CLIMATE ACTION RESERVE

Chile Landfill Protocol V1.0

Workgroup Meeting #2

September 6, 2025

Introduction

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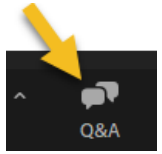
Housekeeping

- **Participation of Workgroup members (WG)**
  - WG can actively participate throughout the meeting
  - Please, keep yourselves muted unless/until would like to speak
  - We will ask and take questions throughout the session. Please use “the raise your hand function.”
- **Participation of attendees/observers**
  - Will remain in listen-only mode
  - May submit questions in the question box 

- **Follow-up and materials**
  - We will follow up via email to answer any questions not addressed during the meeting
  - The slides and a recording of the presentation will be posted online

AGENDA

- Introductions
- Process Overview
- Protocol Considerations
  - Previous meeting pending questions
  - Social and Environmental Safeguards
  - Social Safeguards MRV
  - The GHG Assessment Boundary
  - Quantifying GHG Emission Reductions
  - Project Monitoring & Monitoring Requirements
  - QA/QC requirements
- Open Discussion
- Next Steps

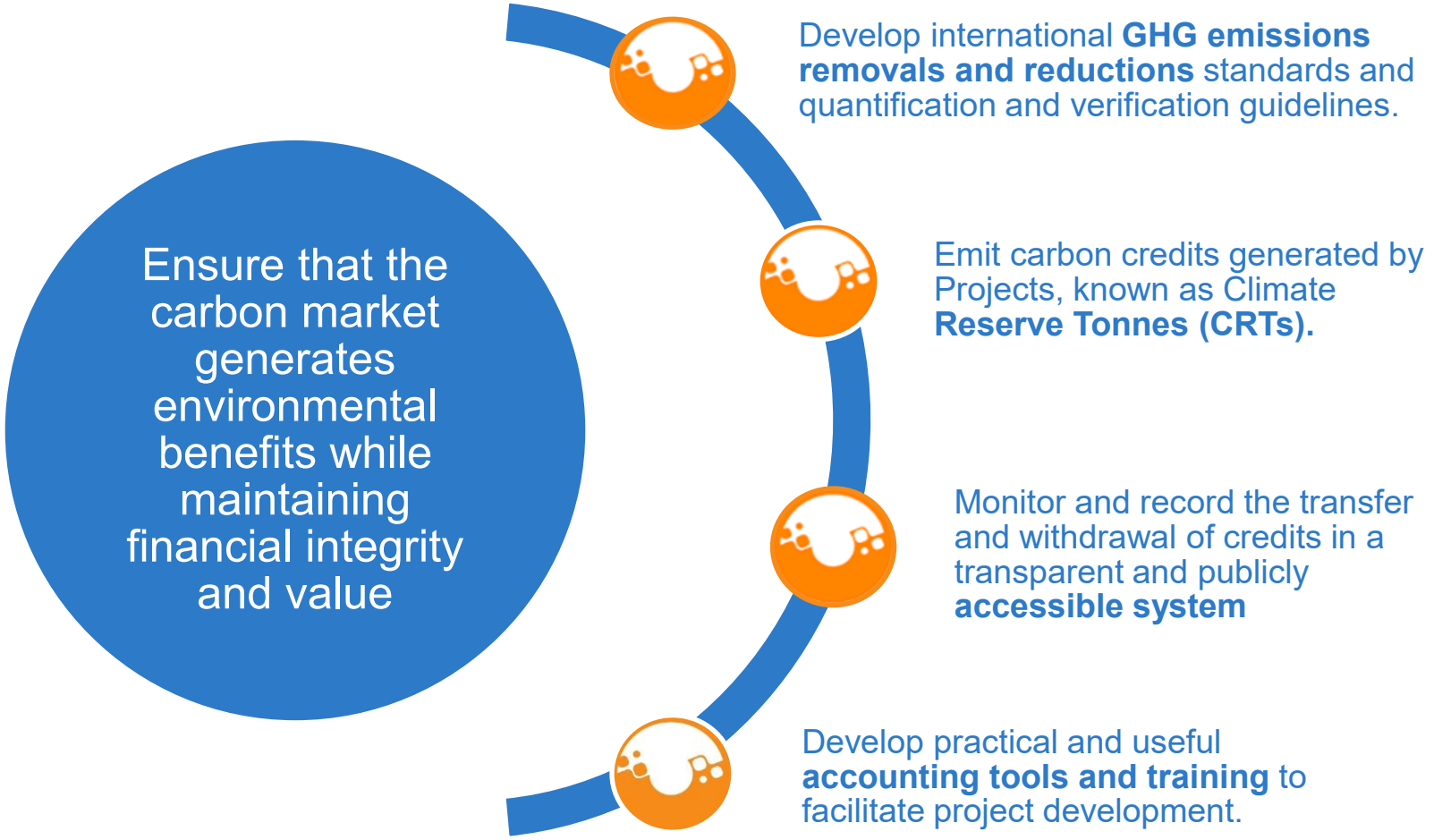
CLIMATE ACTION RESERVE

Climate Action Reserve

Mission: *to develop, promote and support innovative, credible market-based climate change solutions that benefit economies, ecosystems and society*

- ✓ **Develop high-quality, stakeholder-driven, standardized** carbon offset project protocols internationally
- ✓ **Registry of carbon credit projects and offset projects** for voluntary and compliance carbon markets. California and Washington (EEUU); Queretaro (Mexico); CORSIA.
