CLEAN DEVELOPMENT MECHANISM

AM0114

Large-scale Methodology

Shift from electrolytic to catalytic process for recycling of chlorine from hydrogen chloride gas in isocyanate plants

Version 01.0

Sectoral scope(s): 04 and 05

United Nations
Framework Convention on
Climate Change

TABLE OF CONTENTS **Page**

1. INTRODUCTION 4

2. SCOPE, APPLICABILITY, AND ENTRY INTO FORCE 4

2.1. Scope 4

2.2. Applicability 4

2.3. Entry into force 5

3. NORMATIVE REFERENCES 5

4. DEFINITIONS 5

5. BASELINE METHODOLOGY 6

5.1. Project boundary 6

5.2. Selection of the baseline scenario and demonstration of additionality 8

5.3. Baseline emissions 8

5.3.1. Determination of specific electricity consumption of recycled Cl_2 from electrolysis process (*SEC*) 9

5.4. Project emissions 10

5.4.1. Project emissions from combustion of fossil fuel for steam or any other use ($PE_{FC,y}$) 10

5.4.2. Project emissions from electricity use ($PE_{EC,y}$) 11

5.4.3. Project emission from additional Cl_2 generation due to difference in conversion rates between project and baseline ($PE_{CR,y}$) 11

5.5. Leakage 12

5.5.1. Option 1: Estimation of leakage based on the baseline emissions 13

5.5.2. Option 2: Calculation of leakage 13

5.6. Emission reductions 15

5.7. Changes required for methodology implementation in 2^{nd} and 3^{rd} crediting periods 16

5.8. Data and parameters not monitored 16

6. MONITORING METHODOLOGY 19

6.1. Archival of monitoring information 19

6.2. Monitoring and QA/QC information 19
6.3. Monitoring provisions in the CDM tools 20
6.4. Data and parameters monitored 20

1. Introduction

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

Table 1. Methodology key elements

Typical project(s)	This methodology applies to project activities where electrolytic process is replaced by catalytic process for the recycling of chlorine from hydrogen chloride gas in isocyanate plant. The project activity to be implemented as a retrofit in existing isocyanate plants, which produce hydrogen chloride gas in the production process
Type of GHG emissions mitigation action	• Energy efficiency action in chemical process industry. Reduction in electricity consumption and displacement of production of electricity by fossil fuel, where applicable

2. Scope, applicability, and entry into force

2.1. Scope

2. This methodology applies to project activities that replace electrolytic process of recycling chlorine (Cl_2) from hydrogen chloride gas (HCl) in existing isocyanate plants with a new catalytic process.

2.2. Applicability

3. This methodology is not applicable to project activities taking place in Greenfield isocyanate plants.

4. The isocyanate plant, the Cl_2 plant and the electrolytic recycling facilities have operational history of at least three years prior to the starting date of the CDM project activity.

5. The methodology is applicable if emission reductions are claimed up to the design capacity of the isocyanate plant before the implementation of the project activity. If the capacity of isocyanate plant is expanded above the initial design capacity during the crediting period, project participant shall revise the sections on “Establishment and description of baseline scenario” and “Demonstration of additionality” in CDM-PDD and seek approval by the Executive Board (hereinafter referred to as the Board) of the clean development mechanism (CDM) before requesting further issuances.

6. The methodology is applicable for the project activities where the production ratio of HCl to isocyanate in the crediting period shall not change by more than +/-10 per cent compared to the maximum ratio of the three years of the baseline. If the ratio changes by more than +/-10 per cent in any crediting year project participant may choose not to claim the emission reductions for that monitoring period; if project participants want to claim the emission reduction they shall revise the sections on “Establishment and description of baseline scenario” and “Demonstration of additionality” in PDD and seek approval by the Board before requesting further issuances.

7. Emission reductions can be claimed until the remaining life time of the baseline electrolytic process plant, determined according to the latest approved version of the "Tool to determine the remaining lifetime of equipment".

8. Steam for the catalytic process of the project activity, shall be provided by a boiler included in the project boundary.

9. In addition, the applicability conditions included in the tools referred to below apply.

10. Finally, the methodology is only applicable if the procedure for the selection of the most plausible baseline scenario, as outlined below, results in a baseline scenario that is the continuation of current practices, i.e. continued use of electrolytic process to recycle Cl2 from the HCl gas in isocyanate plant.

2.3. Entry into force

11. The date of entry into force is the date of the publication of the EB 79 meeting report on 1 June 2014.

3. Normative references

12. This baseline and monitoring methodology is based on proposed new methodology "NM0366: Cl_2 recycling by catalytic oxidation of HCl instead of electrolysis of HCl aqueous solution".

13. This methodology also refers to the latest approved versions of the following methodological 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";

    (c) "Combined tool to identify the baseline scenario and demonstrate additionality";

    (d) "Tool to determine the remaining lifetime of equipment";

    (e) "Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period".

14. For more information regarding the proposed new methodology and the tools as well as their consideration by the Executive Board (hereinafter referred to as the Board) of the clean development mechanism (CDM) please refer to <http://cdm.unfccc.int/methodologies/PAmethodologies/index.html>.

