CLEAN DEVELOPMENT MECHANISM

CDM-MP84-A02

Draft Large-scale Methodology

AM0027: Substitution of CO_2 from fossil or mineral origin by CO_2 from renewable sources in the production of inorganic compounds

Version 03.0

Sectoral scope(s): 05

DRAFT

United Nations
Framework Convention on
Climate Change

COVER NOTE

1. Procedural background

1. At EB107, the Board requested the MP to revise the methodology “AM0027: Substitution of CO2 from fossil or mineral origin by CO_2 from renewable sources in the production of inorganic compounds” to improve the methodology to:

   (a) clarify the source of baseline CO_2,

   (b) expand the eligibility of sources of CO_2 in the baseline, and

   (c) address provisions that could potentially lead to claiming emission reductions from CO_2 sequestration.

2. Purpose

2. The purpose of the revision is to improve the methodology to clarify the source of baseline CO_2, expand the eligibility of sources of CO_2 in the baseline, and address provisions that could potentially lead to claiming emission reductions from CO_2 sequestration.

3. Key issues and proposed solutions

3. The proposed revision clarifies the source of baseline CO_2 and addresses provisions that referred to emission reductions from CO_2 sequestration.

4. Impacts

4. The revision improves the clarity of the methoody and simplifies its applicability by project participants.

5. Subsequent work and timelines

5. The MP, at its 84th meeting, agreed to seek public inputs on the draft revised methodology. If input is received, the input will be taken into account when preparing the recommendation to the Board. If no input is received, the MP recommends that the Board approve the revision of the methodology. No further work is envisaged.

6. Recommendations to the Board

6. If no input is received during the call for public input, the MP recommends that the Board adopt this draft methodology, to be made effective at the time of the Board’s approval. If inputs are received, this section is not applicable.

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1. Introduction

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

Table 1. Methodology key elements

Typical projects	Industrial processes where renewable sources of CO_2 are used as a substitute input in the production of inorganic compounds displacing CO_2 from fossil or mineral sources.
Type of GHG emissions mitigation action	Feedstock switch. Reduction of GHG emissions by switching from a fossil to a renewable source of CO_2 for the production of inorganic compounds.

2. Scope, applicability, and entry into force

2.1. Scope

3. This methodology applies to project activities that substitute CO_2 obtained from fossil or mineral sources with CO_2 from renewable sources as input in the production of inorganic compounds.

2.2. Applicability

4. This methodology is applicable to industrial production~~/manufacturing~~ processes of inorganic compounds where fossil or mineral sources of CO_2 ~~are presently used as an input and where~~ are substituted by renewable sources of CO_2 ~~are available as a substitute input in the project activity case~~.

5. The methodology is applicable under the following conditions:

~~(a) The residual CO_2 from the processing of biomass was already produced but was not used before the project activity, so that no diversion of CO_2 from other applications is due to the project activity;~~

~~(b) The processing of biomass undergoes no substantial changes in the process with the project activity;~~

~~(c) CO_2, from fossil or mineral sources, used for the production of inorganic compounds in the baseline is from a production process whose only useful output is CO_2. The CO_2 production process from fossil source does not produce any energy by-product;~~

~~(d) CO_2 from fossil or mineral sources that is used for the production of inorganic compounds prior to the project activity will not be emitted to the atmosphere in the project activity;~~

~~(e) There are no substantial changes (e.g. product change) in the production process of inorganic compounds as a result of the project activity;~~

~~(f) Production levels of the plant (tons of inorganic compound produced per year) may in general not increase with the project activity over historic maxima;~~

(g) No additional significant energy quantities are required to prepare the renewable CO_2 from biomass processing for use in the production of inorganic compounds (related CO_2 emissions are below 1% of total emission reduction);

(h) All Carbon in the produced inorganic compounds stems from the CO_2 supplied during the production process.

(a) The biogenic residual CO_2 used by the project activity was produced but not used in the baseline scenario;

(b) The fossil CO_2 used for the production of inorganic compounds in the baseline is sourced from a process which does not involve energy production and will not continue under the project scenario;

(c) The process generating the biogenic residual CO_2 in the baseline undergoes no substantial changes under the project scenario;

(d) The production process of inorganic compounds does not undergo substantial changes (e.g. product change) as a result of the project activity (other than the CO_2 recovery system);

(e) The production levels of the industrial facility consuming the biogenic residual CO_2 should not be increased as a result of the project activity;

(f) The biogenic residual CO_2 used by the project activity does not require significant preparation/purification measures (associated CO_2 emissions shall remain below 1% of the total emission reductions);

(g) All the carbon content of the inorganic compounds produced under the project activity is sourced from the biogenic residual CO_2 supplied by the project activity.

6. This baseline methodology shall be used in conjunction with the approved monitoring methodology AM0027 (Substitution of CO_2 from fossil or mineral origin by CO_2 from renewable sources in the production of inorganic compounds).

2.3. Entry into force

7. The date of entry into force of the methodology is the date of the publication of the EB ## meeting report on DD Month YYYY.

2.4. Applicability of sectoral scopes

8. For validation and verification of CDM projects and programme of activities by a designated operational entity (DOE) using this methodology application of sectoral scope 05 is mandatory.

3. Normative references

9. This methodology is based on the part called "renewable CO_2 activity" of the project activity "Raudi Chemical Salts", proposed by Raudi Indústria e Comércio Ltda., with participation of Coopcana – Cooperativa Agrícola Regional de Produtores de Cana Ltda, whose baseline study and project design document were prepared by Ecoinvest, Brazil.

