need to be included in this analysis, because as indicated in Appendix II, the transportation of conventional plastics is not incorporated into that emission factor.
Purpose of Data	Calculation of project emissions
Comments	If project proponents elect to do an LCA, the PP shall adhere to the guidelines set up two standards published through the International Standards Organization: ISO 14040:2006 & ISO14044:2006. ⁶ The third-party author of the LCA shall attest in its report that one of these standards has been followed.

8.2) Data and Parameters Monitored

Data / Parameter	$Q_{AM,i,y}$
Data unit	Metric tonnes
Description	Quantity of alternative material displacing conventional plastic type i in intermediary products produced by the project
Equation	1, 4 and 7
Source of data	Project proponent
Description of measurement methods and procedures to be applied	<p>The quantity of alternative materials must be weighed on scales that have available calibration procedures from the manufacturer.</p> <p>In addition, to comply with Applicability Conditions 4 and 5 (demonstrating the commercial use/sale of both the intermediary and final products), the project proponent shall obtain either sales records or attestations from the</p>

⁶ <https://www.iso.org/standard/37456.html> and <https://www.iso.org/standard/38498.html>

	<p>compounders indicating the sales the intermediary products to converters, (which should match the quantity of alternative materials produced, taking into account the percentage of these materials in the intermediary products).</p> <p>The project proponent must specify what useful/final products are being sold in the market and demonstrate to the auditor that these final products have in fact been sold.⁷ The output from the project activity will be an intermediary product, which is then converted to a final product. Project proponents shall demonstrate that the final product is of acceptable quality by passing any necessary quality testing in order to be sold into the market. Project proponents shall indicate in the PD what tests are required for the specific useful/final product(s) in the host country in order to be sold into the market and provide data to the VVB that such tests have been successfully completed.</p>
Frequency of monitoring/recording	Continuous and reported daily
QA/QC procedures to be applied	Calibration of scales must be conducted according to the equipment manufacturer's specifications.
Purpose of data	Calculation of baseline and project emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	WAP_i
Data unit	Grams
Description	Weight in grams of a representative sample of the alternative product in the intermediary product that displaces a conventional plastic type i
Equation	2
Source of data	Project proponent
Description of measurement methods and procedures to be applied	The project proponent will weigh a sample of the alternative product that is being produced by the project activity. The sample will be the same dimensions as the WO_i sample.
Frequency of	Once during the crediting period, at validation. If a new

⁷ Receipts, sales records or other evidence shall be provided to the VVB.

monitoring/recording	type of material or product is started during the crediting period, this data will be provided to the WB upon the next verification.
QA/QC procedures to be applied	Calibration of scales must be conducted according to the equipment manufacturer's specifications.
Purpose of data	Calculation of baseline emissions
Calculation method	N/A
Comments	N/A

Data / Parameter:	$Q_{elec,y}$
Data unit	MWH
Description	Incremental increase in electricity used by the compounder as a result of the project activity and supplied by the grid in year y
Equation	5
Source of data	Project proponent
Description of measurement methods and procedures to be applied	Use calibrated electricity meters. Calibration must be conducted according to the equipment manufacturer's specifications. Alternatively, utility billing data can be used.
Frequency of monitoring/recording	Data must be monitored continuously and recorded on at least a daily basis. If utility data is used, monthly bills are acceptable
QA/QC procedures to be applied	The consistency of metered electricity generation should be cross checked with receipts from electricity purchases where applicable
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	EF_{elec}
Data unit	tCO ₂ /MWH
Description	Emission intensity of electricity
Equation	5
Source of data	US eGrid or utility data or similar source if the project is located outside of the US.
Description of measurement methods and	In developing countries, project proponents may use the " Tool to calculate the emission factor for an electricity system " to calculate this parameter.

