Chile a Landfill Protocol
Workgroup Meeting Notes and Takeaways

Workgroup Meeting #2 Notes – 9/03/2025 | 11:00am – 1:00pm (Santiago time)
Reserve Attendees: Celeste Melendez, Miguel López Delgado
Link to review recording

Workgroup Members in attendance:

Organization (alphabetically)	Name	Present (P) or Absent (A)
Energylab	Cristian Mosella	P
CO2CERO	Wilmer Martinez	P
ImplementaSur	Gerardo Canales	A
Grupo de Residuos Solidos Pontifica Universidad Católica de Valparaíso Chile	Marcel Szanto Nerea	A
KDM Empresas	José Santiago Zuñiga Irazabal	A
Mexico2	David Colín	A
Núcleo Biotecnología Curauma Pontificia Universidad Católica de Valparaíso	Andres Morales	A
Superintendencia del Medio Ambiente Gobierno de Chile	Karin Salazar	A
Superintendencia del Medio Ambiente Gobierno de Chile	Christian Calderón Duarte	P
Sustentalia Consultores	Javiera Labbé	P
UniCarbon	Nuno Barbosa	A
Veolia	Laura Landeta	P
VOLTA SpA	Pedro Alarcón Retamal	P
Windfall Bio	McKenzie Wilson	P

Agenda:

1. Introduction
2. Process overview
3. Protocol Considerations
    a. Previous meeting pending questions
    b. Social and Environmental Safeguards
    c. Social Safeguards MRV
    d. The GHG Assessment Boundary
    e. Quantifying GHG Emission Reductions
    f. Project Monitoring & Monitoring Requirements
    g. QA/QC requirements
    h. Oxidation Factor
4. Next steps

Main Points of Discussion and Decisions Made:

1. **Previous meeting pending questions**
    - The Reserve presented the questions and comments addressed in the previous Working Group (WG) meeting, for which additional information had been requested to better understand the context of the landfill sector in Chile. Therefore, WG members are invited to collaborate with their experience and any information they consider relevant for the development of the protocol. The open topics are as follows:
        - Examples of active Landfill Gas Collection and Control Systems and applicable destruction devices in use in the jurisdiction.
        - Further information on the environmental permits and documents required to operate a landfill on a regional level.
        - Further information on the laws/regulations applicable to landfills in Chile (by Province, Regions) and the applicable regulatory agencies, if there were in addition to the SEREMI
        - Inventories or databases that monitor the operation of each landfill, as well as data on landfill gas collection and control systems in the jurisdiction.
        - Further information on the special ownership conditions for Landfills in Chile that should be considered in the protocol. In this case, the Reserve mentioned that no comments were received on this topic, so the scenarios proposed during the previous meeting could be proceeded with for example: Owner (private) + Landfill Operator + Waste Supplier Municipality, or Public Land (military), Landfill Operator, External Operators province/region waste supplier, among others).
        - The Reserve reviewed Supreme Decree No. 189/2005 (Regulations on Basic Health and Safety Conditions in Landfills) the WG and asked for comments on whether the proposed percentage meets the basic safety requirements established in that decree. The WG clarified that this percentage is not required for environmental reasons but rather for occupational safety requirements, and therefore recommended that this percentage be consulted with the SEREMI of Health, as the competent authority. Notwithstanding the above, the WG noted that 5% corresponds to the lower explosive limit of

methane recognized in industrial safety regulations and safety data sheets. In this context, it was agreed that this value is acceptable.
    - Additional information on the impact of CDM or other international standards on common practice in the industry (projects mapped)
        - The Reserve clarified that it seeks to gather information on all landfill projects that participated in the CDM, including a list of their location, capacity, current status, and the status of their gas collection and destruction systems. To this end, the WG is invited to provide background information or experiences that will enable an analysis of their impact and an assessment of the potential for some projects to trade into the Reserve program.
    - Studies and/or data to confirm that the installation of landfill gas collection and control systems not common practice at landfills in Argentina
        - The Reserve mentioned that no studies were received, but comments confirming that it is not a common practice. Reminder of sending comments/studies documents to the Reserve's team
    - Information on the regulatory body that oversees environmental regulations for landfills.
        - The WG clarified that it is the Chilean Government's Superintendency of the Environment that oversees landfills, although SEREMI and regional agencies are also involved.