4. Definitions

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

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

    (a) **Isocyanate plant** - the plant producing organic compounds containing the functional group R–N=C=O. This methodology is restricted to production of isocyanate with two isocyanate groups, known as a di-isocyanate (for example

TDI: Toluene di-isocyanate; MDI: Methylenediphenyl di-isocyanate; HDI: Hexamethylene di-isocyanate);

(b) **Electrolysis process** - chemical decomposition produced by passing an electric current through a liquid or solution containing ions. In this methodology electrolysis is used to produce Cl_2 from HCl;

(c) **Catalytic process** - the process where a catalyst (for example titanium dioxide) is used in the recycling process of the Cl_2 from HCl gas;

(d) **Cl_2 plant** - the plant producing Cl_2 by electrolysis of sodium chloride solution.

5. Baseline methodology

5.1. Project boundary

17. The spatial extent of the project boundary encompasses:

(a) The isocyanate plant with Cl_2 recycled from HCl specifically including:

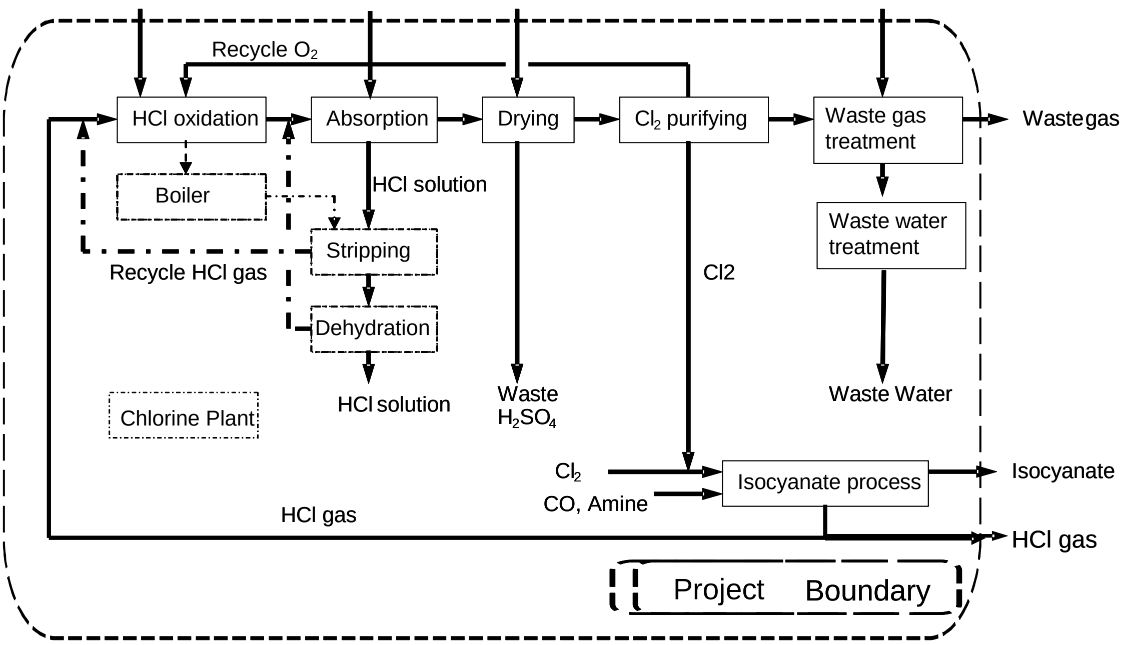
(i) Cl_2 plant;

(ii) On-site electricity and/or heat generation and use for recycling Cl_2 from HCl and onsite treatment of input raw material and waste streams;

(b) All power plants connected physically to the electricity system (grid) that the project plant is connected to.

18. The project boundary diagram is shown in the diagram below:

Figure 1. Project boundary



19. The GHGs included in or excluded from the project boundary are listed in Table 2.

Table 2. Emission sources included in or excluded from the project boundary

Source		Gas	Included	Justification/Explanation
Baseline	Electricity consumption from electrolysis process to recycle Cl_2 from HCl	CO_2	Yes	Major emission source
		CH_4	No	Minor source
		N_2O	No	Minor source
Project activity	Electricity consumption from catalytic process and Cl_2 production from sodium chloride electrolysis	CO_2	Yes	Major emission source
		CH_4	No	Minor source
		N_2O	No	Minor source
	Fuel consumption from catalytic process and Cl_2 production from sodium chloride electrolysis	CO_2	Yes	Major emission source
		CH_4	No	Minor source
		N_2O	No	Minor source

5.2. Selection of the baseline scenario and demonstration of additionality

20. Identify the baseline scenario and demonstrate additionality using the latest version of "Combined tool to identify the baseline scenario and demonstrate additionality" and following the requirements below:

(a) In applying step 1(a); The alternative scenarios for the project activity shall include, but not be limited to:

(i) The continuation of the current situation, i.e. operation of electrolysis process without any new investment or additional expenses to maintain the current situation (status–quo);