procedures to be applied	In the US, eGrid emissions factor for the sub-region where the facility is located may be used. Project proponents shall use the latest available information.
Frequency of monitoring/recording	Annual
QA/QC procedures to be applied	Following “ Tool to calculate the emission factor for an electricity system ” In countries where reliable grid emissions data is available (such as US EPA eGrid data), those factors may be used.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	$Q_{ff,y}$
Data unit	Gallons (oil fuels), cubic meters (natural gas), metric tonnes (solid fuels)
Description	Incremental increase in fossil fuel used by the compounder as a result of the project activity in year y
Equation	6
Source of data	Measurements at project compounder facility
Description of measurement methods and procedures to be applied	Use calibrated flow or gas meters. Calibration must be conducted according to the equipment manufacturer’s specifications.
Frequency of monitoring/recording	Data must be monitored and recorded monthly.
QA/QC procedures to be applied	The consistency of metered fuel use should be cross checked with receipts from fuel suppliers, where applicable
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

8.3) Description of the Monitoring Plan

The project proponent must establish, maintain and apply a monitoring plan and GHG information system that includes criteria and procedures for obtaining, recording, compiling and analyzing data, parameters and other information important for quantifying and reporting GHG emissions relevant for the project and baseline scenarios. Monitoring procedures must address the following:

- Types of data and information to be reported;
- Units of measurement;
- Origin of the data;
- Monitoring methodologies (e.g., estimation, modeling, measurement and calculation);
- Type of equipment used;
- Monitoring times and frequencies;
- QA/QC procedures;
- Monitoring roles and responsibilities, including experience and training requirements; and
- GHG information management systems, including the location, back up, and retention of stored data.

Where measurement and monitoring equipment is used, the project proponent must ensure the equipment is calibrated according to current good practice (e.g., relevant industry standards) and consistent with manufacturer requirements.

All data collected as part of monitoring must be archived electronically and kept at least for 2 years after the end of the last project crediting period. QA/QC procedures must include, but are not limited to:

- Data gathering, input and handling measures;
- Input data checked for typical errors, including inconsistent physical units, unit conversion errors;
- Typographical errors caused by data transcription from one document to another, and missing data for specific time periods or physical units;
- Input time series data checked for large unexpected variations (e.g., orders of magnitude) that could indicate input errors;
- All electronic files to use version control to ensure consistency;
- Physical protection of monitoring equipment;
- Physical protection of records of monitored data (e.g., hard copy and electronic records);
- Input data units checked and documented; and
- All sources of data, assumptions and emission factors documented.

9) REFERENCES

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Plastic pollution is growing relentlessly as waste management and recycling fall short, says OECD, February, 2, 2022. See: <https://www.oecd.org/environment/plastic-pollution-is-growing-relentlessly-as-waste-management-and-recycling-fall-short.htm#:~:text=Plastic%20consumption%20has%20quadrupled%20over,of%20global%20greenhouse%20gas%20emissions.>

APPENDIX I: ACTIVITY METHOD

Background

- The development of alternatives to plastics has been slow to develop. Part of the problem has been the low cost of virgin plastic, which has become even more significant due to pervasive low oil prices and an explosion of hydraulic fracturing. A number of commentators have stated that it is cheaper to produce new plastic than recycle existing plastic. This is particularly an issue for alternatives to conventional plastic products that are usually more expensive and, in some cases, slightly heavier. Plastic has the advantage of being very light and durable, despite the negative publicity around plastic pollution and microplastics. The trend of plastics consumption continues to go upward⁸.
- Numerous studies have highlighted the barriers to alternatives to petroleum-based plastics.⁹ Among the barriers cited are the higher cost of plastics alternatives, customer demand, and hesitancy among large-scale users of plastic materials to switch away from what they know customers accept. This has been a barrier in the adoption of Okeanos' products, which are made from calcium carbonate. In addition, studies cite a lack of manufacturing facilities to produce alternatives at scale, a lack of financial support to develop alternatives (which contribute to the higher cost) and lack of government incentives.
- In addition, it should be noted that as of the writing of this methodology, Okeanos' technology – the use of calcium carbonate as an alternative material – has been available for more than three years, demonstrating that while the project is commercially available at a modest scale, its growth has been limited – indicating barriers to penetration in the wider market.
- The activity penetration option requires that the total amount of plastic production from this alternative does not amount to more than five percent (5%) of total plastic production worldwide. Activity penetration is equal to: Observed Activity (OA) divided by the Maximum Adoption Potential (MAP).

