19. Solid Waste Intermediate Treatment/Composting

1. Typical Project Outline
   - Composting organic wastes.

2. Applicability
   (1) Composting organic wastes that will be dumped to disposal sites in the absence of the project.

3. Methodology of Emission Reduction Calculation

   The emission reduction from the project activity is determined as the differences between the GHG emissions of baseline scenario (methane are emitted to atmosphere without recovery) and project scenario (composting organic wastes).

\[ ER_y = BE_y - PE_y \]

- \( ER_y \): Emission reduction through the project in a year \( y \) (t-CO2e/y)
- \( BE_y \): GHG emission from the baseline scenario in a year \( y \) (t-CO2e/y)
- \( PE_y \): GHG emission from the project scenario in a year \( y \) (t-CO2e/y)

(1) Calculation of Baseline Emission

The baseline emissions are comprised of un-captured methane emitted to the atmosphere from disposal sites and the CO2 emissions from generation of electric power and/or thermal energy that will be replaced by electricity generated or thermal energy by methane captured.

\[ BE_y = (MG_{SWDS,y} - MF_{BL,y}) \times GWP_{CH4} \]

- \( MG_{SWDS,y} \): Methane emission from landfill sites in the baseline (t-CH4/y)
- \( MF_{BL,y} \): Methane quantity to be flared as required by National Regulations before the project starts (t-CH4/y).
- \( GWP_{CH4} \): Methane Global Warming Potential (=25 t-CO2/t-CH4)

Determination of \( MG_{SWDS,y} \):

Methane quantity from disposal sites (CH4 quantity recovered and destroyed by the project) shall be determined by monitoring the quantity of degradable organic carbon reclaimed in the landfill in consideration of decomposition rate.

\[ MG_{SWDS,y} = \varphi_y \times (1 - OX) \times 16/12 \times F \times DOC_{f,y} \times MCF_y \times \sum_{x=1}^{y} \sum_{j} \left\{ W_{j,x} \times DOC_j \times e^{-k_j(x-x)} \times (1 - e^{-k_j}) \right\} \]

- \( \varphi_y \): Model correction factor to account for model uncertainties
- \( OX \): Oxidation rate
- \( F \): Fraction of CH4 in LFG
- \( DOC_{f,y} \): Fraction of degradable organic carbon (DOC) that can decompose
- \( MCF_y \): CH4 correction factor
- \( W_{j,x} \): Average annual quantity of the waste type \( j \) disposed in the SWDS before the project starts (t/y)
- \( DOC_j \): Fraction of degradable organic carbon (by weight) in the waste type \( j \)
19. Solid Waste Intermediate Treatment/Composting

- $x$: Years in the time period in which waste is disposed at the SWDS, extending from the first year in the time period $(x = 1)$ to year $y$ $(x = y)$.
- $y$: Year of the crediting period for which methane emissions are calculated ($y$ is a consecutive period of 12 months).
- $k_j$: Decay rate for the waste type $j$ (unit/y).
- $j$: Type of residual waste or types of waste in the MSW.
- $e$: Base of natural logarithm.

$W_{j,x}$ is determined as follows.

$$W_{j,x} = W_y \times w_j$$

- $W_y$: Average annual quantity of the waste disposed in the SWDS before the project starts ($t/y$).
- $w_j$: Weight fraction of the waste type $j$ in solid waste (weight basis) (%).

Determination of $MF_{BL,y}$:

It is determined by multiplying the methane quantity from landfill with the fraction of decomposed and combusted.

$$MF_{BL,y} = MD_{SWDS,y} \times AF$$

- $MD_{SWDS,y}$: Methane quantity recovered from landfill by the project.
- $F$: Methane fraction required for flare and combustion under the National Regulations before the project starts.
  
  It will be zero as developing countries mostly have no this regulation.