2. Social and Environmental Safeguards

- The Reserve reviewed the following social and environmental safeguards and invited the WG to provide any comments or proposals after the meeting, as follows:
    - Free Prior Informed Consent
    - Ongoing notification, participation, and documentation
        - WG: No comments
    - Labor and Safety
        - The Reserve requested information on specific laws on Occupational Health and Safety for landfill operators.
        - The Reserve requested information on regulatory bodies/agencies that the verifier can contact to confirm regulatory compliance.
        - The WG noted that compliance could be demonstrated by verifying that the project is not in non-compliance, using tools such as SNIFA or risk prevention inspections, which allow confirmation of whether there are any ongoing sanctioning processes; in the absence of such processes, the project is understood to be in compliance with the applicable health and safety regulations, which the PD may substantiate through the submission of documentation confirming the inexistence of open processes. https://snifa.sma.gob.cl/
    - Dispute Resolution/No Disputes
        - WG: No comments
        - The Reserve invited participants to send their comments by email due to time constraints.
    - Environmental Safeguards (EM): Regulatory Compliance
        - The Reserve requested information on the regulatory body that oversees environmental regulations and if there is a regulatory agency/body that the verifier can contact to confirm compliance with the law. In this regard,

the WG, in reference to providing additional information about the Verification Body that can be contacted to confirm regulatory compliance, stated the following:

- The competent regulatory authority for environmental aspects associated with the operation of sanitary landfills is the Superintendence of the Environment (SMA). For non-environmental permits, other authorities are involved, primarily the SEREMI of Health, which grants the necessary authorizations for the operation of the landfills.
- Regarding occupational health and safety, the specific regulations are established in DS No. 594, which "Approves the Regulation on Basic Sanitary and Environmental Conditions in Workplaces," under the authority of MINSAL and applicable through the Regional SEREMI of Health.
- The SNIFA platform serves as the official mechanism to verify compliance with environmental regulations and reflects sanctions imposed by the SMA. Only fines or infringements resulting from verified non-compliance during inspections are published in SNIFA. If a landfill does not have any records published, it is understood that there are no active sanctions.
- In case of inspection, the information is published by the corresponding SEREMIs, which also maintains records of authorized landfills.
- Each landfill has a sectoral license issued by the SEREMI; however, a consolidated list of all facilities is not publicly available.
- Some older landfills hold historical sectoral permits issued by the SEREMI and therefore may not necessarily have an environmental permit.
- To obtain updated information on authorizations and environmental safeguards (e.g., contaminant mitigation measures), it is recommended to consult directly with the national and regional ministry.

  - Environmental safeguards: pollutant mitigation
    - WG: No comments.
  - The Reserve invited participants to send their comments

3. Default Parameters and Values

The Reserve requested the W's collaboration to establish the Emission Factor Tables for Chile and asked for information on the existence of Chile-specific emission factors, so they can be shared. The requested elements include:

- Emission factors for stationary and mobile fuel combustion in Chile.
- Net Calorific Values of fossil fuels in Chile.
- Predetermined destruction efficiencies for combustion devices.
- WG Comments: No observations were received.

4. Safeguards MRV

- The Reserve Presented the Social Safeguard 1 (SS1), Free, Prior and informed consent FPIC and asked if it would be feasible for the scenario proposed between the potential

actors involved in a landfill project in Chile to comply with the protocol and SS1. Considering the relationship between the parties involved, their contract (to clarify the ownership of GHG emissions reductions), the meetings and transfer of project information in the initial moments, as well as the project approval process through voting and acceptance. It was also reminded that these meetings must be documented. The topics discussed, the agreed points, information from the participants, etc. must be noted. These meeting notes must be signed by the present participants.