10. This methodology is based on elements from the proposed new methodology NM0115: "CO_2, electricity and steam from renewable sources in the production of inorganic compounds".

11. For more information regarding the proposal and its consideration by the Executive Board (the Board) please refer to ~~case NM0115: "CO_2, electricity and steam from renewable sources in the production of inorganic compounds" on~~ <http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html>.

12. ~~This methodology also refers to the latest version of the "Tool for the demonstration and assessment of additionality".[1]~~ This methodology also refers to the latest approved versions of "TOOL02: Combined tool to identify the baseline scenario and demonstrate additionality"

3.1. Selected approach from paragraph 48 of the CDM modalities and procedures

13. "Emissions from a technology that represents an economically attractive course of action, taking into account barriers to investment".

4. Definitions

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

15. For the purpose of this methodology the following definitions apply:

(a) **Biogenic residual CO_2 -** stream of CO_2 that is generated through a biological process (e.g. fermentation of biomass) and emitted to the atmosphere in the absence of the project activity;

(b) **CO_2 from fossil/mineral sources -** stream of CO_2 that is produced through combustion of fossil/mineral fuels without any generation of energy.

5. Baseline methodology

5.1. Identification of the baseline scenario and demonstration of additionality

~~16. The methodology determines the baseline scenario through the following steps:~~

~~(a) Step I: Identify alternatives to the project activity;~~

~~(b) Step II: Assess project additionality;~~

~~(c) Step III: Determine the most likely scenario (baseline scenario) from among the alternatives identified.~~

17. The selection of the baseline scenario and demonstration of additionality shall be conducted in accordance with "TOOL02: Combined tool to identify the baseline scenario and demonstrate additionality".

[1] Please refer to: <http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html>.

5.1.1. Step I: Identify alternatives to the project activity Identification of alternative scenarios

18. Project participants shall identify realistic and credible alternatives(s) to each one of the project components in the country where the inorganic compound is produced and consumed. Alternatives should be separately determined regarding scenarios, including:

(a) How would CO_2 be obtained in the absence of the CDM project activity?

(b) What would happen to the primary source of renewable energy in the absence of the project activity?

(c) What would happen to the baseline and project sources of CO_2 in the absence of the project activity?

(a) Generation of residual CO_2 and its fate.

(b) Generation of CO_2 from fossil or mineral sources and it fate.

5.1.1.1. How would CO_2 be obtained in the absence of the CDM project activity?

19. The production of some inorganic compounds requires CO_2 as raw material. The gas reacts with other raw material inside a chemical reactor producing the final product. CO_2 can be obtained from *fossil*, *mineral* or *renewable* sources.

20. Alternatives to the renewable CO_2 activity (the project activity) must be identified through the consultation of technical associations and official (country) information, supported by technical literature or market researches, as appropriate. The alternatives are to be identified inside the country where the project is developed.

21. There is no single standardized source for this type of information, hence, the sources of information must be determined on a project specific basis and evaluated during the validation phase, by the DOE. The sources selected must be well recognized and widespread accepted as a reliable source in the country where the project is developed.

22. For CO_2, the realistic and credible alternative(s) may include, *inter alia*: The alternative scenarios shall include (*inter alia*):

(a) C1: The proposed project activity (use of renewable source of CO_2) not undertaken as a CDM project activity;

(b) C2: The proposed project activity, implemented at a later point in time and not undertaken as a CDM project activity;

(c) C3: The proposed project activity, using the same type of renewable CO_2 but with a lower CO_2 consumption (e.g. CO_2 use efficiency that is common practice in the relevant industry sector);

(d) C4: The use of CO_2 from a particular existing or new plant, on-site or off-site, using other renewable or residual CO_2 sources, such as other biomass sources;

(e) C5: The use of CO_2 from a particular existing or new plant, on-site or off-site, using non-renewable sources of CO_2, such as CO_2 derived from thermochemical processing of fossil hydrocarbons[2], CO_2 derived from mineral products[3], etc. If not used as input for the production of inorganic compounds, the CO_2 would *not* be produced, and would *not* be emitted in the atmosphere fossil/mineral sources without energy outputs;

(f) C6: The use of residual CO_2 in a particular existing or new plant, on-site or off-site, using non-renewable residual CO_2 sources, such as residual CO_2 from other industrial process that uses fossil or mineral as raw materials, as in the cement industry. If not used as input for the production of inorganic compounds, the CO_2 would accrue *anyway* and would be emitted in the atmosphere.

23. Note that the alternatives proposed in this Section are only indicative. Project proponents may propose other possible alternatives and/or eliminate some of the proposed above, based on documented evidence.

5.1.2. Step II: Assess the project additionality and select plausible baseline candidates

24. Project participants, after identifying the alternatives to and building realistic and credible scenarios shall apply the latest approved version of the "Tool for the demonstration and assessment of additionality" for two purposes: (i) to assess project scenario additionality, showing that it is not part of the baseline; and (ii) to identify which one of the alternatives should be excluded from further consideration for baseline determination (e.g. alternatives where barriers are prohibitive or which are clearly economically unattractive). The Tool shall be applied without any modification for the set of alternative scenarios identified.

5.1.3. Step III: Determine the most likely alternative scenario (baseline scenario)

25. Where more than one credible and plausible alternative scenario remains, project participants shall, as a conservative assumption, use the alternative baseline scenario that results in the lowest baseline emissions as the most likely baseline scenario.

26. This methodology is only applicable to a project activity if it can be demonstrated through steps I to III above that alternative C5 is the most likely baseline scenario.