- ✓ **High reputation for integrity and experience** in providing best-in-class registry services for offset markets

The Climate Action Reserve



Principles of the Reserve Program

All registered projects and credits issued by the Reserve must be:

ADITIONAL

Beyond common practices

Beyond regulatory requirements

VERIFIED

Standardized eligibility criteria and quantification methodologies

Independent third-party review.

REAL

Conservative emissions accounting

Prescriptive models and equations

Uncertainty reduction

PERMANENT

Monitoring and reporting processes

Any leakage or loss is quantified and compensated

ENFORCEABLE

Processes to ensure program compliance

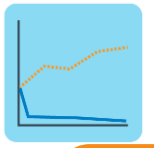
Accountability mechanisms

- The Reserve seeks to be practical and ensures that projects do not have negative impacts
- The standards include social and environmental safeguards to ensure the participation and benefit of the participants

GHG Accounting Standardization

Two elements:

Determination of project eligibility and additionality using standardized criteria rather than project-specific assessments.



Quantification of GHG reductions/removals through a baseline established under certain assumptions, emission factors and monitoring methods.

Objetives:

Minimize personal judgment in project assessment

Reduce transaction costs for the project developer, minimize uncertainties for investors, and increase the transparency of the project when it is approved and verified

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WORKING GROUP

Workgroup Members

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

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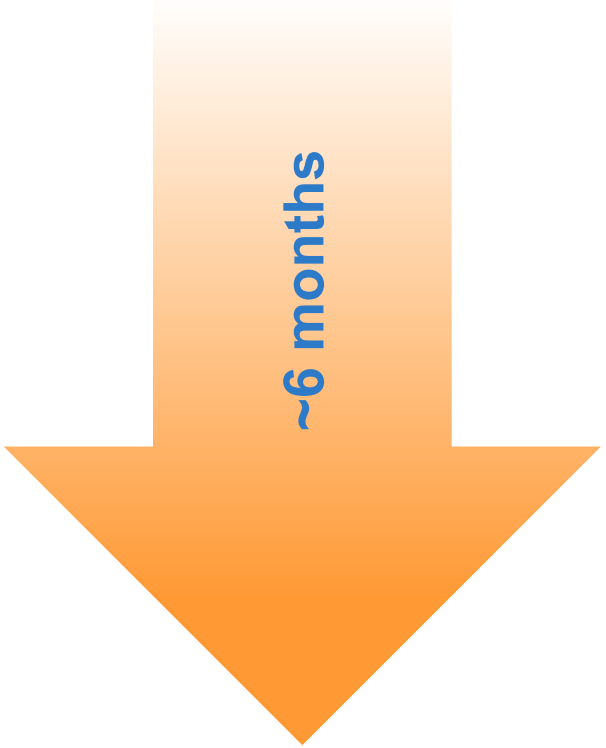
PROCESS OVERVIEW

