REDUCING GAS LEAKAGES WITHIN THE KARNAPHULI GAS DISTRIBUTION NETWORK IN BANGLADESH

Prepared By Kevin James
kjamesqt@gmail.com

Project Title	Reducing Gas Leakages within the Karnaphuli Gas Distribution Network in Bangladesh
Version	3
Report ID	VCS 2738 – VCS Verification Period 1
Date of Issue	18-August-2022
Project ID	2738
Monitoring Period	06-January-2019 to 30-July-2020
Prepared By	Kevin James, Climate Compass
Contact	5004 River Rd., Bethesda, MD 20816, Tel: +1 (202) 340-1112 kjamesqt@gmail.com

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1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

The proposed project was registered as a CDM project on 31-July-2020. The project is reducing gas leakages from components within the Karnaphuli Gas Distribution (KGDCL) network in the People's Republic of Bangladesh, a Least Developed Country.

Construction began on the Bangladesh gas distribution system in the mid- 1960s and over the years the system has not been adequately maintained. As a result, a significant percentage of the natural gas throughput (predominately methane (CH_4)) leaks from components in the system and is released into the atmosphere contributing to global warming. The project is reducing methane, a potent greenhouse gas (GHG).

Leaks in the distribution system are caused by normal component wear, thermal and vibrational stresses and seasonal expansion/contraction cycling from ambient air temperature changes. Natural gas leaks occur through various sources including, ball/gate/plug valves, flanges, and connectors. These components have not been routinely checked for leaks under existing safety practices of KGDCL. The company operators lack the advanced leak detection equipment, advanced repair materials and trained workers to identify chronically leaking components, accurately measure the leak rates and make reliable repairs of the leaks.

The project will lead to the reduction of methane emissions at flanges, valves, insulating joints and other above ground equipment components.[1]

Project activity

The project activity will reduce natural gas leakage in the distribution network of KGDCL through the implementation of advanced leak detection and repairs (LDAR) procedures. The project activities will include inspection and leak measurements, as well as repair works at components in the natural gas above ground distribution system using advanced leak detection and measurement technology including HiFlow Samplers, Leak Measurement Devices, and Gasurveyors as well as advanced repair materials. In addition, selected staff of KGDCL will be trained in advanced leak detection, measurement, and repair techniques.

Milestone of the project activity	Timeline
The date of the commencement of the baseline study when the first activity of measuring and repairing leaks leading to the first methane emission reduction.	06-January-2019

[1] The selected methodology AM0023 (Version 04.0.0) defines a component as "above-ground process equipment in natural gas production, processing, transmission, storage, distribution systems", including valves, flanges and other connectors etc.

Milestone of the project activity	Timeline
Registration of the project activity under CDM	31-July-2020
CDM Crediting period	From 31-July-2020 till 30-July-2030 (Fixed)
1st monitoring period successfully verified under CDM	31-July-2020 – 26-November-2020 (including both days) (issued)
2nd monitoring period successfully verified under CDM	27-November-2020 – 31-December-2020 (including both days) (Issued)
1st monitoring under VCS-Period 1	06-January-2019 to 30-July-2020 (including both days)

GHG emission reductions generated between 06-January-2019 to 30-July-2020 period	**1,002,832 tCO_2e**

1.2 Sectoral Scope and Project Type

Sectoral Scope 10 – Fugitive emissions from fuels (solid, oil, and gas)

This project is not a grouped project.

1.3 Project Proponent

Organization name	EcoGas Asia Limited
Contact person	Ken Newcombe
Title	Director
Address	Brumby Centre, Lot 42, Jalan Muhibbah, Labuan, 87000 Labuan F.T. , Malaysia
Telephone	+1 202 416-2401
Email	knewcombe@cquestcapital.com

1.4 Other Entities Involved in the Project

Organization name	Climate Compass LLC
Role in the project	Project Development and Implementation
Contact person	Kevin James
Title	Managing Director
Address	5004 River Rd., Bethesda, MD 20816
Telephone	+12023401112
Email	kjamesqt@gmail.com

1.5 Project Start Date

6-January-2019 is the date of the commencement of the baseline study when the first activity of measuring and repairing leaks led to the first methane emission reduction.

