**CDM-SSCWG41-A03**

# Draft Small-scale Methodology

# SSC-III.xx: Destruction of hazardous waste using plasma technology including energy recovery

Version 01.0

Sectoral scope(s): 13

# COVER NOTE

## 1. Procedural background

1. The proposed draft methodology is based on the submitted proposal for new methodology "NM088: Destruction of hazardous waste containing carbon using plasma technology and recovery of energy (thermal and/or electrical) using syngas generated". For more information on the proposal please refer to: <https://cdm.unfccc.int/methodologies/SSCmethodologies/pnm/byref/SSC-NM088>. The methodology is in the waste sector, which is a priority sector for the methodological work by the Executive Board (hereinafter referred to as the Board) of the clean development mechanism (CDM).

2. The submission "NM088: Destruction of hazardous waste containing carbon using plasma technology and recovery of energy (thermal and/or electrical) using syngas generated" was considered by the Small-Scale Working Group (SSC WG) at its 40$^{th}$ and 41$^{st}$ meeting in accordance with the "Submission and consideration of a proposed new small scale methodology" (EB 40, annex 2).

## 2. Purpose

3. The objective of this draft new methodology is to propose a new regulatory document to regulate new area.

## 3. Key issues and proposed solutions

4. To ensure environmental integrity, detailed procedure was introduced how to determine the baseline and how to ensure no leakage occurs.

## 4. Impacts

5. Small-scale projects using plasma technology for hazardous waste incineration could apply this new CDM methodology.

## 5. Proposed work and timelines

6. The methodology is recommended by the SSC WG to be considered by the Board at its seventy-fifth meeting. No further work is envisaged.

## 6. Budget and costs

7. No budget implication.

## 7. Recommendations to the Board

8. The SSC WG 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 project(s)** | Construction and operation of hazardous waste plasma incineration facility |
| **Type of GHG emissions mitigation action** | Electricity and/or heat generation using syngas generated in the plasma incineration facility |

# 2. Scope, applicability, and entry into force

## 2.1. Scope

2. The technology covers the use of plasma gasification technology for the destruction of Hazardous Waste (HW) containing carbon as an alternative to the use of conventional incinerators.

## 2.2. Applicability

3. The methodology is applicable to project activities that introduce a new hazardous waste plasma incineration facility, which meets the following applicability conditions:

   (a) The storage of the HW prior to destruction shall comply with local regulations, and shall ensure that there is no methane production during storage, prior to incineration in the project facility;

   (b) The syngas generated in the plasma reactor shall be fully utilised for generation of electricity, hot water and/or steam within the project boundary. Syngas flaring may occur during emergencies and maintenance;

   (c) Non-HW shall not be accepted for the treatment in the project facility;

   (d) Measures to avoid physical leakage of the syngas within the plasma gasification system shall be adopted, including fortified plasma chamber and operation below ambient pressure;

   (e) According to the facility's design and operating procedures, incineration residue with significant carbon content is recycled back into the project facility's plasma reactor. The carbon content of the final residue is monitored ($f_{c,residue,y}$);

   (f) Relevant laws/regulations applicable to the project region must require that all HW be incinerated at a destruction efficiency equal to or higher than 99 per cent;

   (g) There are no incinerators which are allowed, according to local legislation, to incinerate HW with net energy generation in the project region.

4. A project activity which does not replace an existing HW incinerator facility with comparable capacity shall be considered a Greenfield activity.

5. Greenfield projects and project activities involving capacity additions are only eligible if they comply with the requirements for Greenfield projects and capacity increase mentioned in "General guidelines for SSC CDM methodologies, and if the baseline scenario identified is conventional incineration without net excess useful heat generation.

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

7. Furthermore, the applicability criteria of the tools referred to apply.

### 2.3. Entry into force

8. The date of entry into force is the date of the publication of the EB 75 meeting report on 4 October 2013.

## 3. Normative references

9. Project participants shall apply the "General guidelines for SSC CDM methodologies" and the "Guidelines on the demonstration of additionality of small-scale project activities" (previously known as attachment A to appendix B) provided at: <http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html>. mutatis mutandis.

10. This methodology also refers to the latest approved versions of the following tools:

    (a) "Tool to calculate project or leakage $CO_2$ emissions from fossil fuel combustion";

    (b) "Tool to calculate baseline, project and/or leakage emissions from electricity consumption".

## 4. Definitions

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

12. For the purpose of this methodology, the following definitions apply:

    (a) **Gasification** - the process of thermal decomposition of organic compounds at high temperatures, typically more than 800˚C. Gasification converts organic compounds, of both biogenic and fossil origin, into combustible gas (e.g. syngas);

    (b) **Hazardous waste** (**HW**) - waste that can pose a substantial or potential hazard to public health or the environment when improperly managed, as defined by local legislation;

    (c) **Incineration** - the controlled combustion of organic compounds of both biogenic and fossil origin with or without heat capture and utilisation. Ideally, all the organic content is converted into $CO_2$ and $H_2O$;

    (d) **Plasma reactor** - or plasma arc reactor, is a device that use an electric arc to thermally decompose organic and inorganic materials at ultra-high temperatures, typically 1,000 to 1,500°C, into syngas and a vitrified slag residue;

(e) **Project region** - the area from which HW will be treated in the project facility or the area within 200km of the project facility, whichever is greater;

(f) **Syngas** - a gas mixture consisting primarily of carbon monoxide and hydrogen and small amounts of carbon dioxide. It is produced from gasification and may be used as a fuel for energy generation or as an intermediate for the production of other chemicals.