(ii) Rehabilitation of the existing electrolysis process for better recovery efficiency improvement in the current situation, but requiring additional investment or expenses to maintain the current situation/production;

(iii) Rehabilitation of the existing electrolysis process for better recovery efficiency improvement in the current situation by using technology other than used in the plant, but requiring additional investment or expenses to maintain the current situation/production;

(iv) No recycling of Cl_2 and selling HCl in market after appropriate purification and liquefaction;

(v) Implementation of project activity without CDM;

(b) In applying Step 3, the project participants shall consider at least the following in the analysis:

(i) Investments related to the new catalytic process and/or retrofit to existing process;

(ii) Savings related to the decrease in fuel and electricity consumption;

(iii) Saving/expenses related with less raw material consumption and/or reduction in waste generation and treatment, if any;

(iv) Revenue due to increased export of hydrogen, sodium hydroxide, if applicable;

(v) Expenses related to the operation and maintenance;

(vi) Revenues related to the sale of Cl_2 and other products produced in the project facility, including the increased productivity from the baseline, if applicable;

(vii) Revenues through selling of steam generated in the process, if applicable;

(viii) Salvage value of the existing equipment.

5.3. Baseline emissions

21. The Cl_2 and HCl used in the equations below are calculated on 100 per cent purity basis, i.e. quantity of Cl_2 or HCl multiplied by the respective purity.

22. The baseline emissions will occur from the electricity consumption in the electrolysis process for recycling Cl_2 from HCl.

$$BE_y = SEC \times CP_y \times \min(1, \frac{ISO_{design}}{ISO_y}) x \frac{CR_{BL}}{CR_y} \times EF_{EL,k,y}$$ Equation (1)

Where:

BE_y	=	Baseline emissions in year *y* (t CO_2e)
SEC	=	Specific electricity consumption per t of recycled Cl_2 from electrolysis process (MWh/t-Cl_2)
CP_y	=	Production of recycled Cl_2 in year *y* (t-Cl_2)
$EF_{EL,k,y}$	=	Emission factor for electricity generation for sources *k* in year *y* (t CO_2/MWh), calculated according to the ''Tool to calculate baseline, project and/or leakage emissions from electricity consumption''
CR_{BL}	=	Conversion rate from HCl to Cl_2 in baseline (dimensionless; t-Cl_2/t-HCl)
CR_y	=	Conversion rate from HCl to Cl_2 in year *y* (dimensionless; t-Cl_2/t-HCl)
ISO_{design}	=	Design capacity of isocyanate plant on 100 per cent purity basis (t-isocyanate)
ISO_y	=	Amount of isocyanate produced in year *y* on 100 per cent purity basis (t-isocyanate)

5.3.1. Determination of specific electricity consumption of recycled Cl_2 from electrolysis process (*SEC*)

23. The specific electricity consumption in the baseline electrolysis process (*SEC*) is determined as follows:

$$SEC = \min\left[\left(\frac{EC_{-1}}{CP_{-1}}\right), \left(\frac{EC_{-2}}{CP_{-2}}\right), \left(\frac{EC_{-3}}{CP_{-3}}\right)\right]$$ Equation (2)

Where:

EC_{-1}, EC_{-2}, EC_{-3}	=	Amount of electricity consumed for the production of recycled Cl_2 in baseline in the years prior to start date of the project activity (MWh) (-1 is one year prior, -2 is two year prior and -3 is three year prior)[1]
CP_{-1}, CP_{-2}, CP_{-3}	=	Amount of recycled Cl_2 produced in baseline in the years prior to start date of the project activity (t-Cl_2) (-1 is one year prior, -2 is two year prior and -3 is three year prior)

[1] Verifying designated operational entity (DOE) to check the latest three years prior to implementation of the project activity.

24. In absence of the data for the calculation of SEC the default value[2] of 1 MWh/t-Cl_2 can be used.

5.4. Project emissions

25. The Cl_2 and HCl used in the equations below are calculated on 100 per cent purity basis, i.e. quantity of Cl_2 or HCl multiplied by the respective purity.

26. Project emissions in the project activity occur from following sources:

(a) Project emission from combustion of fossil fuel for steam or any other use (including cogeneration) for the project catalytic process;

(b) Project emission from electricity consumption by the project catalytic process;

(c) Project emission from additional Cl_2 production through sodium chloride electrolysis process by the Cl_2 plant, due to difference in conversion rates between the project catalytic process and the baseline electrolysis process.

$$PE_y = PE_{FC,y} + PE_{EC,y} + PE_{CR,y}$$ Equation (3)

Where:

PE_y	=	Project emissions in year *y* (t CO_2e)
$PE_{FC,y}$	=	Project emissions from combustion of fossil fuel for steam or any other use in year *y* (t CO_2e)
$PE_{EC,y}$	=	Project emissions from electricity consumption in year *y* (t CO_2e)
$PE_{CR,y}$	=	Project emissions from additional Cl_2 generation due to difference in conversion rates between the project and baseline in year *y* (t CO_2e)

5.4.1. Project emissions from combustion of fossil fuel for steam or any other use ($PE_{FC,y}$)

27. The project emissions from fossil fuel combustion ($PE_{FC,y}$) by the project catalytic process shall be calculated using the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion". When applying the tool:

(a) Processes *j* in the tool corresponds to the sources of fossil fuel consumption in the project activity, other than for electricity generation. Consumption sources shall include, as relevant, fossil fuels used for steam generation and/or auxiliary fossil fuels use. Fossil fuels used as part of the on-site processing or management of feedstock and by-products shall also be included.