- The Reserve presented SS2 Notification, Participation, and Documentation and mentioned that it would be needed signed documentation to demonstrate compliance. Then understanding that meetings are usually held, and meeting notes can be provided it is understood as feasible.
- The Reserve presented SS3 Labor and Safety and asked what the verification of this safeguard should look like.
- The Reserve presented SS4 Respect Local Land Tenure Rights & No Conflicts. It was stated that it will be mandatory to sign the Attestation of No Conflict attesting that there are no land tenure disputes that affect the project boundary, including all landfill installations directly associated with the carbon project. Additionally, the Reserve conducts a 30-day public comment period for all listed projects prior to registration and has an ongoing dispute resolution process. Projects receiving material complaints will not be registered until a satisfactory dispute resolution plan has been approved.
- The Reserve presented ES1 Air and Water Quality and ES2 Mitigation of Pollutants. It was mentioned that, apart from the signed Attestation of Regulatory Compliance form, the project developer must certify that the project is in material compliance with all applicable laws, including environmental regulations (e.g., air and water quality). Projects must be designed and implemented to mitigate potential emissions of pollutants that may cause degradation of soil, air, surface water, and groundwater quality, and project developers must obtain appropriate local permits prior to installation to avoid violation of all applicable laws. Then, projects must keep the historical records, ongoing monitoring and reporting through data logging of physical measurements, online sources, and government data to demonstrate the project was designed as exposed above.
    - No comments were received from the WG regarding Safeguards MRV.

5. The GHG Assessment Boundary

- The Reserve presented the GHG Assessment Boundary for the project which includes all emissions sources from the operation of the landfill gas collection system to the ultimate destruction of the gas. The primary gases included are CO_2 and CH_4.
    - CO2 emissions associated with the generation, and destruction of landfill gas are considered biogenic emissions (as opposed to anthropogenic) and will not be included in the GHG reduction calculation.
    - This protocol does not account for CO2 reductions associated with the displacement of fossil-based grid-delivered electricity or natural gas.
        - The Reserve mentioned that it is reviewing energy generation from landfill gas destruction. It requested information from the WG on common practice in energy generation and fossil fuel displacement in the sector in Chile. It also requested confirmation of the existence of incentives for fossil fuel displacement that could be obtained through the transformation of landfill gas.

    - N2O emissions are excluded, baseline and project emissions are assumed to be equal or very small
- The Reserve presented the GHG Assessment Boundary also in an example illustration showing all the emission sources of a landfill project. It was noted that not all of the sources presented would always be in a project. In addition, it was mentioned that leakage is not expected with these protocols.
    - No comments from the WG

6. Quantifying GHG Emission Reductions

- The Reserve presented the quantification of GHG Emissions Reductions of a Landfill Project that are quantified by comparing actual project emissions to baseline emissions at the landfill
    - Baseline emissions are an estimate of the GHG emissions from sources within the GHG Assessment Boundary that would have occurred in the absence of the landfill project.
    - Project emissions are actual GHG emissions that occur at sources within the GHG Assessment Boundary. Project emissions must be subtracted from the baseline emissions to quantify the project's total net GHG emission reductions.
    - GHG emission reductions must be quantified and verified on at least an annual basis.
        - Project developers may choose to quantify and verify GHG emission reductions on a more frequent basis if they desire.
        - The length of time over which GHG emission reductions are quantified and verified is called the "reporting period."
    - Project developers shall use the calculation methods provided in this protocol to determine baseline and project GHG emissions to quantify GHG emission reductions.
- The Reserve presented the organizational chart for equations and invited WG members and observers to review this section of the Protocol to provide any comments that may arise.
- The Reserve presented the quantification of Baseline Emissions. The baseline scenario assumes that all uncontrolled methane emissions are released to the atmosphere except for the portion of methane that would be oxidized by bacteria in the soil of uncovered landfills, absent from the project.
    - Projects can be grouped into different categories depending upon the baseline scenario and take the appropriate deduction.
        - Landfills where no previous destruction took place prior to project implementation
        - Landfills where previous collection and/or destruction took place with a non-qualifying destruction device
        - Landfills where previous collection and destruction took place with a qualifying destruction device
        - Closed landfills where previous collection and destruction took place in a qualifying flare
    - Any project at a landfill where methane was collected and destroyed at any time prior to the project start date – even if the prior collection and/or destruction system was removed or has been dormant for an extended period of time – must apply the pre-project deduction