Protocol Development Overview

- **GOAL**: To create a robust Chile Landfill Protocol that provides best practices for GHG accounting to generate Climate Reserve Tonnes (CRTs)
  - Incentivize the capture and destruction of methane emissions from landfill operations
  - Direct carbon finance to the landfill sector and make biogas control system projects more financially attractive to investors
  - Adhere to high quality offset criteria and Reserve's principles
  - Leverage lessons learned from the Reserve's Mexico and US Landfill Protocols
  - Solicit and incorporate expert stakeholder feedback

Protocol Development Timeline

1. Kick-off meeting (*July 1 2025*)
2. Workgroup process
   - Formation (*July 2025*)
   - Meeting 1 (*August 6, 2025*)
   - Meeting 2 (*Today September 3th, 2025 – tentative*)
   - Meeting 3 *(September 24th 2025 – tentative 30/6)*
3. 30-day public comment period (TBD *2025*)
4. Propose to Board adoption *(TBD 2025)*



Workgroup Process and Expectations

CAR/Process:

- Manage the protocol development process
- Hold 2 or 3 workgroup meetings
- Reserve staff identify and solicit feedback on specific protocol criteria
  - **Specific questions for WG will be highlighted in red**
- Reserve staff will share the draft protocol with WG
- Revise protocol based on feedback

WG/Expectations:

- Attend all (~2-3) workgroup sessions
- Be active participants: provide input and ask questions on protocol concepts and language
- After meetings, share additional input and expertise as needed
- Review draft protocol and provide written feedback to Reserve staff
- Be constructive, collaborative, and productive

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PROTOCOL CONSIDERATIONS

Previous meetings pending questions

- [x] The protocol is specifically designed for landfills, defined as sites where solid waste is deposited.
- [x] The protocol does not distinguish between project scales.
- [ ] Definition of passive flares or burners.
- [x] Information on the permits and documents a landfill must have to operate in accordance with current national and regional regulations (EIA), Environmental Impact Statement, and permits from the Regional Health Authority (SEREMI de Salud). **If there are any specific regional regulations, please share them.**
- Different types of solid waste disposal methods in Chile.
- Examples of active Landfill Gas Collection and Control Systems and applicable destruction devices in use in the jurisdiction.
- Inventories or databases that track the operation of each landfill and data on landfill gas collection and control systems in the jurisdiction.
- Additional information on the impact of CDM or other international standards on common practice in the industry (projects mapped)

Previous meetings pending questions

- Studies and/or data to confirm that the installation of landfill gas collection and control systems not common practice at landfills in Chile
- Further information on the national, provincial, and/or local environmental permits and documents required to operate a landfill.
- Regarding Supreme Decree No. 189/2005 (Regulation on Basic Health and Safety Conditions in Landfills), please propose/justify the deduction percentage to ensure that the volume of gas burned to comply with safety regulations is not credited as an emission reduction. Currently, 5% is proposed.
- Further information on the special ownership conditions for Landfills in Chile that should be considered in the protocol. What documents should verifiers review to confirm ownership of landfill facilities in Chile
- Please review the shared sections of the protocol and provide your comments or considerations.

Social and Environmental Safeguards

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Social Safeguards

- Free, Prior, and Informed Consent (FPIC)
- Ongoing Notification, Participation, and Documentation
- Labor and Safety
- Dispute Resolution

Environmental Safeguards

- Air and Water Quality
- Mitigation of Pollutants

Social Safeguards

Free, Prior, and Informed Consent (FPIC)

Project developers must address the following topics with the landfill operator prior to project approval:

- **Concepts of climate change and carbon markets**.
- **Requirements associated with landfill projects**, including ongoing monitoring, reporting, and verification (MRV).
- **Estimates of costs and benefits** associated with the landfill project and the division of costs and distribution of benefits or benefit sharing. The source used for carbon pricing estimates must be disclosed.

After the topics have been addressed, **landfill operators must approve the landfill project** under this protocol and the project developer

Feedback?