[2] Lowest value based on 'HCl electrolysis using ODC (oxygen depolarized cathode) technology' 207th ECS meeting.

5.4.2. Project emissions from electricity use (*$PE_{EC,y}$*)

28. The project emissions from electricity consumption ($PE_{EC,y}$) by the project catalytic process shall be calculated using the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”.

5.4.3. Project emission from additional Cl_2 generation due to difference in conversion rates between project and baseline (*$PE_{CR,y}$*)

29. This emission should be calculated for the sodium chloride electrolysis process of the Cl_2 plant only when the conversion rate in the catalytic process of the project activity is lower than the baseline electrolysis process.

$$PE_{CR,y} = \left[\frac{(CR_{BL} - CR_y)}{CR_y}\right] x\ (CP_y\ x\ SE_{Cl2})$$ Equation (4)

Where:

CR_{BL}	=	Conversion rate from HCl to Cl_2 in baseline (dimensionless; t-Cl_2/t-HCl)
CR_y	=	Conversion rate from HCl to Cl_2 in year *y* (dimensionless; t-Cl_2/t-HCl)
SE_{Cl2}	=	Specific emissions from the Cl_2 production by sodium chloride electrolytic process (t CO_2/t-Cl_2)

5.4.3.1. Calculation of conversion rate

$$CR_{BL} = \max\left[\left(\frac{CP_{-1}}{HCl_{-1}}\right), \left(\frac{CP_{-2}}{HCl_{-2}}\right), \left(\frac{CP_{-3}}{HCl_{-3}}\right)\right]$$ Equation (5)

Where:

HCl_{-1}, HCl_{-2}, HCl_{-3}	=	Amount of HCl used in the recycling process in baseline in the years prior to start date of the project activity (t-HCl) (-1 is one year prior, -2 is two year prior and -3 is three year prior)
CP_{-1}, CP_{-2}, CP_{-3}	=	Amount of recycled Cl_2 produced in baseline in the years prior to start date of the project activity (t-Cl_2) (-1 is one year prior, -2 is two year prior and -3 is three year prior)

30. In absence of the data to obtain CR_{BL}, a default value of 1 (100 per cent conversion) should be used.

31. The conversion rate shall be calculated in year *y* by dividing the recycled t - Cl_2 by t-HCl used in the project HCl recycling facility.

5.4.3.2. Calculation of specific emissions from Cl_2 production by sodium chloride electrolysis process (SE_{Cl2})

$$SE_{Cl2} = \max\left[\begin{array}{c}\left(\frac{PE_{EC,Cl2Nacl,-1} + PE_{FC,CI2Nacl,-1}}{Cl2Nacl_{-1}}\right),\left(\frac{PE_{EC,Cl2Nacl,-2} + PE_{FC,CI2Nacl,-2}}{Cl2Nacl_{-2}}\right),\\ \left(\frac{PE_{EC,Cl2Nacl,-3} + PE_{FC,CI2Nacl,-3}}{Cl2Nacl_{-3}}\right),\left(\frac{PE_{EC,Cl2Nacl,y} + PE_{FC,CI2Nacl,y}}{Cl2Nacl_{y}}\right)\end{array}\right] \quad \text{Equation (6)}$$

Where:

$PE_{EC,Cl2Nacl,-1}$, $PE_{EC,Cl2Nacl,-2}$, $PE_{EC,Cl2Nacl,-3}$,	=	Emissions from the electricity consumed for Cl_2 production from sodium chloride process in baseline in the years prior to start date of the project activity (t CO_2) (-1 is one year prior, -2 is two year prior and -3 is three year prior)
$PE_{EC,Cl2Nacl,y}$	=	Emissions from the electricity consumed for Cl_2 production from sodium chloride process in year *y* (t CO_2)
$PE_{FC,Cl2Nacl,-1}$, $PE_{FC,Cl2Nacl,-2}$, $PE_{CC,Cl2Nacl,-3}$,	=	Emissions from the fuel consumed for Cl_2 production from sodium chloride process in baseline in the years prior to start date of the project activity (t CO_2) (-1 is one year prior, -2 is two year prior and -3 is three year prior)
$PE_{FC,Cl2Nacl,y}$	=	Emissions from the fuel consumed for Cl_2 production from sodium chloride process in year *y* (t CO_2)
$Cl2Nacl_{-1}$, $Cl2Nacl_{-2}$, $Cl2Nacl_{-3}$	=	Amount of Cl_2 produced by sodium chloride electrolysis process in baseline in the years prior to start date of the project activity (t-Cl_2) (-1 is one year prior, -2 is two year prior and -3 is three year prior)
$Cl2Nacl_y$	=	Amount of Cl_2 produced by sodium chloride electrolysis process in year *y* (t-Cl_2)

32. The emissions from electricity consumption for the Cl2 production by sodium chloride electrolysis process shall be calculated using the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”. The values obtained for $PE_{EC,y}$ in the tool will be used for $PE_{EC,Cl2Nacl}$ for respective years.