# 5. Baseline methodology

## 5.1. Project boundary

13. The project boundary include:

(a) The physical, geographical sites of the plasma reactor and its associated subsystems are situated, including the generation of energy using syngas and/or waste heat from the hot gas/quenching process;

(b) The location syngas generated is consumed;

(c) The relevant electricity grid;

(d) All HW incinerators the project region.

## 5.2. Baseline emissions

14. The baseline emissions ($BE_y$) in year *y* are:

(a) Fossil fuels used in the baseline incinerator or for generating other thermal energy required (such as for reducing the moisture of low calorific value wastes). ($BE_{FF,y}$);

(b) Electricity used in the baseline incinerator and auxiliaries ($BE_{elec,y}$);

(c) From the generation of electricity equivalent to the net electricity and heat generated by the project activity ($BE_{EG,y}$).

15. Thus the baseline emissions may be expressed as:

$$BE_y = \frac{BE_{FF,x} + BE_{EC,x}}{Q_{HW,x}} \times Q_{HW,y} \times 0.95 + BE_{EG,y} \qquad \text{Equation (1)}$$

Where:

| | | |
|---|---|---|
| $BE_y$ | = | Baseline emissions in year *y* (t $CO_2$) |
| $BE_{FF,x}$ | = | Historical emissions due to baseline fossil fuel consumption (t $CO_2$) |
| $BE_{EC,x}$ | = | Historical emissions due to baseline electricity consumption (t $CO_2$) |
| $Q_{HW,y}$ | = | Quantity of HW incinerated in year *y* (t) |
| $Q_{HW,x}$ | = | Historical quantity of HW incinerated (t) |

| | | |
|---|---|---|
| $0.95$ | = | Factor accounting to possible operation below optimum conditions in the baseline |
| $BE_{EG,y}$ | = | Baseline emissions due to project net energy generation (t $CO_2$) |

16. Emissions due to baseline fossil fuel consumption ($BE_{FF}$) shall be calculated for HW incinerated in the baseline using "Tool to calculate project or leakage $CO_2$ emissions from fossil fuel combustion" and be based on fuel consumption. It shall be calculated using historical data. If this information is not available, manufacturer specifications may be used, ensuring conservativeness by using the highest efficiency and the fuel with lowest emission factor.

17. Emissions due to baseline electricity consumption ($BE_{EC}$) shall be calculated as per current version of "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" and be based on electricity consumption. It shall be calculated using historical data. If this information is not available, manufacturer specifications may be used, ensuring conservativeness by using the most favourable operation conditions.

18. When calculating $BE_{EC,x}$, $BE_{FF,x}$ and $Q_{HW,x}$ the following data source shall be used:

    (a) For project activities in which a conventional HW incinerator with no heat recovery and with capacity comparable to the capacity of the project incineration facility is being replaced by the project, data from the replaced HW incinerator shall be used for determining baseline emissions;

    (b) For all other project activities, data from the most efficient HW incinerator in the project region (i.e. least GHG emissions per tonne HW incinerated) shall be used to determine baseline emissions.

19. Baseline emissions due to project net energy generation ($BE_{EG,y}$) (thermal and/or electrical) that is being replaced by Syngas and heat recovery shall be calculated as per "AMS-I.C: Thermal energy production with or without electricity" and/or "AMS-I.D: Grid connected renewable electricity generation", as applicable. The net electricity generation is derived from the annual gross generation minus the annual on-site consumption.

20. Whenever historical data is requested, noted by the subscript *x*, the most recently available three years available at the beginning of the project's validation process shall be taken, applying the same period for all historical parameters. If this information is not available or if the data are not from three consecutive years, project proponents may apply for deviation from this methodology.

## 5.3. Leakage

21. No leakage is expected.

## 5.4. Project emissions

22. Project emissions are due to fuel and additive consumption, as well as due to increased amount of HW incineration compared to the baseline:

$$PE_y = PE_{ADD,y} + PE_{C,y} + PE_{FF,y} \quad \text{Equation (2)}$$

Where:

$PE_y$ = Project emission in year *y* (t $CO_2$)

$PE_{ADD,y}$ = Project emissions due to additives consumption (t $CO_2$)

$PE_{C,y}$ = Project emission due to increased compliance in year *y* (t $CO_2$)

$PE_{FF,y}$ = Project emission due to auxiliary fuel consumption in year *y* (t $CO_2$)

23. Emissions due to supplementary fuel consumption ($PE_{FF,y}$) shall be calculated according to the "Tool to calculate project or leakage $CO_2$ emissions from fossil fuel combustion".

24. Emissions due to additives consumption ($PE_{ADD,y}$) shall be calculated by assuming all carbon content of the additives is converted to $CO_2$.