Social Safeguards

- **Ongoing Notification, Participation, and Documentation:**

The project developer must review with the landfill operator on an annual basis the following topics:

  - Ongoing project activities, **including MRV**
  - Credits issued
  - Purchase agreements, project finances, and ongoing benefit sharing arrangements

Project notification and documentation must be presented to the landfill operator in an appropriate format and language to ensure understanding.

- **Labor and Safety:**

The project developer must attest that the project is in material compliance with all applicable laws, including labor or safety laws.

  – Is there a specific law regarding the safety and labor of landfill operators? in addition toSupreme Decree No. 189 of 2003?

  – Is there a regulatory agency the VB could contact to confirm compliance with the law?

- **Dispute Resolution/ No Conflicts:**

- The Reserve holds 30-day public comment on all listed projects prior to registration and has an ongoing dispute resolution process. Projects that receive material complaints will not be registered until a satisfactory dispute resolution plan has been approved.

Feedback?

Environmental Safeguards

- The environmental safeguard requirements include:
  - **Regulatory Compliance:**

    The project developer must attest that the project is in material compliance with all applicable laws, including environmental regulations (e.g., air and water quality).

    - What regulatory body oversees environmental regulations?
    - Is there a regulatory agency/ body the VB could contact to confirm compliance with the law? Superintendency of the Environment (SMA) – What is the process or document that is obtained?

  - **Mitigation of Pollutants:**

    Projects must be designed and implemented to mitigate potential releases of pollutants that may cause degradation of the quality of soil, air, surface and groundwater and project developers must acquire the appropriate local permits prior to installation to prevent violation of all applicable laws

    Feedback?

Parameters/Default Values

Emission Factor Tables for Chile

- Fuel Emission Factor for Stationary and Mobile Combustion Fuels in Chile (currently using IPCCC as a reference)?
- Fossil Fuels Net Calorific Values
- Default Destruction Efficiencies for Combustion Devices