33. The emissions from fossil fuel combustion for Cl_2 production by sodium chloride electrolysis process shall be calculated using the “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion”. The values obtained for $PE_{FC,j,y}$ in the tool will be used for $PE_{FC,Cl2Nacl}$ for respective years.

5.5. Leakage

34. Leakage in the project activity can occur from following sources:

(a) Leakage due to consumption of more feeding material in project activity than baseline;

(b) Leakage due to fuel and electricity consumption for the treatment of the higher waste generation in project activity than in baseline.

35. Leakage can be calculated based on the following two options:

5.5.1. Option 1: Estimation of leakage based on the baseline emissions

$$LE_y = 0.05\ x\ BE_y \quad \text{Equation (7)}$$

Where:

LE_y	=	Leakage in year *y* (t CO_2e)
0.05	=	Based on the available evidences leakage is less than five per cent of the baseline emissions. Five per cent is used as a conservative default value for the estimation

36. Project activities using option 1 shall not monitor the parameters required for leakage. The option for the leakage shall be clearly stated in the PDD and shall not be changed during the crediting period.

5.5.2. Option 2: Calculation of leakage

$$LE_y = LE_{Feed,y} + LE_{waste,y} \quad \text{Equation (8)}$$

Where:

LE_y	=	Leakage in year *y* (t CO_2e)
$LE_{Feed,y}$	=	Leakage due to consumption of more feeding material in project activity than baseline in year *y* (t CO_2)
$LE_{waste,y}$	=	Leakage due to fuel and electricity consumption for the treatment of the higher waste generation in project activity than in baseline (t CO_2)

5.5.2.1. Leakage due to consumption of more feeding material in project activity than in baseline (***$LE_{FEED,y}$***)

37. This emission should be calculated only when the specific feeding material required in the project activity is more than the baseline.

$$LE_{FEED,y} = \sum_f \left[\frac{FEED_{f,y}}{CP_y} - \min\left(\frac{FEED_{f,-1}}{CP_{-1}}, \frac{FEED_{f,-2}}{CP_{-2}}, \frac{FEED_{f,-3}}{CP_{-3}}\right) \right] x (CP_y\ x\ SE_f) \quad \text{Equation (9)}$$

Where:

$FEED_{f,y}$	=	Consumption of feed type f (sulphuric acid, sodium hydroxide, oxygen and water) for recycled Cl_2 in year *y* (t or m^3)
$FEED_{f,-1}$, $FEED_{f,-2}$, $FEED_{f,-3}$	=	Amount of feed type *f* (sulphuric acid, sodium hydroxide, oxygen and water) consumed for production of recycled Cl_2 in baseline in the years prior to start date of the project activity (t or m^3) (-1 is one year prior, -2 is two year prior and -3 is three year prior)
SE_f	=	Specific emissions from the feed type *f* (t CO_2/t or m^3)

38. Sulphuric acid is produced in exothermic process and it should be considered in leakage if it is used in less quantity in the project activity.

5.5.2.1.1. Calculation of specific emissions from feeding materials (*SE_f*)

$$SE_f = \frac{E_{EC,f,y} + E_{FC,f,y}}{FEED_{f,y}}$$ Equation (10)

Where:

$E_{EC,f,y}$	=	Emissions from the electricity consumed for feeding material in year *y* (t CO_2)
$E_{FC,f,y}$	=	Emissions from the amount of fuel consumed for feeding material in year *y* (t CO_2)

39. In case of feeding material prepared inside the project boundary these emissions to be included in the project emissions. If the feeding materials are produced outside the project boundary then the emissions shall be considered from vendor’s plants or information provided by vendor(s).

40. The emissions from electricity consumption shall be calculated using the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”.

41. The emissions from fossil fuel combustion shall be calculated using the “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion”.

