# 20. Waste Water Management/Methane Recovery

## 1. Typical Project Outline

- Methane recovery and application from existing waste water treatment systems.
- Methane recovery and application from new waste water treatment systems.

## 2. Applicability

(1) Methane recovery from waste water treatment systems.

(2) Application of the recovered methane for power or/and thermal generation.

## 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 (recovery methane from the waste water treatment systems).

$$ER_y = BE_y - PE_y$$

$ER_y$ : Emission reduction through the projet in a year y (t-$CO_2$e/y)

$BE_y$ : GHG emission from the baseline scenario in a year y (t-$CO_2$e/y)

$PE_y$ : GHG emission from the project scenario in a year y (t-$CO_2$e/y)

(1) Calculation of Baseline Emission

The baseline emissions cover emissions from the following sources

- $CO_2$ emissions from electricity and fossil fuels consumed in the baseline scenario
- Methane emitted to the atmosphere from waste water treatment sites
- $CO_2$ emissions from generation of electric power and/or thermal energy that will be replaced by electricity or thermal energy generated by the project.

$$BE_y = BE_{EC,y} + BE_{FC,y} + BE_{ww,y} + BE_{EN,y}$$

$BE_{EC,y}$ : $CO_2$ emissions from electricity consumed in the baseline in year y (t-$CO_2$e/y)

$BE_{FC,y}$ : $CO_2$ emissions from fossil fuels consumed in the baseline in year y (t-$CO_2$e/y)

$BE_{ww,y}$ : Methane emission from wastewater treatment sites in year y (t-$CO_2$e/y)

$BE_{EN,y}$ : $CO_2$ emissions from generation of electric power and/or thermal energy that will be replaced by electricity or thermal energy generated by the project in year (t-$CO_2$e/y)

Determination of $BE_{EC,y}$:

It is determined by multiplying fuel consumption with $CO_2$ emission factor.

$$BE_{EC,y} = EC_{BL,y} \times EF_{elec}$$

$EC_{BL,y}$ : Electricity consumption in the baseline (MWh/y)

$EF_{elec}$ : $CO_2$ emission factor of the electricity (t-$CO_2$/MWh)

Determination of $BE_{FC,y}$:

It is determined as follows.

$$BE_{FC,y} = \sum_i \left( FC_{BL,i,y} \times NCV_{fuel,i} \times EF_{fuel,i} \right)$$

$FC_{BL,i,y}$ : Amount of the fuel i consumed in the baseline in year y (t/y)

$NCV_{fuel,i}$ : Net calorific value of the fuel i used in the baseline (TJ/t)

$EF_{fuel,i}$ : $CO_2$ emission factor of the fuel i used in the baseline (t-$CO_2$/TJ)

Determination of $BE_{ww,y}$ :

It is determined multiplying the volume of wastewater treated in the system, the COD removed through the treatment process, $CH_4$ producing capacity, and global warming potential.

$$BE_{ww,y} = Q_{ww,BL,y} \times COD_{ww,BL,y} \times MCF_{ww,BL,y} \times BO_{o,ww} \times UF_{BL} \times GWP_{CH4}$$

$Q_{ww,BL,y}$ : Volume of wastewater treated in wastewater treatment system in the baseline scenario in year y ($m^3$/y)

$COD_{ww,BL,y}$ : Chemical oxygen demand removed by the wastewater treatment system in the baseline scenario（t-COD/$m^3$）

$MCF_{ww,BL,y}$ : $CH_4$ correction factor for the wastewater treatment system in the baseline scenario

$BO_{o,ww}$ : $CH_4$ producing capacity of the wastewater (t-$CH_4$/t-COD)

$UF_{BL}$ : Model correction factor to account for model uncertainties

$GWP_{CH4}$ : Global Warming Potential of $CH_4$（=25 t-$CO_2$/t-$CH_4$）

Determination of $BE_{EN,y}$:

It is determined by the quantity of electricity and thermal energy generated after by the project and corresponding $CO_2$ emission factors.

$$BE_{EN,y} = BE_{elec,y} + BE_{ther,y} = EG_{PJ,y} \times EF_{elec} + HG_{PJ,y}/\eta_{BL} \times EF_{fuel,i}$$

$BE_{elec}$ : Baseline emissions to generate the same amount of electricity generated by project activity in year y (t-$CO_2$/y)

$BE_{heat,y}$ : Baseline emissions to generated the same amount of thermal energy produced by the project activity (t-$CO_2$/y)

$EG_{PJ,y}$ : Amount of electricity generated by the project in year y (MWh/y)

$EF_{elec}$ : $CO_2$emission factor of the electricity (t-$CO_2$/MWh)

$HG_{PJ,y}$ : Amount of thermal energy generated by the project in year y (TJ/y)

$\eta_{BL}$ : Energy efficiency of the boiler/air heater used in the absence of the project activity to generate the thermal energy.

It will be “1” as a conservative value.

$EF_{fuel,i}$ : $CO_2$emission factor of the fuel i used in the absence of the project (t-$CO_2$/TJ)

(2) Calculation of Project Emission

The project emissions equals to emissions of methane leakages from the methane recovery system.

$PE_y = PE_{ww,y}$

$PE_y$ : GHG emission from the project in year y (t-$CO_2$e/y)

$PE_{ww,y}$ : Methane leakage from the methane recovery system (t-$CO_2$e/y)

Determination of $PE_{ww,y}$:

It is determined as follows.