Determining the Market Penetration Rate in Individual Countries and Globally

- Okeanos, which produces intermediary products containing very high-levels of calcium carbonate, is manufacturing the compound in four locations. In the US, Okeanos hopes to reach a total output in the coming years of around 500,000 tonnes of output. In 2023, Okeanos expects to manufacture 30,000 tons of CaCO₃ material that will displace plastics. This level is essentially the OA. There is no other company replacing plastics at the level required by this methodology (40% or greater). This assertion is also validated by a senior official from the European Calcium Carbonate Association, which is provided below.

⁸ Statista (2021). *Annual production of plastics worldwide from 1950 to 2020*. Available at: <https://www.statista.com/statistics/282732/global-production-of-plastics-since-1950/>

⁹ Vimal, K. et al (2020). Analysis of barriers that impede the elimination of single-use plastic in developing economy context. *Journal of Cleaner Production*. Available at: <https://doi.org/10.1016/j.jclepro.2020.122629> and Senechal, K. (2018). Barriers to the Elimination of Plastic in Single Use Beverage Containers in Byron Bay, NSW. *School for International Training*. Available at: https://digitalcollections.sit.edu/isp_collection/2851/



Brussels, January 23rd, 2023

To whom it may concern,

“To the best of the organization’s knowledge there are no other companies out there using CaCO₃ in finished polyolefin plastic packaging applications at loads of 40% or higher and if there is, it is not a common place in the market. Okeanos technology offers a novel solution to the plastic packaging market.”

Yours sincerely,



Celia Gryspeirt
Secretary General

- In addition to the OA, it is important to understand the overall size of the plastics market and the subset of that market where this technology can be deployed (the MAP). The total production of plastic worldwide comes to about 460 million tons per year, as estimated by the OECD.¹⁰ However, given today’s technology, not 100% of plastics can be displaced by CaCO₃. Today, it is estimated that products cannot exceed 70% CaCO₃ without losing some of the necessary qualities that plastic has. Thus, this consideration reduces the MAP from 460 million tons to 329 million tons (70%). Other than this constraint, the methodology developers see no other constraint on the use of CaCO₃, and thus the AP is 30,000/370,000,000 or 0.008%.

Supporting Evidence: In addition to the data provided above, the table below reinforces the lower percentage that CaCO₃ is used in the plastics market overall. In this case, the plastic market currently uses around 13,800,000 tons of CaCO₃ overall. If the total available plastics market is 370 million tons,

¹⁰ <https://www.oecd.org/environment/plastic-pollution-is-growing-relentlessly-as-waste-management-and-recycling-fall-short.htm#:~:text=Plastic%20consumption%20has%20quadrupled%20over,of%20global%20greenhouse%20gas%20emissions.>

that's a penetration rate of 3.7%. Thus, even if this project activity included *any* level of CaCO₃ input into plastics (not limited to 40% or more), that would still be less than 5%.

Calcium Carbonate Market: Volume in Kilo Ton, By End-User Industry, Global, 2017-2027

End-User Industry	2017	2018	2019	2020	2021	2022 (est.)	2027 (f)	% CAGR (2022-2027)
Paper	55,283.26	56,135.52	57,193.94	53,895.10	54,858.83	55,890.18	61,164.71	1.82%
Plastic	13,154.63	13,430.88	13,718.30	13,216.21	13,491.10	13,779.81	15,712.66	2.66%
Adhesives and Sealants	5,037.51	5,202.23	5,375.99	5,263.63	5,432.07	5,609.70	6,698.04	3.61%
Construction	10,787.01	11,050.21	11,326.47	11,244.92	11,758.81	12,011.62	13,570.17	2.47%
Paints and Coatings	7,976.47	8,187.05	8,408.92	8,341.65	8,529.34	8,740.01	10,024.32	2.78%
Pharmaceutical	6,299.29	6,526.07	6,766.23	7,412.40	8,103.24	8,904.65	15,147.33	11.21%
Automotive	7,982.62	8,155.05	8,334.46	7,450.17	7,581.30	7,757.18	8,832.34	2.63%
Agriculture	14,379.96	14,670.43	14,978.51	14,749.34	14,944.03	15,111.40	16,782.58	2.12%
Rubber	12,999.78	13,277.98	13,568.77	13,121.00	13,410.97	13,748.93	15,532.90	2.47%
Others (Food, Personal Care, Etc.)	10,026.39	10,350.24	10,689.73	10,531.52	10,873.79	11,247.85	13,501.50	3.72%
Total	143,926.92	146,985.67	150,361.31	145,225.94	148,983.48	152,801.34	176,966.56	2.98%