5.2. Additionality

27. The additionality of the project activity shall be demonstrated and assessed using the latest version of the **"Tool for the demonstration and assessment of additionality"** agreed by the CDM Executive Board, available at the UNFCCC CDM web site[4].

5.3. Project boundary

28. For the purpose of determining GHG emissions of the **baseline**, project participants shall include the following emissions sources:

[2] Fossil origin, by thermochemical processing of synthesis gas (methane, for example) or of other hydrocarbons derived from petrochemical industry. CO_2 that is purchased from suppliers of industrial gases normally stems from thermochemical processing.

[3] Mineral origin, whether from the calcination of calcium carbonate (CaCO3), as in the Solvay process, renown as the most usual fabrication process of sodium bicarbonate worldwide, or directly obtained from mineral ore that contains the inorganic compound.

[4] Please refer to: < http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html>.

(a) GHG emissions from on-site production of inorganic compounds (if any); and

(b) GHG emissions from final use of inorganic compounds (if any).

29. For the purpose of determining the GHG emissions of the **project activity**, project participants shall include the following emission sources:

(a) Sequestration of CO_2 from the atmosphere (if any);

(b) GHG emissions from on-site processing of biomass that generates the residual CO_2 (if any); and

(c) GHG emissions from on-site production of inorganic compounds (if any); and

(d) GHG emissions from final use of inorganic compounds (if any).

30. Figures 1 and 2 provides an overview on the project activity boundary, Figure 2 shows the baseline boundary.

Figure 1. Baseline boundaryscenario

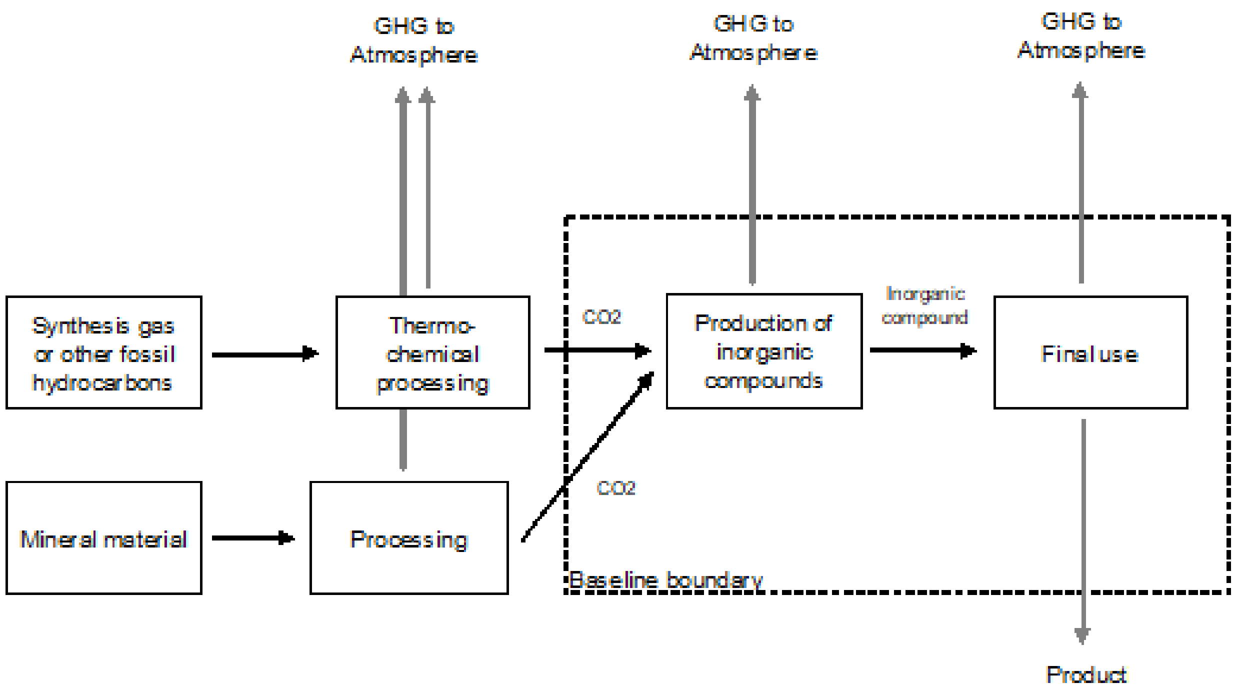
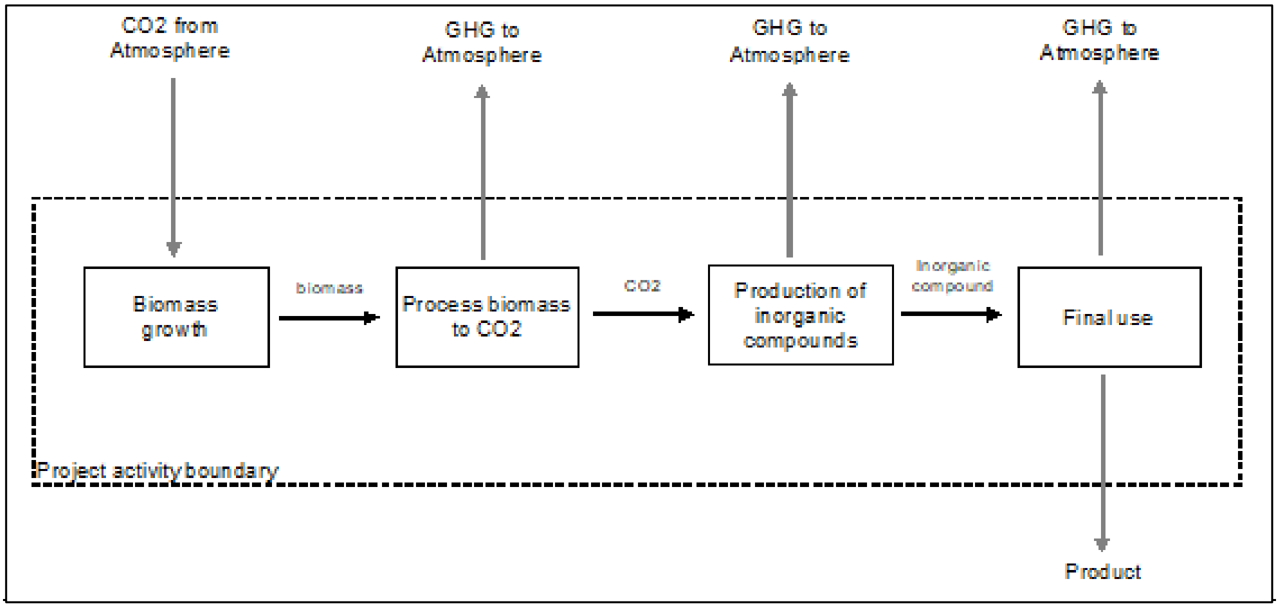