5.5.2.2. Leakage due to fuel and electricity consumption for the treatment of the higher waste generation in project activity than in baseline (*$LE_{waste,y}$*)

42. If the emissions are occurring inside the project boundary these shall be included in the project emissions. This emission should be calculated only when the specific waste generation is more in the project activity is lower than the baseline.

$$LE_{waste,y} = \sum_w \left[\frac{Waste_{w,y}}{CP_y} - \min\left(\frac{Waste_{w,-1}}{CP_{-1}}, \frac{Waste_{w,-2}}{CP_{-2}}, \frac{Waste_{w,-3}}{CP_{-3}}\right) \right] x (CP_y \; x \; SE_W)$$ Equation (11)

Where:

$Waste_{w,y}$	=	Generation of waste type *w* (spent sulphuric acid and waste water) by recycling process in year *y* (t or m^3)
$Waste_{w,-1}$, $Waste_{w,-2}$, $Waste_{w,-3}$,	=	Amount of waste type *w* (spent sulphuric acid and waste water) generated by production of recycled Cl_2 in baseline in the years prior to start date of the project activity (t or m^3) (-1 is one year prior, -2 is two year prior and -3 is three year prior)
CP_y	=	Production of recycled Cl_2 in year *y* (t-Cl_2)
CP_{-1}, CP_{-2}, CP_{-3}	=	Amount of recycled Cl_2 produced in baseline in the years prior to start date of the project activity (t-Cl_2) (-1 is one year prior, -2 is two year prior and -3 is three year prior)
SE_w	=	Specific emissions from electricity and fuel consumed for waste treatment for waste type *w* (t CO_2/t or m^3)

5.5.2.2.1. Calculation of specific emissions from electricity and fuel consumption for waste treatment for waste type *w* (SE_w)

$$SE_w = \frac{E_{EC,w,y} + E_{FC,w,y}}{Waste_{w,y}} \quad \text{Equation (12)}$$

Where:

$E_{EC,wy}$	=	Emissions from the electricity consumed for the treatment of waste type *w* in year *y* (t CO_2)
$E_{FC,wy}$	=	Emissions from the amount of fuel consumed for the treatment of waste type *w* in year *y* (t CO_2)

43. The emissions from electricity consumption process shall be calculated using the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”.

44. The emissions from fossil fuel combustion shall be calculated using the “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion”.

5.6. Emission reductions

45. Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y \quad \text{Equation (13)}$$

Where:

ER_y	=	Emission reductions in year *y* (t CO_2e)
BE_y	=	Baseline emission in year *y* (t CO_2e)
PE_y	=	Project emissions in year *y* (t CO_2e)
LE_y	=	Leakage in year *y* (t CO_2e)

5.7. Changes required for methodology implementation in 2nd and 3rd crediting periods

46. Refer to the latest approved version of the tool "Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period".

5.8. Data and parameters not monitored

47. In addition to the parameters listed here, the provisions on data and parameters not monitored in the tools referred to in this methodology apply.

Data / Parameter table 1.

Data / Parameter:	**HCl_{-1}, HCl_{-2}, HCl_{-3}**
Data unit:	t-HCl
Description:	Amount of HCl used in the recycling process in baseline in the years prior to start date of the project activity (-1 is one year prior, -2 is two year prior and -3 is three year prior)
Source of data:	Historical data from on-site measurements in plant records
Measurement procedures (if any):	Measured with an Integrating density and flow meter
Monitoring frequency:	Constantly measured and recorded monthly
QA/QC procedures:	According to vender specifications and/or international standards.
Any comment:	For fulfilment of applicability condition; maximum ratio of HCl to isocyanate will be calculate by these values in baseline. This ratio shall remain fixed during the crediting period

Data / Parameter table 2.

Data / Parameter:	**ISO_{-1}, ISO_{-2}, ISO_{-3}**
Data unit:	t-isocyanate
Description:	Amount of isocyanate produce in the isocyanate plant in baseline in the years prior to start date of the project activity (-1 is one year prior, -2 is two year prior and -3 is three year prior)
Source of data:	Historical data from on-site measurements in plant records
Measurement procedures (if any):	Measured with an Integrating density and flow meter
Monitoring frequency:	Constantly measured and recorded monthly
QA/QC procedures:	According to vender specifications and/or international standards
Any comment:	For fulfilment of applicability condition; maximum ratio of HCl to isocyanate will be calculate by these values in baseline. This value shall remain fixed during the crediting period

Data / Parameter table 3.

Data / Parameter:	**ISO_{design}**
Data unit:	t-isocyanate
Description:	Design capacity of isocyanate plant on 100 per cent purity basis

Source of data:	Data from technology supplier/commissioning report
Measurement procedures (if any):	-
Monitoring frequency:	-
QA/QC procedures:	-
Any comment:	For fulfilment of applicability condition and baseline emission

Data / Parameter table 4.

Data / Parameter:	**Quality (purity) of HCl in baseline**
Data unit:	wt. %
Description:	Annual average purity of HCl
Source of data:	Result of chemical analysis/ gas chromatograph/online flow meter
Measurement procedures (if any):	Measured with chemical analysis by potassium iodide adsorption method and Gas chromatograph is used for the analysis of carbon dioxide and oxygen in Cl_2
Monitoring frequency:	Measured periodically (annually) and recorded
QA/QC procedures:	According to vender specifications and/or international standards
Any comment:	The quality will be used to calculate the 100 per cent pure values of HCl production

Data / Parameter table 5.

Data / Parameter:	**Quality (purity) of Isocyanate in baseline**
Data unit:	wt. %
Description:	Annual average purity of icocyanate
Source of data:	Result of chemical analysis/ gas chromatograph/online flow meter
Measurement procedures (if any):	As per international standards
Monitoring frequency:	Measured periodically (annually) and recorded
QA/QC procedures:	According to vender specifications and/or international standards
Any comment:	The quality will be used to calculate the 100 per cent pure values of isocyanate

Data / Parameter table 6.