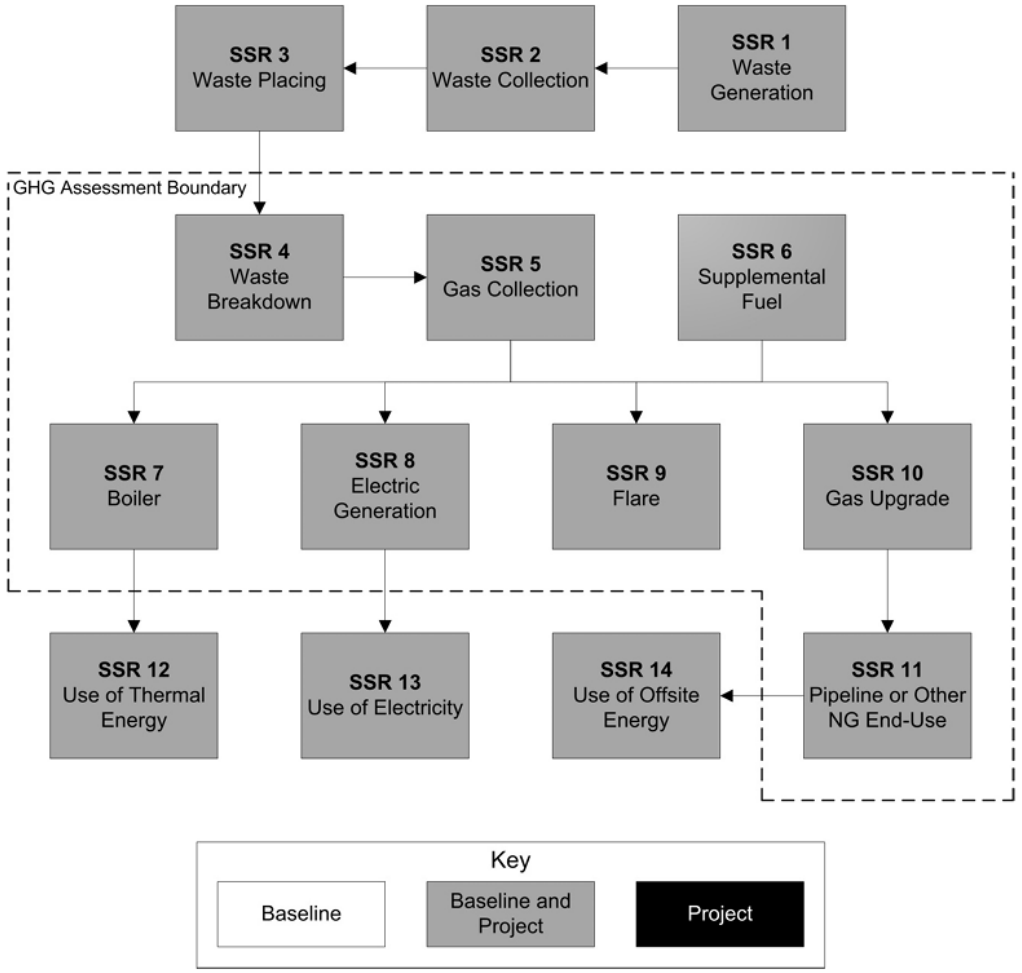
Safeguards MRV

Eligibility Rule	Eligibility Criteria	Frecuency
Social Safeguard 1 - FPIC	Signed documentation demonstrating compliance with social safeguard 1 FPIC. Clarify the overview of stakeholders involved and to be considered in order to comply with the requirements of these safeguards	Once during the first verification
Social Safeguard 2 - Ongoing Notification, Participation, and Documentation	Signed documentation demonstrating compliance with social safeguard 2 Ongoing Notification, Participation, and Documentation.	Every verification
Social Safeguard 3 – Labor and Safety	Signed Attestation of Regulatory Compliance form attesting to be in material compliance with all applicable laws, including labor and safety. Verifiers should contact the applicable government agencies.	Every verification
Social Safeguard 4 – Respect Local Land Tenure Rights & No Conflicts	Signed 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. Verifiers should contact the applicable government agencies.	Every verification
Environmental Safeguard 1 – Air and Water Quality	Signed Attestation of Regulatory Compliance form attesting to be in material compliance with all applicable laws, including those related to air and water quality. Verifiers should contact the applicable government agencies.	Every verification
Environmental Safeguard 2 – Mitigation of Pollutants	Historical records and ongoing monitoring and reporting through data logging of physical measurements, online sources, and government data to demonstrate the project was designed and implemented to mitigate potential releases of pollutants that may cause degradation of the quality of soil, air, surface and groundwater, and project developers have acquired the appropriate local permits prior to installation to prevent violation of all applicable laws. Verifiers should contact the applicable government agencies.	Every verification

The GHG Assessment Boundary

- The GHG Assessment Boundary for the project includes all emission sources from the operation of the landfill **gas collection system** to the ultimate destruction of the landfill gas.
  - **Primary gases included:** CO2 and CH4
  - **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.
- **N2O emissions are excluded**, baseline and project emissions are assumed to be equal or very small

The GHG Assessment Boundary



- All SSRs within the dashed line are taken into account in this protocol.
- Not all SSRs will occur in all projects.
- Leakage is not expected with these protocols
- Comments?