Figure ~~1~~2. Project ~~activity boundary~~ scenario



31. Table 2 illustrates in detail which emissions sources are included and ~~which are~~ excluded from the project boundary ~~for determination of both baseline and project emissions~~.

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

	Source	Gas	Included	Justification/Explanation
Baseline	~~Processing of fossil or mineral hydrocarbons~~ Use of fossil/mineral fuels to produce CO_2	~~CO_2~~	Yes	Main source of emissions.
		~~CH_4~~	~~No~~	
		~~N_2O~~	~~No~~	
	~~Production of inorganic compounds~~ Biogenic process producing CO_2	CO_2	Yes ~~(but cancelled out)~~	~~Due to applicability criteria, the process of the production of inorganic compounds is not changed with the implementation of the project activity, and potential baseline and project emissions are the same~~ Main source of emissions.
		CH_4	No	Excluded for simplification
		N_2O	No	Excluded for simplification
	~~Final use~~	~~CO_2~~	~~Yes~~	~~CO_2 is either emitted to the atmosphere or stored~~
		~~CH_4~~	~~No~~	~~Excluded for simplification~~
		~~N_2O~~	~~No~~	~~Excluded for simplification~~

	Source	Gas	Included	Justification/Explanation
Project activity	~~Uptake of CO_2 by biomass growth~~	~~CO_2~~	~~Yes (but included elsewhere)~~	~~CO_2 uptake in biomass growth is covered by the fact that renewal CO_2 is treated climate-neutral~~
		~~CH_4~~	~~No~~	
		~~N_2O~~	~~No~~	
	~~Processing of biomass, producing residual CO_2~~ Biogenic process producing CO_2	CO_2	Yes ~~(but cancelled out)~~	~~May be an important emission source. However, due to applicability criteria, the biomass processing is not changed with the implementation of the project activity, and baseline and project emissions are the same~~ Main source of emissions.
		CH_4	No	Excluded for simplification
		N_2O	No	Excluded for simplification
	~~Production of inorganic compounds~~ Use of fossil/mineral fuels to produce CO2	CO_2	Yes ~~(but cancelled out)~~	~~Due to applicability criteria, the process of the production of inorganic compounds is not changed with the implementation of the project activity, and potential baseline and project emissions are the same~~ Main source of emissions.
		CH_4	No	Excluded for simplification
		N_2O	No	Excluded for simplification
	~~Final use~~	~~CO_2~~	~~Yes~~	~~CO_2 is either emitted to the atmosphere or stored~~
		~~CH_4~~	~~No~~	~~Excluded for simplification~~
		~~N_2O~~	~~No~~	~~Excluded for simplification~~

5.4. Final use and emission reductions

32. The project activity ~~reduces net CO_2 emissions to the atmosphere or leads to C sequestration by substituting~~ substitutes CO_2 from fossil or mineral ~~origin~~ sources ~~by~~ with biogenic residual CO_2 ~~that originates from the processing of biomass~~ as input for the production ~~process~~ of inorganic compounds.

33. In the final use, the inorganic compounds may either (i) thermally dissolve or (ii) not dissociate~~:~~. However, the project activity does not affect the fate of the produced inorganic compounds. Therefore, it may be assumed that the final use of the product would be the same in the baseline and project scenarios.

~~(a) Assuming that the inorganic compound molecules thermally dissolve in the final use. Hence, if a project activity uses renewable CO_2 instead of non-renewable CO_2 of fossil or mineral origin, emissions of non-renewable CO_2 during the final use of the compound are avoided.~~

~~(b) On the other hand, in the case the inorganic compound molecules do not dissociate during the final use, the result of the project activity is carbon sequestration, because CO_2 is continuously sequestered from the atmosphere by the production~~

of inorganic chemical. Hence, the project activity leads to the permanent removal of CO_2 from the atmosphere (or "negative" emissions).

34. It is important to note, however, that the main objective of the “renewable CO_2 activity” is not to sequester CO_2 from the atmosphere. The point about sequestration is to demonstrate that, even in the case some portion of the chemical doesn’t dissociate during the final use phase, the activity continues to lead to emissions reductions.