- Given the early stage of this technology, it is difficult to say exactly what the resource and other constraints are to adoption of this technology. The main feedstock for Okeanos, CaCO₃, is ubiquitous, and there are no particular barriers that would limit the adoption of this technology, which can displace just about any plastic product. Thus, for the purposes of this methodology, the MAP is the entire plastics market. Therefore, the activity penetration level of the project activity covered by this methodology is below the five percent threshold, and the project activity may be deemed additional. Okeanos would have to increase its planned production (again not its current production) by 25 times to reach that threshold.
- Additionally, given the low penetration of this activity, the only baseline scenarios that are reasonable to consider are: 1) the continued manufacturing of traditional plastic material with no plastic substitutes; 2) the large-scale adoption of this technology many years into the future, at which point the five percent threshold for activity penetration would be exceeded and the activity would no longer be eligible for crediting.



APPENDIX II: EMISSION FACTORS

Introduction

This appendix provides additional information about the calculation of the following emission factors:

1. EF_i : the emission factor for GHGs caused by the production of virgin plastic materials; and
2. DF_{EL} : the discount factor applied to account for the end of life of plastic material that is incinerated, releasing CO_2

Emission Factor for the Production of Plastic Material (EF_i)

Introduction and Background

This methodology relies on emission factors for each type of plastic produced by the project activity in order to calculate baseline emissions associated with the displacement of virgin plastic production (EF_i). This appendix provides additional information about how EF_i is determined, including default factors for projects located in the United States and the process that must be used by projects located outside of the United States to calculate EF_i .

Emissions associated with the manufacture of plastic materials through conventional processes include the extraction and processing of raw materials, which are primarily petroleum products, emissions associated with the manufacturing process itself, and emissions associated with the transportation of plastic materials. These emissions vary depending on the type of plastic material – the production of polypropylene, for example, generates almost 40% fewer emissions than the production of polystyrene.

Calculation of Default Factors for Projects in the United States

Projects located in the United States may use a default value for EF_i , based on the United States Environmental Protection Agency (U.S. EPA) Waste Reduction Model (WARM), which was created to calculate the GHG emissions of waste management practices in the United States, including from the recycling and landfilling of plastic materials.

The WARM model disaggregates the different sources of emissions associated with plastic production and includes process energy from the petroleum refining process, process non-energy emissions, and transportation emissions, as shown in Table 3a below¹¹. For the purposes of this methodology, only process and process non-energy emissions are included because emissions from the transportation of plastic materials are not expected to be different in the baseline and project scenarios (e.g., because traditional plastic or GHG-containing plastic both must be transported to their final destination).

¹¹ U.S. Environmental Protection Agency Office of Resource Conservation and Recovery (2020). Documentation for Greenhouse Gas Emission and Energy Factors Used in the Waste Reduction Model (WARM): Containers, Packaging, and Non-Durable Good Materials Chapters. Available at: https://www.epa.gov/sites/production/files/2020-12/documents/warm_containers_packaging_and_non-durable_goods_materials_v15_10-29-2020.pdf



Note – The tCO₂e in Table 3a and Table 3b, below, are expressed in short tons. For the purposes of calculating baseline emissions in Equation 2, the default values included in Table 4, below, have been converted into metric tCO₂e.

Table 3a: Source Reduction Emission Factors for Plastic

Material (a)	Process Energy (b)	Transportation Energy €	Process Non-Energy (d)	Net emissions (e) [e=b+c+d]
HDPE	1.18	0.15	0.20	1.53
LDPE	1.40	0.15	0.21	1.76
PET	1.74	0.07	0.39	2.20
LLDPE	1.14	0.15	0.25	1.54
PP	1.17	0.13	0.21	1.51
PS	1.86	0.15	0.45	2.46
PVC	1.68	0.08	0.14	1.90

The WARM model takes into account that some plastic is created from recycled materials, and therefore not all plastic materials on the market are from 100% raw materials, in its calculation of net emissions from plastic production. Table 3b, below, includes the emissions from “raw material acquisition” for the current mix of recycled vs. virgin plastic in the market (column “b”), as opposed to column “c” which calculates the emission factor for 100% virgin inputs. Note that the values in Table 3b are negative because this section of the WARM model is referencing reductions in emissions for every ton of plastic where its use is avoided.