25. Project emissions might occur if additional carbon is incinerated compared to the baseline, due to increased amount of HW incinerated in the project region resulting from increased compliance with regulations requiring HW incineration. Project proponents may set the project compliance rate to 1 conservatively.

$$PE_C = Q_{C,HW,y} \times \left( MAX \left( \left( CR_y - CR_{BL} \right), 0 \right) \right) \times \frac{44}{12} \quad \text{Equation (3)}$$

Where:

$PE_C$ = Project emissions due to changed compliance (t $CO_2$)

$Q_{C,HW,y}$ = Quantity of carbon in HW incinerated in year *y* (t C)

$CR_y$ = Laws/regulations compliance rate in year *y*

$CR_{BL}$ = Laws/regulations compliance rate in the baseline

### 5.4.1. Emission reduction calculation

$$ER_y = BE_y - PE_y \quad \text{Equation (4)}$$

## 5.5. Project activity under a programme of activities

26. There are no additional points when considered under the programme of activities, as the individual project activities would be servicing an identified area.

# 6. Monitoring methodology

**Data / Parameter table 1.**

| **Data / Parameter:** | $\mathbf{Q_{HW,y}}$ |
|---|---|
| Data unit: | t |
| Description: | Quantity of HW incinerated in year *y* |
| Source of data: | Operation records based on weight-bridge, convey or scales or similar |

| | |
|---|---|
| Measurement procedures (if any): | - |
| Monitoring frequency: | Yearly |
| QA/QC procedures: | Cross check with delivery receipts and contractual agreements |
| Any comment: | All waste delivery receipts and contractual agreements shall be used to monitor that the waste incinerated is HW. Emission reductions may not be claimed for periods in which waste is incinerated which is not HW |

**Data / Parameter table 2.**

| **Data / Parameter:** | $\mathbf{BE_{EG,y}}$ |
|---|---|
| Data unit: | t $CO_2$ |
| Description: | Baseline emissions due to project net energy generation |
| Source of data: | Electricity meters, flow meters, enthalpy measurements |
| Measurement procedures (if any): | Apply procedures from AMS-I.C and/or AMS-I.D, as applicable |
| Monitoring frequency: | Continuously |
| QA/QC procedures: | Cross check with receipts for energy sold/exported and with the amount of syngas generated |
| Any comment: | The net electricity generation shall be derived from the gross generation minus the on-site consumption, calculated on an annual basis |

**Data / Parameter table 3.**

| **Data / Parameter:** | $\mathbf{PE_{ADD,y}}$ |
|---|---|
| Data unit: | t $CO_2$ |
| Description: | Project emissions due to additives consumption |
| Source of data: | Operation records |
| Measurement procedures (if any): | The carbon content of the additives shall be determined by an independent laboratory or by the supplier, and multiplied by the mass of the additives. It is assumed all carbon is converted to $CO_2$ |
| Monitoring frequency: | Yearly |
| QA/QC procedures: | Cross check with receipts and inventory |
| Any comment: | - |

**Data / Parameter table 4.**

| **Data / Parameter:** | $\mathbf{PE_{FF,y}}$ |
|---|---|
| Data unit: | t $CO_2$ |
| Description: | Project emission due to auxiliary fuel consumption in year *y* |
| Source of data: | Operation records |
| Measurement procedures (if any): | Apply the "Tool to calculate project or leakage $CO_2$ emissions from fossil fuel combustion" |

| | |
|---|---|
| Monitoring frequency: | Yearly |
| QA/QC procedures: | Cross check with receipts and inventory |
| Any comment: | - |

**Data / Parameter table 5.**

| **Data / Parameter:** | $\mathbf{Q_{C,HW,y}}$ |
|---|---|
| Data unit: | t C |
| Description: | Quantity of carbon in HW incinerated in year *y* |
| Source of data: | Either stack gas measurements or regular sorting of waste samples |
| Measurement procedures (if any): | - |
| Monitoring frequency: | At least every three months |
| QA/QC procedures: | - |
| Any comment: | - |

**Data / Parameter table 6.**

| **Data / Parameter:** | $\mathbf{CR_y}$ |
|---|---|
| Data unit: | fraction |
| Description: | Laws/regulations compliance rate in year *y* |
| Source of data: | Official information from relevant association, authorities or directly from the incineration facilities in the country |
| Measurement procedures (if any): | The parameter shall be weighted by the amount of HW incinerated in each incinerator, or if the information is not available, by the incinerators' capacities |
| Monitoring frequency: | Annually |
| QA/QC procedures: | - |
| Any comment: | - |

**Data / Parameter table 7.**

| **Data / Parameter:** | $\mathbf{f_{C,residue,y}}$ |
|---|---|
| Data unit: | fraction |
| Description: | Mass fraction of carbon in incineration residues in year *y* |
| Source of data: | Laboratory analysis |
| Measurement procedures (if any): | Mass fraction of the dry vitrified slag residue shall be conducted by an accredited laboratory |
| Monitoring frequency: | At least every three months |
| QA/QC procedures: | - |
| Any comment: | Emission reductions may not be claimed for periods in which the parameter value exceeds one per cent |

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## Document information

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