35. The renewable CO_2 may be obtained from the processing of biomass, e.g. from the waste CO_2 stream, which was previously released to the atmosphere, generated in the fermentation of sugar cane juice for the production of ethanol.

36. In Table 3, representations of both situations, with and without dissociation in the final use, are presented.

Table 3. Emissions balance in the “renewable CO_2 activity”

		Does the compound release CO_2 in the final use?	**What happens to emissions in the project activity scenario?**	**What would happen to emissions in the baseline scenario?**	**Emissions balance, from the difference between baseline and project emissions**
Project scenario with renewable CO_2 and baseline scenario with non-renewable CO_2	**SITUATION 1 With dissociation**	Yes, compound molecule dissociates and CO_2 is emitted to the atmosphere in the final use	CO_2 emissions occur and are renewable (net emission is zero)	Fossil or mineral CO_2 emissions would occur (net emission would be positive)	Emissions reductions occur due to the avoidance of non-renewable CO_2 emissions
	SITUATION 2 Without dissociation	No, compound molecule does not dissociate and CO_2 is not emitted to the atmosphere in the final use	Atmosphere CO_2 is sequestered by the chemical molecule (net emission is negative)	Fossil or mineral CO_2 would be sequestered by the chemical molecule (net emission would be zero)	Emissions reductions occur due to the sequestration of atmosphere CO_2 by the chemical molecule

37. Please note that, switching from one situation to the other does not affect the net emission reductions of the project, as it may be assumed that the final use of the product in the baseline would be the same as in the project activity. It means that, if in the project activity scenario CO_2 is released in the final use, it would also happen in the baseline scenario and vice-versa, and the emissions reductions would be the same, independently of the situation describing the final use.

5.5. Baseline emissions (non-renewable CO_2 activity)

38. If the baseline scenario C.5 is identified (see Section "Identification of baseline scenario"), i.e. the production of the inorganic compound with fossil or mineral CO_2 sources, then emissions of the baseline due to the final use of the inorganic compounds are calculated as below.

39. When the final use of the inorganic compound emits CO_2 to the atmosphere, the emissions from the final use of the inorganic compounds are *N* moles of CO_2 for each mol of inorganic compound used. Hence, the following emission factor for the "CO_2 activity" results [in tCO_2/t of inorganic compound]:

$$EF_{CA} = 44(N/M) \quad \text{Equation (1)}$$

Where:

44	=	The molecular weight of CO_2, [g/mol]
N	=	The carbon content of the inorganic compound, i.e., the number of carbon atoms in the inorganic compound molecule that would thermally dissociate in the final use of one molecule of the compound. *N* is a fixed parameter that depends on the inorganic compound involved, [non dimensional]
M	=	The molecular weight of the inorganic compound, a fixed parameter that depends on the inorganic compound involved. It is calculated straightforwardly by summing the atomic weights of the compound constituents, in [g]

40. This is based on the assumption that all Carbon in the produced inorganic compounds stems from the CO_2 supplied during the production process (applicability criterium).

41. The calculation of the baseline emissions (*B*) consists of three parts, the GHG emission (*BE*) and sequestration (*BS*) parts during final consumption, as well as possible emissions related to the activity, e.g. from the production of inorganic compounds (*BI*). It is are calculated as follows: under the assumption that all the carbon content in the inorganic compounds produced is sourced from the CO_2 supplied by the project activity.

$$B = BE - BS + BI \quad \text{Equation (2)}$$

$$BE_y = BE_{CO2,FF,y} - BE_{CO2,bio,y} + BE_{process,y} \quad \text{Equation (1)}$$

Where:

BE_y	=	Baseline emissions in year *y* (t CO_2)
$BE_{CO2,FF,y}$	=	Baseline emissions of CO_2 from fossil/mineral sources (t CO_2)
$BE_{CO2,bio,y}$	=	Baseline emissions of CO_2 from biogenic sources (t CO_2)
$BE_{process,y}$	=	Baseline emissions from the production process (t CO_2)

42. This is based on the assumption that all Carbon in the produced inorganic compounds stems from the CO_2 supplied during the production process (applicability criterium).

5.5.1. Baseline emissions of CO_2 from fossil/mineral sources

43. The baseline emissions of non-renewable CO_2 are of CO_2 from fossil/mineral sources are calculated based on N moles of CO_2 for each mol of inorganic compound as follows:

~~$BE = EF_{CA} m_1 (1 - k_B)$~~ ~~Equation (3)~~

$$BE_{CO2,FF,y} = EF_{CA} \times m_y \times \left(1 - m_{bio}/\left(m_{bio} + m_{ff}\right)\right) \quad \text{Equation (2)}$$

Where:

EF_{CA}	=	$44(N/M)$
44	=	The molecular weight of CO_2 (g/mol)
N	=	The carbon content of the inorganic compound, i.e., the number of carbon atoms in the inorganic compound molecule that would thermally dissociate in the final use of one molecule of the compound. *N* is a fixed parameter that depends on the inorganic compound involved (non dimensional)
M	=	The molecular weight of the inorganic compound, a fixed parameter that depends on the inorganic compound involved. It is calculated by summing the atomic weights of the compound constituents (g)
m_y	=	Amount of inorganic compound produced in year y (t)
m_{bio}	=	Amount of biogenic residual CO_2 used in the baseline scenario (t)
m_{ff}	=	Amount of fossil/mineral CO_2 used in the baseline scenario (t)