(2) Calculation of Project Emission

The project emissions is comprised of the GHG emission from electricity and fuel consumption in the LFG recovery plants or power generating plants after the project starts as follows;

$$PE_y = PE_{EC,y} + PE_{FC,y} + PE_{CH4,y} + PE_{N2O,y}$$

- $PE_y$: GHG emission from the project ($t-CO_2e/y$).
- $PE_{EC,y}$: GHG emission from electricity consumption by the project in year $y$ ($t-CO_2e/y$).
- $PE_{FC,y}$: GHG emission from fossil fuel consumption by the project in year $y$ ($t-CO_2e/y$).
- $PE_{CH4,y}$: GHG emission from methane in composting process in year $y$ ($t-CO_2e/y$).
- $PE_{N2O,y}$: GHG emission from N$_2$O in composting process in year $y$ ($t-CO_2e/y$).

Determination of $PE_{EC,y}$:

It is determined as follows.

$$PE_{EC,y} = EC_{PJ,y} \times EF_{elec}$$

- $EC_{PJ,y}$: Amount of electricity consumption by the project in year $y$ (MWh/y).
- $EF_{elec}$: CO$_2$ emission factor of the electricity ($t-CO_2$/MWh).
19. Solid Waste Intermediate Treatment/Composting

Determination of $PE_{FC,i,y}$:

It is determined as follows.

$$PE_{FC,i,y} = \sum_i (FC_{P,i,y} \times NCV_{fuel,i} \times EF_{fuel,i})$$

$FC_{P,i,y}$: Amount of fuel consumption by the project in year $y$ (t/y)
$NCV_{fuel,i}$: Net calorific value of the fuel $i$ used (TJ/t)
$EF_{fuel,i}$: CO2 emission factor of the fuel $i$ (t-CO2/TJ)

Determination of $PE_{CH4,y}$:

It is determined as follows.

$$PE_{CH4,y} = Q_y \times GWP_{CH4} \times EF_{CH4,def}$$

$Q_y$: Amount of wastes being composted in year $y$ (t/y)
$GWP_{CH4}$: Methane Global Warming Potential (=25 t-CO2/t-CH4)
$EF_{CH4,def}$: Methane emission factor of composting (t-CH4/t)

Determination of $PE_{N2O,y}$:

It is determined as follows.

$$PE_{N2O,y} = Q_y \times GWP_{N2O} \times EF_{N2O,def}$$

$Q_y$: Amount of wastes being composted in year $y$ (t/y)
$GWP_{N2O}$: N2O Global Warming Potential (=298 t-CO2/t-N2O)
$EF_{N2O,def}$: N2O emission factor of composting (t-N2O/t)

4. Data and Parameters Estimated and Need Monitoring

<table>
<thead>
<tr>
<th>Data</th>
<th>Description</th>
<th>For baseline emission calculation</th>
<th>Data Sources</th>
<th>For baseline emission calculation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Ex-ante</td>
<td>Ex-post</td>
<td>Ex-ante</td>
</tr>
<tr>
<td>$\varphi_y$</td>
<td>Model correction factor to account for model uncertainties</td>
<td>0.75</td>
<td>N/A</td>
<td>N/A</td>
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<td>(Default value: Methodological Tool: Emissions from solid waste disposal sites)</td>
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<tr>
<td>F</td>
<td>Fraction of CH4 in LFG</td>
<td>0.5</td>
<td>N/A</td>
<td>N/A</td>
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<tr>
<td>(Default value: 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 5 Waste)</td>
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<td></td>
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<tr>
<td>OX</td>
<td>Oxidation rate</td>
<td>0.1</td>
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<tr>
<td>(Default value: Methodological Tool: Emissions from solid waste disposal sites)</td>
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</table>
### 19. Solid Waste Intermediate Treatment/Composting