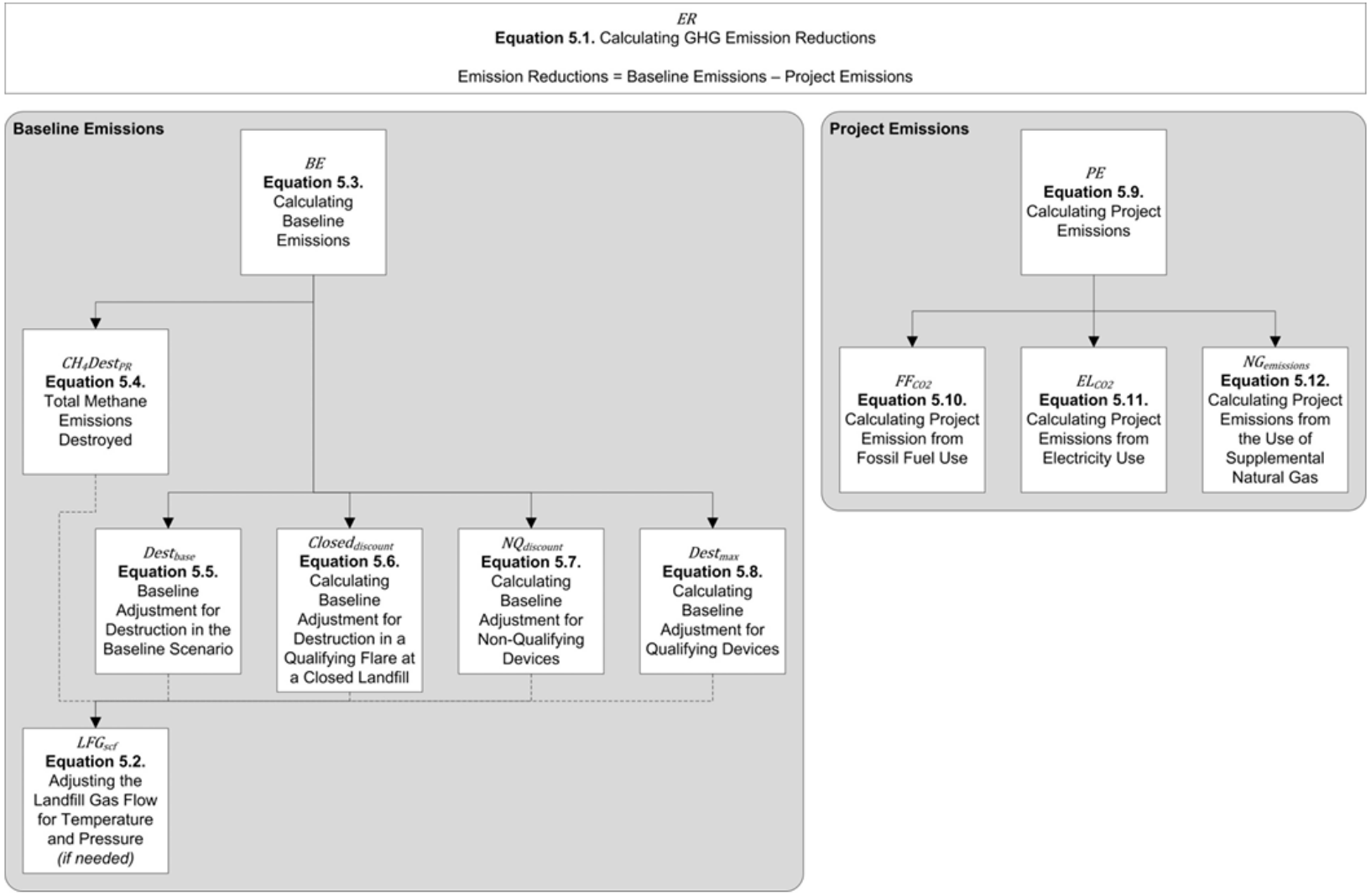
Quantifying GHG Emission Reductions

- GHG emission reductions from a landfill project 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.

Net reduction = Baseline emission – Project emissions.

- 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.

Quantifying GHG Emission Reductions



Quantifying Baseline Emissions

- Traditional baseline emission calculations are not required for this protocol for the quantification of methane reductions. 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 the project.
- Projects can be grouped into different categories depending upon the baseline scenario and take the appropriate deduction.
  - **Landfills where no previous destructio**n took place prior to project implementation
  - **Landfills where previous collection and/or destruction** took place with a nonqualifying 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

Quantifying Baseline Emissions

- This protocol accounts for the difference in **electricity consumption** between the baseline scenario and the project by
  - assuming no electricity consumption in the baseline and deducting the annual indirect CO2 emissions due to the project activity from the annual project emission reductions.
- 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.**

Quantifying 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

  - Comments?

Monitoring Requirements

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.**

Monitoring Equipment

- Does Chile have access 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 for to confirm operational status of flares

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 to be 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

Comments?

Monitoring Requirements

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:

1. 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;
2. 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;
3. For any period where one or more destruction devices within this arrangement is 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.