~~Thus,~~

~~$BE = 44(N/M) m_1 (1 - k_B)$~~ ~~Equation (4)~~

5.5.2. Baseline emissions of CO_2 from biogenic sources

44. The ~~sequestration in the~~ baseline ~~is~~ emissions of CO_2 from biogenic sources are calculated as follows:

~~$BS = EF_{CA} m_2 k_B$~~ $BE_{CO2,bio,y} = EF_{CA} \times m_y \times \left(m_{bio}/\left(m_{bio} + m_{ff}\right)\right)$ Equation (3)

Where:

EF_{CA}	=	$44(N/M)$
44	=	The molecular weight of CO_2 (g/mol)
N	=	The carbon content of the inorganic compound, i.e., the number of carbon atoms in the inorganic compound molecule that would thermally dissociate in the final use of one molecule of the compound. *N* is a fixed parameter that depends on the inorganic compound involved (non dimensional)
M	=	The molecular weight of the inorganic compound, a fixed parameter that depends on the inorganic compound involved. It is calculated by summing the atomic weights of the compound constituents, in (g)
m_y	=	Amount of inorganic compound produced in year y (t)

m_{bio}	=	Amount of residual CO_2 used in the baseline scenario (t)
m_{ff}	=	Amount of fossil/mineral CO_2 used in the baseline scenario (t)

~~Thus,~~

$$BS = 44(N/M)m_2 k_B$$ ~~Equation (5)~~

45. ~~Definition of parameters and variables is provided at the end of the project emissions section below.~~

5.6. Project Emissions ~~(Renewable CO_2 activity)~~

46. The ~~calculation of the project emissions (*P*) also consists of three parts, the GHG emission (*PE*) and sequestration (*PS*) parts during final consumption, as well as other possible emissions related to the activity, e.g. from the production of inorganic compounds (*PI*). It is~~ project emissions are calculated as follows:

$$P = PE - PS + PI$$ ~~Equation (6)~~

$$PE_y = PE_{CO2,FF,y} - PE_{CO2,bio,y} + PE_{process,y}$$ Equation (4)

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Where:

BE_y	=	Project emissions in year *y* (t CO_2)
$PE_{CO2,FF,y}$	=	Project emissions of CO_2 from fossil/mineral sources in year *y* (t CO_2)
$PE_{CO2,bio,y}$	=	Project emissions of CO_2 from biogenic sources in year *y* (t CO_2)
$PE_{process,y}$	=	Project emissions from the production process in year *y* (t CO_2)

5.6.1. Project emissions of CO_2 from fossil/mineral sources

47. The project emissions of CO_2 from fossil/mineral sources are calculated based on N moles of CO_2 for each mol of inorganic compound as follows:

48. ~~The emissions of non-renewable CO_2 are~~

$$PE = EF_{CA} m_1 (1 - k_p)$$ ~~Equation (7)~~

~~Thus,~~

$$PE = 44(N/M)m_1(1 - k_p)$$ ~~Equation (8)~~

$$PE_{CO2,FF,y} = EF_{CA} \times m_y \times \left(1 - m_{bio,y}/(m_{bio,y} + m_{ff,y})\right)$$ Equation (5)

Where:

EF_{CA}	=	$44(N/M)$
44	=	The molecular weight of CO_2, (g/mol)
N	=	The carbon content of the inorganic compound, i.e., the number of carbon atoms in the inorganic compound molecule that would thermally dissociate in the final use of one molecule of the compound. *N* is a fixed parameter that depends on the inorganic compound involved (non dimensional)
M	=	The molecular weight of the inorganic compound, a fixed parameter that depends on the inorganic compound involved. It is calculated by summing the atomic weights of the compound constituents (g)
m_y	=	Amount of inorganic compound produced in year y (t)
$m_{bio,y}$	=	Amount of biogenic residual CO_2 used in the project activity in year *y* (t)
$m_{ff,y}$	=	Amount of fossil/mineral CO_2 used in the project activity in year *y* (t)

5.6.2. Project emissions of CO_2 from biogenic sources

49. ~~The sequestration in the project activity is~~ The project emissions of CO2 from biogenic sources are calculated as follows:

~~$PS = EF_{CA} m_2 k_p$~~ ~~Equation (9)~~

~~Thus,~~

~~$PS = 44(N/M) m_2 k_p$~~ ~~Equation (10)~~

~~Where:~~

~~m_1~~	=	~~The amount of the inorganic compound that releases CO_2 in the final use, in [t]~~
~~m_2~~	=	~~The amount of the inorganic compound that does *not* release CO_2 in the final use, in [t]~~
~~$m = m_1 + m_2$~~	=	~~The total amount of the inorganic compound produced, in [t]~~
~~k_b and k_p~~	=	~~Non-dimensional correction factors for renewable CO_2 in the baseline and project activity and are calculated as follows:~~

~~$k_b = m_{br}/(m_{br} + m_{bnr})$ and $k_p = m_{pr}/(m_{pr} + m_{pnr})$~~

~~Where:~~

~~m_{br}~~	=	~~m_{br} is the total amount of renewable CO_2 used in the baseline scenario~~
~~m_{bnr}~~	=	~~m_{bnr} is the total amount of non-renewable CO_2 used in the baseline scenario~~
~~m_{pr}~~	=	~~m_{pr} is the total amount of renewable CO_2 used by the project~~

~~m_{pnr}~~	=	~~m_{pnr} is the total amount of non-renewable CO_2 used by the project~~

$$PE_{CO2,bio,y} = EF_{CA} \times m_y \times (m_{bio,y}/(m_{bio,y} + m_{ff,y}))$$ Equation (6)

Where:

EF_{CA}	=	$44(N/M)$
44	=	The molecular weight of CO_2 (g/mol)
N	=	The carbon content of the inorganic compound, i.e., the number of carbon atoms in the inorganic compound molecule that would thermally dissociate in the final use of one molecule of the compound. *N* is a fixed parameter that depends on the inorganic compound involved (non dimensional)
M	=	The molecular weight of the inorganic compound, a fixed parameter that depends on the inorganic compound involved. It is calculated by summing the atomic weights of the compound constituents (g)
m_y	=	Amount of inorganic produced in year y (t)
$m_{bio,y}$	=	Amount of biogenic residual CO_2 used in the project activity in year *y* (t)
$m_{ff,y}$	=	Amount of fossil/mineral CO_2 used in the project activity in year *y* (t)

5.7. Leakage emissions

50. Potential leakage emissions due to diversion of CO_2 from other users are considered to be zero if the biogenic residual CO_2 used by the project activity was produced but not used in the baseline scenario, as per the applicability condition 4 (a) of this methodology.

5.8. Emission Reductions

51. Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y$$ Equation (7)

~~52. The applicability criteria (see above) require that neither the processing of biomass (generating waste renewable CO_2) nor the production process (for inorganic compounds) undergo substantial changes with the project activity. With this, it may be assumed that potential GHG emissions from the biomass processing and the production process remain the same in the baseline (*BI*) and in the project activity (*PI*) case:~~

~~$$BI = PI$$ Equation (11)~~

~~53. The total emission reduction which covers direct emissions of GHG and sequestration can be written as:~~

~~$$ER = B - P = (BE - PE) + (PS - BS) + (BI - PI)$$ Equation (12)~~

$$ER = (BE - PE) + (PS - BS)$$ Equation (13)

$$ER = 44(N/M)(m_1 + m_2)(k_p + k_b)$$ Equation (14)

$$ER = 44(N/M)\ m\ (k_p + k_b)$$ Equation (15)

5.9. Leakage

54. The main potential source of leakage for this project activity lies in an increase in emissions due to diversion of CO_2 from other users to the project as a result of the project activity.

55. This source of leakage is zero if the conditions under which the methodology is applicable are satisfied:

    (a) The residual CO_2 from the processing of biomass was already produced but was not used before the project activity, so that no diversion of CO_2 from other applications is due to the project activity.

56. Project participants must provide adequate evidence of this condition during the validation of the project activity.

6. Monitoring Methodology

6.1. Source

57. This methodology is based on the part called "renewable CO_2 activity" of the project activity "Raudi Chemical Salts", proposed by Raudi Indústria e Comércio Ltda., with participation of Coopcana – Cooperativa Agrícola Regional de Produtores de Cana Ltda, whose baseline study and project design document were prepared by Mr. Rodrigo Marcelo Leme, from Ecoinvest, Brazil.

58. For more information regarding the proposal and its consideration by the Executive Board please refer to case NM0115: " CO_2, electricity and steam from renewable sources in the production of inorganic compounds" on <http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html>.

59. This methodology also refers to the latest version of the "Tool for the demonstration and assessment of additionality"[5].

6.2. Applicability

60. This monitoring methodology shall be used in conjunction with the approved baseline methodology AM0027 (Substitution of CO_2 from fossil or mineral origin by CO_2 from renewable sources in the production of inorganic compounds). The same applicability conditions as in baseline AM0027 apply.

[5] Please refer to: < http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html>.

61. ~~All data collected as part of monitoring should be archived electronically and be kept at least for 2 years after the end of the last crediting period. 100% of the data should be monitored if not indicated differently in the comments in the tables below.~~

6.3. Parameters not monitored.

~~6.4. Project emissions parameters~~

62. ~~The following table illustrates the data to be collected or used in order to monitor emissions from the project and baseline activity.~~

Data / Parameter table 1.

Data / Parameter:	**N**
Data unit:	Non dimensional
Description:	Carbon content of the inorganic compound, i.e., the number of carbon atoms in the inorganic compound molecule that would thermally dissociate in the final use of one molecule of the compound
Source of data:	Technical literature, such as, chemical engineers handbooks
Measurement procedures (if any):	
Monitoring frequency:	Once, at the validation
QA/QC procedures:	Check consistency with literature
Any comment:	This is a fixed parameter that needs to be demonstrated through the chemical dissociation equation in the final use of each compound produced

Data / Parameter table 2.

Data / Parameter:	**M**
Data unit:	g/mol
Description:	Molecular weight of the inorganic compound.
Source of data:	Technical literature, such as, chemical engineers handbooks
Measurement procedures (if any):	
Monitoring frequency:	Once, at the validation
QA/QC procedures:	Check consistency with literature
Any comment:	This is a fixed parameter calculated from the summation of the atomic weights of the compound constituents

Data / Parameter table 3.

Data / Parameter:	m_{ff}
Data unit:	t
Description:	Amount of fossil/mineral CO_2 used in the baseline scenario
Source of data:	Project site records
Measurement procedures (if any):	

Monitoring frequency:	Monthly, over three years before the start of the project activity
QA/QC procedures:	
Any comment:	The amount of non-renewable CO_2 eventually used in the baseline needs to be monitored directly in the site before the start of the project activity. The means of monitoring depends on each specific project. In case that no renewable CO_2 has been used before the start of the project activity, m_{bnr} has not to be monitored

Data / Parameter table 4.