Data / Parameter:	**EC_{-1}, EC_{-2}, EC_{-3}**
Data unit:	MWh
Description:	Amount of electricity consumed for the production of recycled Cl_2 in baseline in the years prior to start date of the project activity (-1 is one year prior, -2 is two year prior and -3 is three year prior)
Source of data:	Historical data from on-site measurements in plant records
Measurement procedures (if any):	Measured with a continuous energy meter(s)

Monitoring frequency:	Constantly measured and recorded monthly
QA/QC procedures:	According to vender specifications and/or international standards
Any comment:	-

Data / Parameter table 7.

Data / Parameter:	**CP_{-1}, CP_{-2}, CP_{-3}**
Data unit:	t-Cl_2
Description:	Amount of recycled Cl_2 produced in the baseline in the years prior to start date of the project activity (-1 is one year prior, -2 is two year prior and -3 is three year prior)
Source of data:	Historical data from on-site measurements in plant records
Measurement procedures (if any):	Measured with an Integrating density and flow meter
Monitoring frequency:	Constantly measured and recorded monthly
QA/QC procedures:	According to vender specifications and/or international standards
Any comment:	-

Data / Parameter table 8.

Data / Parameter:	**Quality (purity) of Cl_2**
Data unit:	wt. %
Description:	Annual average purity of Cl_2 produced by recycling process and Cl_2 plant
Source of data:	Result of chemical analysis and gas chromatograph
Measurement procedures (if any):	Measured with chemical analysis by potassium iodide adsorption method and Gas chromatograph is used for the analysis of carbon dioxide and oxygen in Cl_2
Monitoring frequency:	Measured periodically (annually) and recorded
QA/QC procedures:	According to vender specifications and/or international standards
Any comment:	Will be used to calculate the production on 100 per cent purity basis

Data / Parameter table 9.

Data / Parameter:	**$Cl2Nacl_{-1}$, $Cl2Nacl_{-2}$, $Cl2Nacl_{-3}$**
Data unit:	t-Cl_2
Description:	Amount of Cl_2 produced by sodium chloride electrolysis process in the baseline in the years prior to start date of the project activity (-1 is one year prior, -2 is two year prior and -3 is three year prior)
Source of data:	Historical data from on-site measurements in plant records
Measurement procedures (if any):	Measured with an Integrating density and flow meter
Monitoring frequency:	Constantly measured and recorded monthly
QA/QC procedures:	According to vender specifications and/or international standards
Any comment:	-

Data / Parameter table 10.

Data / Parameter:	**$FEED_{f,-1}$, $FEED_{f,-2}$, $FEED_{f,-3}$**
Data unit:	t or m^3
Description:	Amount of feed type *f* (sulphuric acid, sodium hydroxide, oxygen and water) consumed for production of recycled Cl_2 in the baseline in the years prior to start date of the project activity (-1 is one year prior, -2 is two year prior and -3 is three year prior)
Source of data:	Historical data from on-site measurements in plant records
Measurement procedures (if any):	Flow meters/weighing feeders or any other meter based on feeding material
Monitoring frequency:	Constantly measured and recorded monthly
QA/QC procedures:	According to vender specifications
Any comment:	Will be used only if option 2 of leakage is opted

Data / Parameter table 11.

Data / Parameter:	**$Waste_{w,-1}$, $Waste_{w,-2}$, $Waste_{w,-3}$**
Data unit:	t or m^3
Description:	Amount of waste type *w* (spent sulphuric acid and waste water) generated by production of recycled Cl_2 in the baseline in the years prior to start date of the project activity (-1 is one year prior, -2 is two year prior and -3 is three year prior)
Source of data:	Historical data from on-site measurements in plant records
Measurement procedures (if any):	Flow meters/weighing feeders or any other meter based on waste material
Monitoring frequency:	Constantly measured and recorded monthly
QA/QC procedures:	According to vender specifications
Any comment:	Will be used only if option 2 of leakage is opted

6. Monitoring methodology

6.1. Archival of monitoring information

48. All data collected as part of monitoring should be archived electronically and be kept at least for two years after the end of the last crediting period. One hundred per cent of the data should be monitored if not indicated otherwise in the tables below.

6.2. Monitoring and QA/QC information

49. In the CDM-PDD, project proponents have to provide information concerning the system in place to ensure the quality of the data. It should include the actions to be undertaken to constitute and to maintain the needed measurement equipment to satisfy the requirements concerning the quality of the data:

(a) The inventory, identification and the description of the measurement equipment used;

(b) The description of the QA/QC procedures for monitoring;

(c) The organizational structure and the responsibilities;

(d) The calibration and verification of the measurement equipment;

(e) The connecting of standard equipment to data logging devices;

(f) The process of recording data entries.