        - The WG commented on whether this also applies to projects transitioning from other standards to the Reserve program.
        - The Reserve clarified that transitions from other landfills do not follow the same logic, as it is considered that the projects were already operating under the carbon market. In any cases, all fundamental aspects of the protocol—additionality, eligibility, crediting period, etc.—will be reviewed according to the most up-to-date version of the protocol to determine whether such projects are eligible for implementation under the Reserve Program.
- The Reserve presented the quantification of Project Emissions. Certain GHG emissions may occur or increase as a result of the project activity and therefore must be deducted from the overall project reductions.
    - The following categories of emissions must be accounted for under this protocol:
        - Total annual indirect carbon dioxide emissions resulting from consumption of electricity from the grid
        - Total annual carbon dioxide emissions from the on-site destruction of fossil fuel
        - Total annual carbon dioxide emissions from the combustion of supplemental natural gas
        - Total annual methane emissions from the incomplete combustion of supplemental natural gas
    - Emissions resulting from incomplete destruction of landfill gas or the fugitive release of landfill gas do not need to be accounted for. It is assumed that these would have been released to the atmosphere in the baseline scenario as well
    - No comments from the WG

7. Project Monitoring & Monitoring Requirements

- The Reserve presented the monitoring requirements. Project developers are responsible for monitoring project performance and operating the landfill gas collection and destruction system in accordance with the manufacturer's recommendations for each system component.
    - The Protocol requires a monitoring plan to be established for all project-related monitoring and reporting activities.
        - It will serve as a basis for verifiers to confirm that the monitoring requirements of the Protocol have been and continue to be met, and that strict ongoing monitoring and recording is being carried out.
        - It should cover all aspects of monitoring and reporting contained in this protocol and should specify how data for the parameters will be collected and recorded.
        - It should include details of the frequency with which data is obtained, the recording plan; the frequency with which instruments are cleaned, inspected, field verified and calibrated. In addition, the role of the person performing each specific monitoring activity, as well as the QA/QC arrangements. This is to ensure that data collection and metric calibration is ongoing and accurate.
        - Must include a detailed diagram of the landfill gas collection and destruction system, including the placement of all meters and equipment that affect FSRs within the GHG Assessment Limits.

        - Must include the procedures that the project developer will follow to determine and demonstrate that the project passes the Legal Requirement Test at all times.
    - Methane emission reductions from landfill gas capture and control systems must be monitored with measurement equipment that directly meters:
    - The flow of landfill gas delivered to each destruction device, measured continuously and recorded every 15 minutes or totalized and recorded at least daily, adjusted for temperature and pressure
    - The fraction of methane in the landfill gas delivered to the destruction device, measured continuously and recorded every 15 minutes and averaged at least daily (measurements taken at a frequency that is between daily and weekly may be used with the application of a 10% discount). Projects may not be eligible for crediting if methane concentration is not measured and recorded at least weekly.
    - The operational activity of the destruction device(s) monitored and documented at least hourly to ensure landfill gas destruction. Alternatively, the presence of a safety shut off valve.
        - A WG member asked whether there was a specific format for data recording. The Reserve clarified that the Protocol does not establish a particular recording method but rather defines which data must be recorded and how frequently. All data must be verifiable by an independent third party and may come either from centralized digital monitoring systems or from manual data collection systems.
    - The Reserve asked the WG if there is access in Chile to the following equipment:
        - Continuous flow meters
        - Continuous methane concentration analyzers
        - Portable instruments to acquire methane data (i.e., handheld methane analyzer)
        - Portable instruments to conduct field checks for calibration accuracy of monitoring equipment
        - Devices that can automatically self-calibrate
        - Pressure transmitters for alternative flow monitoring
        - Meters installed on the wellhead to improve biogas collection efficiency
        - Thermocouples to confirm operational status of flares
- The Reserve continued presenting monitoring requirements:
    - If discontinuous CH4 concentration monitoring is to be employed, then the project developer shall develop a prescriptive methodology for how such monitoring is carried out.
    - Methane fraction of the landfill gas is to be measured on a wet/dry basis, depending on the basis (i.e., measured on the same basis) of measurement for flow, temperature, and pressure.
        - Methane and flow meters must be installed in the same location relative to any moisture-removing components and operate on the same basis
        - Allowed variation: flow meter on dry basis and methane on wet basis.
        - No comments from the WG.
    - If there are any periods when not all destruction devices measured under a single flow meter are operational, methane destruction during these periods will be eligible provided that the verifier can confirm all the following conditions were met:

        - The destruction device efficiency of the least efficient destruction device in operation shall be used as the destruction efficiency for all destruction devices monitored by this meter.
        - All devices are either equipped with valves on the input gas line that close automatically if the device becomes non-operational (requiring no manual intervention) or designed in such a manner that it is physically impossible for gas to pass through while the device is non-operational.
        - For any period where one or more destruction devices within this arrangement are not operational, it must be documented that the remaining operational devices have the capacity to destroy the maximum gas flow recorded during the period. For devices other than flares, it must be shown that the output corresponds to the flow of gas.
        - No comments from the WG.
    - All destruction devices must have their operational status monitored and recorded at least hourly. If these data are missing or never recorded for a particular device, that device will be assumed to be not operating and no emission reductions may be claimed for landfill gas destroyed by that device during the period when data are missing.
    - All flow data collected must be corrected for temperature and pressure at 0 ºC and 1 atm, either internally or via Equation 5.2. The temperature and pressure of the landfill gas must be measured continuously**.**
- The Reserve presented direct use scenarios: where gas is delivered offsite to a third-party end user (not commercial natural gas transmission/distribution system) must make reasonable effort to obtain operational status of the destruction device(s).
    - Alternatively, the verifier must confirm to a reasonable level of assurance that there is no release of gas, including:
        - Signed attestation of no catastrophic failure.
        - In person interview with the owner of the destruction device(s).
        - Exam safety features and equipment design.
        - Records that corroborate type and level of operation of the destruction device (e.g. engine output data).

- The Reserve presented the suggested arrangement of the landfill gas flow meters and methane concentration metering equipment.
    - The number of flow meters must be sufficient to track the total flow as well as the flow to each destruction device. The presented scenario includes one more flow meter than would be necessary to achieve this objective.
    - No comments from the WG.

8. QA/QC requirements

- The Reserve presented the QA/QC requirements
    - The Monitoring Plan should include quality assurance/quality control (QA/QC) provisions to ensure that data acquisition and meter calibration are performed consistently and accurately. Metering equipment is sensitive to gas quality (moisture, particulates, etc.), so a strict QA/QC procedure for calibration of such equipment should be established in the monitoring plan. Measuring instruments should be inspected and calibrated according to the following schedule.
    - All gas flow meters, and continuous methane analyzers must be:

- Cleaned and inspected every quarter, as specified in the project's monitoring plan, with activities and results documented by site personnel. Cleaning and inspection frequency must
- Field checked for calibration accuracy by a third-party technician with the percent drift documented, using either a portable instrument (such as a pitot tube) or manufacturer specified guidance, at the end of – but no more than two months prior to or after – the end date of the reporting period
    - The Reserve requested information about the potential third-party technician for the field check for calibration accuracy.
- Calibrated by the manufacturer or a certified third-party calibration service per manufacturer's guidance or every 5 years when calibration frequency is not specified by the manufacturer.
    - The WG asked about inspections, on-site checks, and calibrations, noting that calibration is often understood as an on-site verification of equipment status.
      The Reserve clarified that:
    - Meters must be inspected quarterly, documenting activities performed, and additional maintenance (e.g., sensor cleaning) should be carried out if recommended by the manufacturer. The monitoring plan may also include extra activities to ensure equipment operability.
    - An on-site check is a validation of the meter at its location to confirm accuracy and record any deviation. All flow meters and continuous methane analyzers must be checked on-site by an external technician, either using portable instruments (such as a Pitot tube) or following the manufacturer's guidelines.
    - All meters must be calibrated according to the manufacturer's instructions, or at least every 5 years if no frequency is specified. Calibration may be performed by the manufacturer, a recommended or ISO 17025-accredited laboratory, or by an accredited service provider on-site.
- All flow meters and methane analyzers should be within a +/-5% threshold for accuracy.