Data / Parameter:	m_{bio}
Data unit:	t
Description:	Amount of biogenic residual CO_2 used in the baseline
Source of data:	Project site records
Measurement procedures (if any):	
Monitoring frequency:	Monthly, over three years before the start of the project activity
QA/QC procedures:	
Any comment:	This variable is calculated from m and m_{bnr}. The calculation depends on the chemical produced and the stoichiometric equation that represents its production. With the stoichiometric equation, and the monitored variables m and m_{bnr}, the calculation is performed as a conventional stoichiometric calculation. In case that no renewable CO_2 has been used before the start of the project activity, m_{br} is 0

6.5. Parameters monitored.

Data / Parameter table 5

Data / Parameter:	m_y
Data unit:	t
Description:	~~Total a~~Amount of ~~chemical~~ inorganic compound produced in year y
Source of data:	Company books, sales documents
Measurement procedures (if any):	
Monitoring frequency:	Monthly
QA/QC procedures:	Any direct measurements with mass or volume meters at the plant site should be cross-checked with an annual energy balance that is based on purchased quantities and stock changes
Any comment:	This variable is monitored directly in the site. It is the total amount of production. For instance, the sales receipts that contain the quantity sold may be used for monitoring

Data / Parameter table 4.

Data / Parameter:	$m_{pnr,ff,y}$
Data unit:	t
Description:	Total aAmount of non-renewable fossil/mineral CO_2 used in the process in the project activity in year *y*
Source of data:	Local measurements through field instruments
Measurement procedures (if any):	
Monitoring frequency:	Monthly
QA/QC procedures:	
Any comment:	The amount of non-renewable CO_2 eventually used in the project needs to be monitored directly in the project site. The means of monitoring depends on each specific project. For instance, if If CO_2 is purchased from external suppliers, then, this variable can be monitored from the amount of CO_2 purchased. The purchase receipts may be used for this purpose

Data / Parameter table 5.

Data / Parameter:	$m_{pr,bio,y}$
Data unit:	t
Description:	Total aAmount of renewablebiogenic residual CO_2 used in the process in the project activity in year *y*
Source of data:	Local measurements through field instruments
Measurement procedures (if any):	
Monitoring frequency:	Monthly
QA/QC procedures:	
Any comment:	This variable is calculated from *m* and m_{pnr}. The calculation depends on the chemical produced and the stoichiometric equation that represents its production. With the stoichiometric equation, and the monitored variables *m* and m_{pnr}, the calculation is performed as a conventional stoichiometric calculation

6.6. Baseline emission parameters

63. The following table illustrates the data to be collected or used in order to estimate emissions from the baseline activity.

Data / Parameter table 6.

Data / Parameter:	m_{bnr}
Data unit:	t
Description:	Total amount of non-renewable CO_2 used in the process before the start of the project activity
Source of data:	Project site records
Measurement procedures (if any):	

~~Monitoring frequency:~~	~~Monthly, over three years before the start of the project activity~~
~~QA/QC procedures:~~	
~~Any comment:~~	~~The amount of non-renewable CO_2 eventually used in the baseline needs to be monitored directly in the site before the start of the project activity. The means of monitoring depends on each specific project. In case that no renewable CO_2 has been used before the start of the project activity, m_{bnr} has not to be monitored~~

~~Data / Parameter table 7.~~

~~Data / Parameter:~~	~~m_{br}~~
~~Data unit:~~	~~t~~
~~Description:~~	~~Total amount of renewable CO_2 used in the process before the start of the project activity~~
~~Source of data:~~	~~Project site records~~
~~Measurement procedures (if any):~~	
~~Monitoring frequency:~~	~~Monthly, over three years before the start of the project activity~~
~~QA/QC procedures:~~	
~~Any comment:~~	~~This variable is calculated from m and m_{bnr}. The calculation depends on the chemical produced and the stoichiometric equation that represents its production. With the stoichiometric equation, and the monitored variables m and m_{bnr}, the calculation is performed as a conventional stoichiometric calculation. In case that no renewable CO_2 has been used before the start of the project activity, m_{br} is 0~~

Data / Parameter table 8.

Data / Parameter:	***Product***
Data unit:	Description of chemical substance
Description:	Type of inorganic compound produced
Source of data:	Plant operator
Measurement procedures (if any):	
Monitoring frequency:	Annually after start of project activity
QA/QC procedures:	Type of inorganic compound well known to producers
Any comment:	The type of inorganic compound produced is monitored to assure that the product does not change ~~and that the methodology remains applicable~~

~~64. Monthly, project participants should provide the stoichiometric balance of the process or database of measured quantities. Field instruments must be regularly checked, calibrated, and maintained. The amounts monitored should be cross-checked with the legal purchase receipts of these products.~~

~~6.7. Leakage~~

~~65. The main potential source of leakage for this project activity lies in an increase in emissions due to diversion of CO_2 from other users to the project as a result of the project activity. This condition is checked in the validation of the project.~~

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Document information

Version	*Date*	*Description*
03.0	12 April 2021	MP 84, Annex 2 A call for public input will be issued for this draft document. If no public input is received, this draft document will be considered by the Board at EB 110. Revision to: • clarify the source of baseline CO_2; • expand the eligibility of sources CO_2 in the baseline; and • address provisions that could potentially lead to claiming emission reductions from CO_2 sequestration.
02.0	29 September 2006	EB 26, Annex 10 Revision to clarify that the approved methodology is applicable to project activities where the generation of CO_2 from fossil or mineral sources in the baseline is only for the purpose of producing CO_2 used for the production of inorganic compounds and there is no energy by-product of CO_2 production from fossil source and its consumption in the baseline.
01.0	25 November 2005	EB 22, Annex 12 Initial adoption.

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