Note that the figures in column “e” in Table 3a do not match column “b” in Table 3b below. This is because the transportation energy in the WARM model does not include retail transportation, which is 0.04 tCO₂/t of plastic for all plastic types¹². The values in column “e” of Table 3a are equal to: [net emissions from 100% virgin inputs, Table 3b] – [0.04].

¹² See Table 5-4 on page 5-5 of U.S. Environmental Protection Agency Office of Resource Conservation and Recovery (2020). Documentation for Greenhouse Gas Emission and Energy Factors Used in the Waste Reduction Model (WARM): Containers, Packaging, and Non-Durable Good Materials Chapters. Available at: https://www.epa.gov/sites/production/files/2020-12/documents/warm_containers_packaging_and_non-durable_goods_materials_v15_10-29-2020.pdf

Table 3b: Raw Material Acquisition and Manufacturing Emission Factor for Virgin Production of Plastics (tCO₂e/Short Ton)

Material (a)	Raw Material Acquisition and Manufacturing for Current Mix of Inputs (b)	Raw Material Acquisition and Manufacturing for 100% Virgin Inputs (c)	Net Emissions for Current Mix of Inputs (d)	Net Emissions for 100% Virgin Inputs (e)
HDPE	-1.47	-1.57	-1.47	-1.57
LDPE	-1.80	-1.80	-1.80	-1.80
PET	-2.20	-2.24	-2.20	-2.24
LLDPE	-1.58	-1.58	-1.58	-1.58
PP	-1.55	-1.55	-1.55	-1.55
PS	-2.50	-2.50	-2.50	-2.50
PVC	-1.95	-1.95	-1.95	-1.95
Mixed Plastics	-1.92	-1.98	-1.92	-1.98

The net emission factor (EF_i) for each type of plastic is calculated as:

$$[(\text{net emissions for current mix of inputs (Table 3b)}) - (\text{transportation energy (Table 3a)}) - (\text{retail transportation})] \times (\text{conversion factor from short tons to metric tonnes, equal to 1.102})$$

For example, the net emissions factor for HDPE would be equal to:

$$[(1.47) - (0.15) - (0.04)] \times (1.102) = 1.41$$

There are a few types of plastic material eligible to be produced through project activities, but not included in the U.S. EPA WARM model report. These forms of plastic are:

- Thermoplastic urethane (TPU)
- Acrylonitrile butadiene styrene (ABS)
- Polycarbonate (PC)

Emission factors for these plastic materials were derived from a report prepared for the City of Winnipeg¹³. The emission factors included in this report are inclusive of emissions associated with transportation. Therefore, to calculate emission factors for ABS, TPU and PC that are equivalent to the emission factors for other eligible plastic materials, an estimate of transportation emissions was subtracted from the total emissions. The EPA data from the WARM model specifies 0.19 metric tonnes of CO₂/per short ton of plastic (equal to 0.21 metric tonne of CO₂/per metric tonne of plastic) as the highest (and therefore most conservative) value for emissions from transportation. This value was subtracted from total emissions for the emission factors for ABS, TPU and PC included in Table 4 below. It is reasonable to infer that transporting ABS, TPU and PC would be similar in cost and energy to all other types of plastics, a point reinforced by the fact that the transport figures in the WARM model (except for PVC) are all in a very small

¹³ City of Winnipeg (2012). *Emission Factors in kg CO₂-Equivalent per Unit*. Available at: https://www.winnipeg.ca/finance/findata/matmgt/documents/2012/682-2012/682-2012_Appendix_H-WSTP_South_End_Plant_Process_Selection_Report/Appendix%207.pdf

range. The emission factors for TPU and PC were derived from the “Other Plastics” emission factor.