Comments?

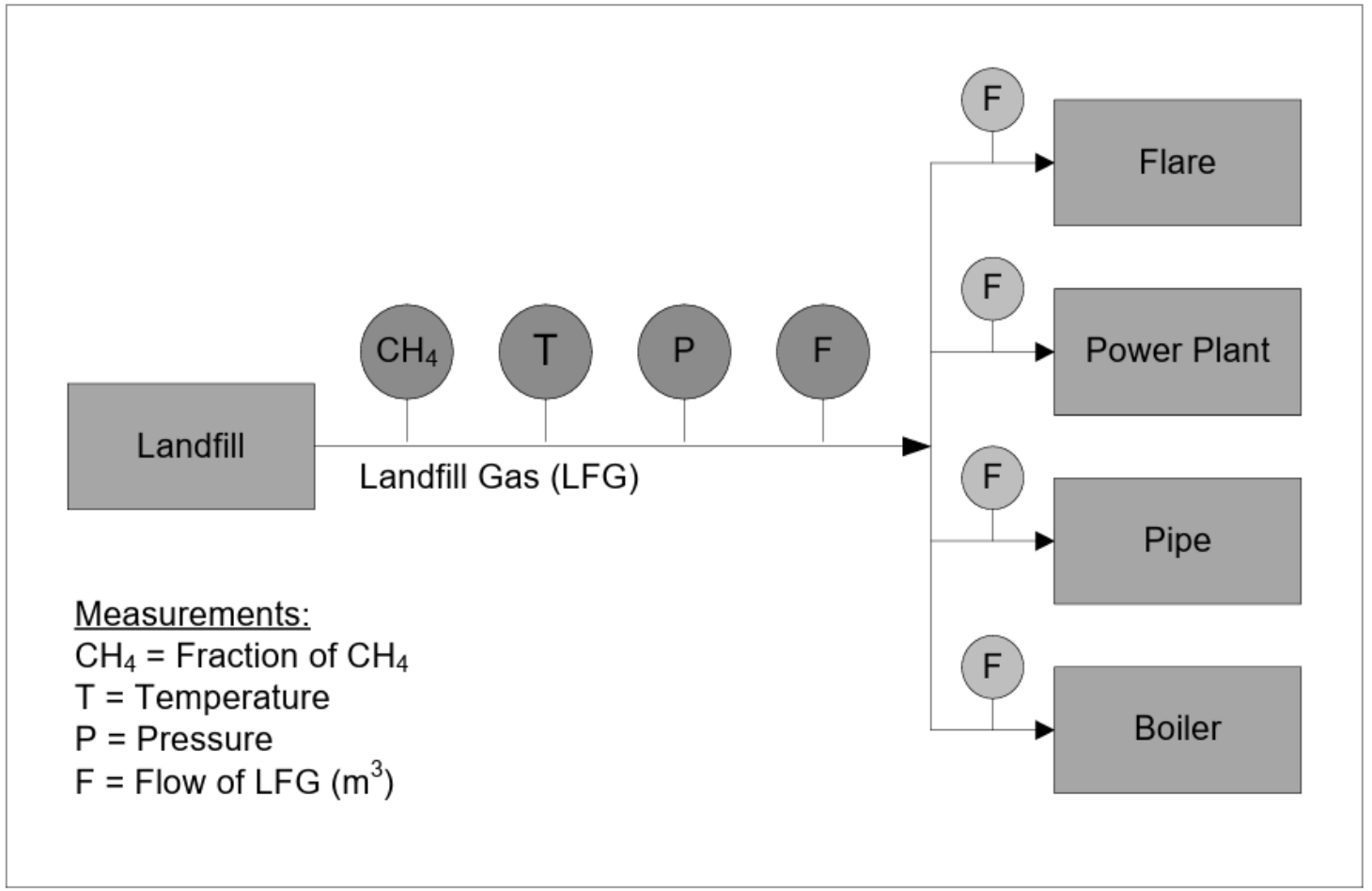
Monitoring Requirements

- 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 0o C and 1 atm, either internally or via Equation 5.2. The temperature and pressure of the landfill gas must be measured continuously.