$PE_{ww,y} = MG_{PJ,y} \times GWP_{CH4} \times EF_{CH4,def}$

$MG_{PJ,y}$ : Amount of methane recovered in year y (t-$CH_4$/y)

$GWP_{CH4}$ : Global Warming Potential of $CH_4$ (=25 t-$CO_2$/t-$CH_4$)

$EF_{CH4,def}$ : Methane leakage factor of the methane recovery system (t-$CH_4$ leaked/t-$CH_4$ produced)

Determination of $MG_{PJ,y}$:

It is determined as follows.

$MG_{PJ,y} = Q_{ww,PJ,y} \times COD_{ww,PJ,y} \times MCF_{ww,PJ,y} \times BO_{o,ww} \times UF_{PJ}$

$Q_{ww,PJ,y}$ : Volume of wastewater treated in the project in year y ($m^3$/y)

$COD_{ww,PJ,y}$ : Chemical oxygen demand removed by the sludge treatment system in the project (t-COD/$m^3$)

$MCF_{ww,PJ,y}$ : $CH_4$ correction factor for the wastewater treatment system in the project

$BO_{o,ww}$ : $CH_4$ producing capacity of the wastewater (t-$CH_4$/t-COD)

$UF_{PJ}$ : Model correction factor to account for model uncertainties

**4. Data and Parameters Estimated and Need Monitoring**

| Data | Description | Data Sources | | | |
|---|---|---|---|---|---|
| | | For baseline emission calculation | | For project emission calculation | |
| | | Ex-ante | Ex-post | Ex-ante | Ex-post |
| $EC_{BL,y}$ | Electricity consumption in the baseline (MWh/y) | A historical average based on the monitored/recorded values | A historical average based on the monitored/recorded values | N/A | N/A |
| $EF_{elec}$ | In the case of a grid $CO_2$ emission factor (t-$CO_2$/MWh) | 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. | | N/A | |
| | In the case of stand alone power generation or mini grid: $CO_2$ emission factor of diesel generator (t-$CO_2$/MWh) | A default value (Table 5, Appendix) If there is no default value applied or if there is another appropriate value, that value may be used. | | N/A | |

| | | | | | |
|---|---|---|---|---|---|
| $FC_{BL,i,y}$ | Amount of fuel i consumed in the baseline (t/year) | A historical average based on the monitored/recorded values | A historical average based on the monitored/recorded values | N/A | N/A |
| $NCV_{fuel,i}$ | Net calorific value of fuel i used in the baseline (TJ/t) | 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. | | N/A | |
| $EF_{fuel,i}$ | $CO_2$ emission factor of fuel i used in the baseline (t-$CO_2$/TJ) | An IPCC default value (Table 2, Appendix) If there is no default value applied or if there is another appropriate value, that value may be used. | | N/A | |
| $Q_{ww,BL,y}$ | Volume of wastewater treated in wastewater treatment system in the baseline scenario ($m^3$/y) | A monitored value | A monitored value | N/A | N/A |
| $Q_{ww,PJ,y}$ | Volume of wastewater treated in wastewater treatment system in the project ($m^3$/y) | N/A | N/A | A planned value | A monitored value |
| $COD_{ww,BL,y}$ | Chemical oxygen demand removed by the wastewater treatment system in the baseline scenario（t-COD/$m^3$） | A monitored value | A monitored value | N/A | N/A |
| $COD_{ww,PJ,y}$ | Chemical oxygen demand removed by the wastewater treatment system in the project（t-COD/$m^3$） | N/A | N/A | A planned value | A monitored value |
| $MCF_{ww,BL,y}$ | $CH_4$ correction factor for the wastewater treatment system in the baseline scenario | Default value of IPCC (Table 10, Appendix) | | N/A | N/A |
| $MCF_{ww,PJ,y}$ | $CH_4$ correction factor for the wastewater treatment system in the project | N/A | N/A | Default value of IPCC (Table 10, Appendix) | |
| $BO_{o,ww}$ | $CH_4$ producing capacity of the wastewater (t-$CH_4$/t-COD) | 0.25 (Default value: 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 5 Waste) | | | |
| $UF_{BL}$ | Model correction factor to account for model uncertainties for baseline | 0.94 (Default value: FCCC/SBSTA/2003/10/Add.2) | | N/A | N/A |
| $UF_{PJ}$ | Model correction factor to account for model uncertainties for project | N/A | N/A | 1.06 (Default value: FCCC/SBSTA/2003/10/Add.2) | |
| $EG_{PJ,y}$ | Amount of electricity generated by the project (MWh/y) | A planned value | A Monitored value | N/A | N/A |
| $HG_{PJ,y}$ | Amount of thermal energy generated by the project (TJ/y) | A planned value | A Monitored value | N/A | N/A |
| $EF_{CH4,def}$ | Methane leakage factor of methane recovery | N/A | | 0.1 (Default value: Methodological Tool | |

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|---|---|---|---|
| | system ($tCH_4$ leaked/$tCH_4$ produced) | | Project and leakage emissions from anaerobic digesters (Version 01.0.0)) |

**5. Others**

(1) Project Boundary

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

(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. Therefore, this methodology ignores the leakage provided that the technology is using equipment not transferred from another activity.

(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.H (Methane recovery in wastewater treatment, Version 16). However, this methodology simplified the methodology by using default values as more as possible. For example, emissions from sludge that is not covered in the methane recovery system and waster water after treated are ignored due conservatives and simplicity. Moreover, there is no limitation for the emission reduction in the methodology like the small-scale CDM methodologies did.

Also, it is a project that collects methane generated in wastewater treatment facilities and uses it for power generation and heat supply, and there seems to be no significant difference between $N_2O$ generated in the baseline and the project. Therefore, $N_2O$ is ignored.