Table 4: Default Emission Factors for EF_i for projects located in the United States

Plastic Type	Emission Factor (tCO ₂ e/metric tonne of plastic material produced)
HDPE	1.41
LDPE	1.77
PET	2.30
LLDPE	1.53
PP	1.52
PS	2.55
PVC	2.02
ABS	3.25
TPU	2.49
PC	2.49

Note that project proponents must use the latest version of the WARM model (or similar sources of data in other countries) when developing a new project.

Discount Factor for Incinerated Plastic Material (DF_{EL})

Introduction

DF_{EL} is the discount factor that is applied to account for the fact that CO₂ from the alternative material be re-released when the final product is incinerated. DF_{EL} represents the proportion of incinerated plastic to non-incinerated plastic.

This section sets out in more detail the three ways that DF_{EL} can be determined: 1) a default value for U.S.-based projects; 2) criteria for projects to determine DF_{EL} where appropriate data is available; and 3) a conservative global default value.

Default Factor for Projects Located in the United States

The U.S. Environmental Protection Agency (U.S. EPA) has collected and reported data on the generation and disposition of waste in the United States for more than 30 years. This information is used to measure the success of waste reduction and recycling programs across the country and characterize the U.S. national waste stream and can be used to determine DF_{EL} in the United States.

Based on the information included in the U.S. EPA Advancing Sustainable Materials Management: 2014 Fact Sheet Assessing Trends in Material Generate, Recycling, Composting, Combustion with Energy Recovery and Landfilling in the United States (November 2016)¹⁴, 15% of total plastics are incinerated in

¹⁴ See Table 1. Generation, Recycling, Composting, Combustion with Energy Recovery and Landfilling of



the U.S. Therefore, the default factor for DF_{EL} in the U.S. is: 0.15.

Procedure for Projects Located Outside of the United States

Where projects are located outside of the United States, they must determine the percent of plastic incinerated in the country or geographic region of the project in order to determine DF_{EL} . Independent market estimates from government, academic or trade association sources may be used to determine the level of plastic incineration in a particular country. Where a single source does not include sufficient information to determine the percent of plastic incinerated in a particular country, multiple sources of data may be used. For example, where 5 million tonnes of waste are incinerated in a country and 10% of such waste is plastic products, then 500,000 tonnes of plastic may be assumed to be incinerated in that country. Where another source shows that 1.5 million tonnes of plastics is consumed in that country, then the default factor may be set at 30% (equal to: (plastic products incinerated) / (total plastic consumed) = (500,000) / (1,500,000)).

The project proponent must calculate DF_{EL} in terms of tCO_2e /metric tonne of plastic material produced and apply this calculated discount factor to determine emissions in Equation 4.

Global Default Value

Where data is not available to determine a specific default factor for the percent of plastic that is incinerated in a particular country, a conservative global default value must be used. **The conservative global default for DF_{EL} is: 0.40.**

This **conservative global default value for DF_{EL} is based on an estimate of the percent of plastic that is incinerated in Europe, which** has the highest level of plastics incineration of any known country or region. According to a report from Plastics Europe¹⁵, 36% of post-consumer plastic produced in Europe was incinerated for energy generation. **Therefore**, for the purposes of the methodology, where a project proponent cannot find data on the level of baseline plastics incineration in a country where a project compounder facility is located, the global default value for DF_{EL} is conservatively set at 40%.

Materials in MSW, 2014*, in the column for “combustion as a percent of generation”, which refers to the percent combusted as a percent of total waste generation for that category, in the U.S. Environmental Protection Agency (2016). *Advancing Sustainable Materials Management: 2014 Fact Sheet Assessing Trends in Material Generation, Recycling, Composting, Combustion with Energy Recovery and Landfilling in the United States*. Available at: https://www.epa.gov/sites/production/files/2016-11/documents/2014_smmfactsheet_508.pdf

¹⁵ Plastics Europe (2015). *Plastics—The Facts 2014: An Analysis of European Plastics Production, Demand and Waste Data*. Available at: https://www.plasticseurope.org/application/files/5515/1689/9220/2014plastics_the_facts_PubFeb2015.pdf