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Default Value</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DOC_{ly}</strong></td>
<td>Fraction of degradable organic carbon (DOC) that can decompose</td>
<td>0.5</td>
<td>(Default value: 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 5 Waste)</td>
</tr>
<tr>
<td><strong>DOC_{j}</strong></td>
<td>Fraction of degradable organic carbon (by weight) in the waste type j</td>
<td>Default value of IPCC (Table 9, Appendix)</td>
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<tr>
<td><strong>MCF_{y}</strong></td>
<td>CH$_4$ correction factor</td>
<td>Default value of IPCC (Table 10, Appendix)</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>W_{y}</strong></td>
<td>Average annual quantity of waste disposed to the SWDS before in baseline the in year y (t/y)</td>
<td>From the following sources in the order of priority: i) Interview with disposal site managers ii) Assumption as per design of the disposal sites</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>w_{j}</strong></td>
<td>Weight fraction of the waste type j in solid waste (weight basis) (%)</td>
<td>Default value of IPCC (Table 13, Appendix) If there is no default value applied or if there is another appropriate value, that value may be used.</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>k_{j}</strong></td>
<td>Decay rate for the waste type j</td>
<td>Default value of IPCC (Table 11, Appendix) If there is no default value applied or if there is another appropriate value, that value may be used.</td>
<td>N/A</td>
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<tr>
<td><strong>EF_{elec}</strong></td>
<td>In the case of a grid CO$_2$ emission factor (t-CO$_2$/MWh)</td>
<td>A default value (Table 4, Appendix) If there is no default value applied or if there is another appropriate value, that value may be used.</td>
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<tr>
<td><strong>NCV_{fuel,i}</strong></td>
<td>Net calorific value of the fuel i used in the project (TJ/t)</td>
<td>An IPCC default value (Table 1, Appendix) If there is no default value applied or if there is another appropriate value, that value may be used.</td>
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<tr>
<td><strong>EF_{fuel,i}</strong></td>
<td>CO$_2$ emission factor of the fuel i used in the project (t-CO$_2$/TJ)</td>
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<td><strong>EC_{PJ,ly}</strong></td>
<td>Amount of electricity consumption by the project in year y (MWh/y)</td>
<td>A planned value</td>
<td>N/A</td>
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<tr>
<td><strong>FC_{PJ,ly}</strong></td>
<td>Amount of fuel consumption by</td>
<td>A planned value</td>
<td>N/A</td>
</tr>
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</table>
19. Solid Waste Intermediate Treatment/Composting

<table>
<thead>
<tr>
<th>EF_{CH4,def}</th>
<th>Methane emission factor of composting (t-CH4/t)</th>
<th>N/A</th>
<th>0.002 (Methodological Tool Project and leakage emissions from composting (Version 01.0.0))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q_y</td>
<td>Amount of wastes to be composted in year y (t/y)</td>
<td>N/A</td>
<td>Planned value</td>
</tr>
<tr>
<td>EF_{N2O,def}</td>
<td>N2O emission factor of composting (t-N2O/t)</td>
<td>N/A</td>
<td>0.0002 (Methodological Tool Project and leakage emissions composting (Version 01.0.0))</td>
</tr>
</tbody>
</table>

5. Others

(1) Project Boundary

The project boundary is the site where the project activity is being done, where the wastes are composting.

(2) Leakage

Construction of power plants, replacement of facility: the indirect emissions potentially leading to leakage due to activities such as product manufacturing or materials transport in consideration of Life Cycle Assessment, LCA of disposal of waste at a solid waste disposal site. The contribution of this emission is relatively small and negligible compared with the GHG emission reduction after the project starts. This formula ignores the leakage because ACM0001 methodology also ignores it.

(3) Comparison with existing CDM methodologies

The logic of emission reduction calculation in the methodology is almost the same as that of the AMS-III.F (Avoidance of methane emissions through composting, Version 11). However, this methodology simplified the methodology by using default values as more as possible. Moreover, there is no limitation for the emission reduction in the methodology like the small-scale CDM methodologies did.