6.3. Monitoring provisions in the CDM tools

50. The monitoring provisions in the tools referred to in this methodology apply.

6.4. Data and parameters monitored

Data / Parameter table 12.

Data / Parameter:	**Quality (purity) of Cl_2**
Data unit:	wt. %
Description:	Annual average purity of Cl_2 produced by recycling plant and Cl_2 plant
Source of data:	Result of chemical analysis and gas chromatograph
Measurement procedures (if any):	Measured with chemical analysis by potassium iodide adsorption method and Gas chromatograph is used for the analysis of inert gas, carbon dioxide and oxygen in Cl_2 and/or according to international standards and/or according to national standards
Monitoring frequency:	Measured periodically (annually) and recorded
QA/QC procedures:	According to vender specifications and/or international standards and/or national standards
Any comment:	Shall be used for calculation of production of Cl_2 on 100 per cent purity

Data / Parameter table 13.

Data / Parameter:	**Quality (purity) of HCl**
Data unit:	wt. %
Description:	Annual average purity of HCl produce in the plant
Source of data:	Result of chemical analysis and gas chromatograph or online meter
Measurement procedures (if any):	As per international standards and/or national standards
Monitoring frequency:	Measured periodically (annually) and recorded
QA/QC procedures:	According to vender specifications and/or international standards and/or national standards
Any comment:	Shall be used for the calculation of HCl production on 100 per cent purity

Data / Parameter table 14.

Data / Parameter:	**Quality (purity) of isocyanate**
Data unit:	wt. %
Description:	Annual average purity of Isocyanate
Source of data:	Result of chemical analysis and gas chromatograph or online meter and/or according to international standards and/or according to national standard
Measurement procedures (if any):	As per international standards and/or national standards
Monitoring frequency:	Measured periodically (annually) and recorded
QA/QC procedures:	According to vender specifications and/or international standards and/or national standards
Any comment:	-

Data / Parameter table 15.

Data / Parameter:	**CPy**
Data unit:	t-Cl_2
Description:	Production of recycled Cl_2 in year *y*
Source of data:	On-site measurements and plant records
Measurement procedures (if any):	Measured with an Integrating density and flow meter
Monitoring frequency:	Constantly measured and recorded monthly
QA/QC procedures:	According to vender specifications and/or international standards
Any comment:	CP_y on 100 per cent purity is calculated by multiplying amount of recycled Cl_2 and quality (purity) of Cl_2

Data / Parameter table 16.

Data / Parameter:	**HCly**
Data unit:	t-HCl
Description:	Amount of HCl used in the recycling process in year *y*
Source of data:	On-site measurements and plant records
Measurement procedures (if any):	Measured with an Integrating density and flow meter
Monitoring frequency:	Constantly measured and recorded monthly
QA/QC procedures:	According to vender specifications and/or international standards and/or national standards
Any comment:	HCly is calculated by using amount of HCl used in the recycling process and Quality (purity) of HCl

Data / Parameter table 17.

Data / Parameter:	**ISOy**
Data unit:	t-isocyanate
Description:	Amount of isocyanate produced in year *y*

Source of data:	On-site measurements and plant records
Measurement procedures (if any):	Measured with an Integrating density and flow meter
Monitoring frequency:	Measured and recorded monthly
QA/QC procedures:	According to vender specifications and/or international standards
Any comment:	To be used for the applicability condition. ISOy is calculated by using amount of icoyanate and quality (purity) of isocyanate

Data / Parameter table 18

Data / Parameter:	**$Cl2Nacl_y$**
Data unit:	t-Cl_2
Description:	Amount of Cl_2 produced by sodium chloride electrolysis process in the year *y*
Source of data:	On-site measurements and plant records
Measurement procedures (if any):	Measured with an Integrating density and flow meter
Monitoring frequency:	Constantly measured and recorded monthly
QA/QC procedures:	According to vender specifications and/or international standards
Any comment:	$Cl2Nacl_y$ is calculated by using amount of Cl_2 production and Quality (purity) of Cl_2 of electrolysis process of NaCl

Data / Parameter table 19.

Data / Parameter:	**$FEED_y$**
Data unit:	t or m^3
Description:	Amount of feed type *f* (sulphuric acid, sodium hydroxide, oxygen and water) consumed for production of recycled Cl_2 in the year *y*
Source of data:	On-site measurements and plant records
Measurement procedures (if any):	Flow meters/ weighing feeders or any other meter based on feeding material
Monitoring frequency:	Constantly measured and recorded monthly
QA/QC procedures:	-
Any comment:	Will be used only if option 2 of leakage is opted

Data / Parameter table 20.

Data / Parameter:	**$Waste_y$**
Data unit:	t or m^3
Description:	Amount of waste type *w* (spent sulphuric acid and waste water) generated by production of recycled Cl_2 in the year *y*
Source of data:	On-site measurements and plant records

Measurement procedures (if any):	Flow meters/weighing feeders or any other meter based on waste material
Monitoring frequency:	Measured and recorded monthly
QA/QC procedures:	-
Any comment:	Will be used only if option 2 of leakage is opted

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