Direct Use Scenarios

- Direct use: 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, 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 inverview 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)

Monitoring Requirements



Instrument QA/QC Requirements

- All gas flow-meters and continuous methane analyzers must be:
  - Inspected quarterly with activities documented.
  - 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
    - Would it be possible to have a third-party technician assessment?
  - 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.
    - Are there manufacturers or certified services available in Chile
- All flow meters and methane analyzers should be within a +/-5% threshold for accuracy.

Instrument QA/QC

- **Inspections:**

All flow meters and continuous methane analyzers must be inspected on a quarterly basis, with the following information documented:

  - Date and time of inspection, Device serial number(s) and location
  - Qualitative observations
  - Corrective measures
  - Staff member's name performing the activities

- **Field Checks**

Field checks must be conducted by a third-party technician with no material interest in the project, within no more than two months before or after the end of the reporting period.

The following conditions must be documented:

  - "As-found" condition / "As-left" condition if cleaning or adjustment occurred.
  - Percent drift relative to the expected value must be calculated, not relative to full scale.

Instrument QA/QC

- **Calibraciones**
- All meters must be calibrated according to manufacturer specifications, or at least once every five years if no frequency is specified.
  - Calibrations may be performed by: The manufacturer; An ISO 17025–accredited laboratory; A certified external service provider (including in situ calibration, if approved)
  - The operating range covered (flow rates, temperature, pressure) must be documented.
- **Inactive Periods**
- If a flow meter is removed for more than 60 days and is not restarted during the reporting period:
  - Accuracy must be checked within two months prior to removal, or The meter must be recalibrated before reinstallation.
- **Portable Instruments**
- If used for weekly gas measurements or to validate accuracy:
  - They must be maintained and calibrated according to manufacturer specifications or by an ISO 17025–accredited laboratory.
  - Field calibration with a reference gas is required prior to each use.

¿Feedback?

Missing Data

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 thermal coupler on the flare), then no emission reductions can be registered for the period of inoperability.

Remaining Topics

Section 5.1 Quantifying Baseline Emissions - The oxidation factor (OX)

The OX reflects the amount of methane from landfills that is oxidized in the soil or other material covering the waste. Well-managed landfills may have a higher OX rate than uncontrolled dump sites, where sites with thick, well aerated material differ from those with no cover. The OX shall be determined based on the following scenarios:

- Equal to 0.0 for landfills that have a geomembrane (synthetic) cover with less than 12 inches of cover soil for above, the landfill area.
- Equal to 0.10 for landfills that don't meet the condition above, and the methane flux is unknown or if the landfill does not have a soil cover of at least 24 inches for the majority of the landfill area.
- Equal to 0.10 for landfills that have a soil cover of at least 24 inches for a majority of the landfill area and the methane flux rate is greater than 70 g/m2/d.
- Equal to 0.25 for landfills that have a soil cover of at least 24 inches for the majority of the landfill area and the methane flux rate is 10 – 70 g/m2/d.
- Equal to 0.35 for landfills that have a soil cover of at least 24 inches for a majority of the landfill area and the methane flux rate is less than 10 g/m2/d.

✓ Is methane flux testing feasible in Chile?

✓ Are there national or regional regulations or guidelines for communicating/determining oxidation factors depending on the type of landfill cover in Chile? What is the OX used for national emissions inventories?

✓ Other comments?

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NEXT STEPS

Next steps

- ***For Interested Stakeholders:***
  - Still can submit Local Engagement Form
  - Email interest to sign up for updates as an observer
  - Email us feedback anytime
- ***For Reserve:***
  - Compile a notes summary on the discussion
  - Post recording, notes, and presentation to the webpage
  - Incorporate feedback from workgroup discussion
  - Identify areas of focus for next workgroup meeting (if needed)
- ***For Workgroup:***
  - Email feedback on today's discussion (by Septembre 10th)
  - Look out for information for the next meeting's discussion topics
  - Tentative next Workgroup Meeting: September 24th , 11:00-13:00 Chile time – Comments?

Key contacts

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THANK YOU!