- The WG asked what happens if the accuracy threshold is greater than 5%.
    - The Reserve clarified that, for the period between the last successful field check and any calibration event confirming accuracy outside the ±5% threshold, all data from that meter or analyzer must be scaled according to the following procedure. These adjustments must be applied throughout the period from the last successful field check until the meter is properly calibrated.
    - For calibrations indicating under-reporting (lower flow rates or lower methane concentration), the measured values should be used without correction.
    - For calibrations indicating over-reporting (higher flow rates or higher methane concentration), the measured values must be adjusted based on the largest calibration shift recorded at the time of calibration.

- The Reserve presented the missing data scenario and invited the WG members to review appendix C of the Protocol
    - In situations where the flow rate or methane concentration monitoring equipment is missing data, the project developer shall apply the data substitution methodology provided in Appendix C. If for any reason the destruction device monitoring equipment is inoperable (for example, the thermocouple on the flare), then no emission reductions can be registered for the period of inoperability.
    - No comments from the WG.

9. **Oxidation factor (OX)**
   The Reserve presented to the WG oxidation factors based on the U.S. Code of Federal Regulations (CFR), which will be reviewed in greater detail at the next meeting. In the meantime, the WG was invited to review these values in the shared presentation for consideration in the Protocol.

Next steps

- The Reserve reviewed the next steps
    - WG should send their comments on the items discussed at the second meeting in writing by September 15, 2025.
    - The next WG meeting was planned for September 24, 2025, at 11:00-13:00 Santiago time, or September 30, 2025, at 11:00-13:00 Santiago time
        - No other comments received from the WG.

Pending Questions for the Workgroup:

- Please review and provide information or comments on the pending questions and inquiries to the WG that were addressed in the previous meeting, as well as on the shared sections of the protocol draft. WG members are invited to contribute with their experience and any information they consider relevant for the development of the protocol.
- Please review the Free Prior Informed Consent and Notification and Participation (Social Safeguards 1 and 2). Specifically, please clarify the overview of stakeholders involved and to be considered to comply with the requirements of these safeguards.
- Regarding the SS and SA discussed during the WG meeting, please provide any other SA or SS proposals as applicable.
- Please provide information on specific Occupational Safety and Health laws for landfill operators and the applicable regulatory body/agency.
- Please provide the Emission Factors for Stationary and Mobile Combustion Fuels in Chile, Net Calorific Values of Fossil Fuels in Chile, Predetermined Destruction Efficiencies for Combustion Devices. Alternatively, confirm that the use of existing values is appropriate.
- Please provide inventories or databases that track the operation of each landfill and data on landfill gas collection and control systems at any scale.
- Please provide studies and/or data to confirm that the installation of landfill gas collection and control systems is not common practice at landfills in Chile

- Please provide information on waste management practices in Chile, including any official government reports, the national emissions inventory for the waste sector, or other relevant documents that provide context.
- Please provide information on the participation of landfills projects in Chile in CDM or other international standards. Please provide a list including their location, capacity, status, and the condition of their gas collection and destruction systems.
- Please send comments, documentation, or related studies that could support the fact that the methane fraction does not vary daily, or in few days, or even weekly
- Please provide further information on the passive destruction systems usually installed and the monitoring equipment used, if any.
- Please provide examples of commonly used equipment for:
    - Continuous flow meters
    - Continuous methane concentration analyzers
    - Portable instruments to acquire methane data (i.e., handheld methane analyzer)
    - Portable instruments to conduct field checks for calibration accuracy of monitoring equipment
    - Devices that can automatically self-calibrate
    - Pressure transmitters for alternative flow monitoring
    - Meters installed on the wellhead to improve biogas collection efficiency
    - Thermocouples to confirm operational status of flares
- Please confirm feasibility of the suggested arrangement for the landfill gas flow meters and methane concentration metering equipment
- Please provide further information about the potential third-party technician for the field check for calibration accuracy. Location of the instrumental labs, ownership (private/public), services and/or expertise, accreditation and/or approval from the manufacturer, and others.
- Please review the slides referring to the oxidation factor
- Please send any questions or additional comments on the topics presented during WG meetings 1 and 2 of this protocol.
- Currently, the Reserve's landfill protocol does not account for CO2 reductions associated with the displacement of electricity generated by fossil fuels and supplied by the grid or the replacement of natural gas. In this regard, please submit any comments or justification as to why the protocol should account for this, if it is common practice in Chile, and a proposal on how you would assess its additionality.