1.6 Project Crediting Period

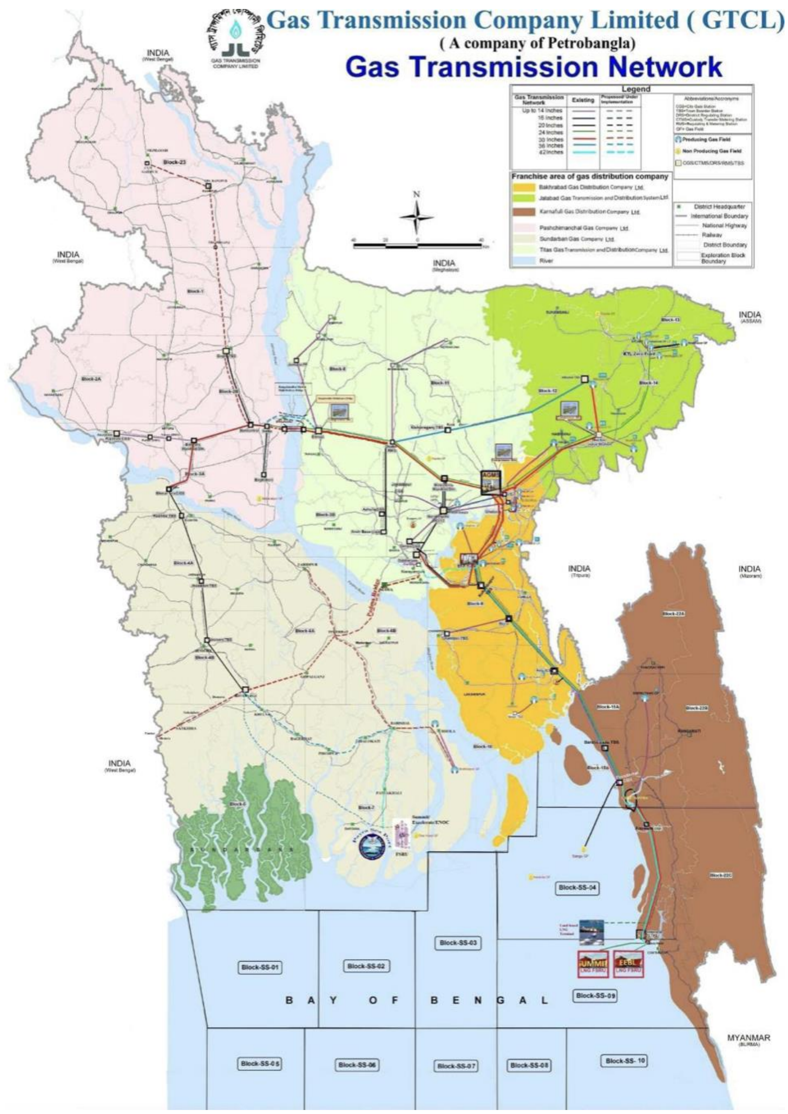
06-January-2019 to 05-January 2029 (10 years fixed crediting period).

1.7 Project Location

The entire above ground gas transmission and distribution system found in the service and franchise areas operated by: Karnaphuli Gas Distribution Company Limited including with its Headquarters at 137/A, CDA Avenue, Sholashahar, Chittagong Bangladesh (22.367532, 91.826444). The Company carries out transmission and distribution of natural gas within the southeast part of Bangladesh including Chittagong, Rangamati, Khagrachori, Bandorban, and Coxsbazar.

The exact locations of all the identified and repaired leaks are recorded in the monitoring system database using GPS coordinate, and a street address when possible or a description of the location. A photo of the leak repair will also be provided for each leak include in the project. The map below indicates the general area in brown color included in the project.

Map 1



1.8 Title and Reference of Methodology

The methodology AM0023 (Version 04.0.0) the project utilized is a methodology approved under CDM Program, that is a VCS approved GHG program.

Approved baseline and monitoring methodology for large-scale CDM project activities: AM0023 (Version 04.0.0): “Leak detection and repair in gas production, processing, transmission, storage and distribution systems and in refinery facilities”.

The methodology above refers also to the latest “Combined tool to identify the baseline scenario and demonstrate additionality.”

1.9 Participation under other GHG Programs

The project is registered under the United Nations Clean Development Mechanism (CDM) Program with the registration number 10560 and all project information can be found at https://cdm.unfccc.int/Projects/DB/RINA1583158638.05/view

1st monitoring period (CDM)	31-July-2020 to 26-November-2020 (including both days)	218,034 CERs
2nd monitoring period (CDM)	27-November-2020 to 31-December-2020 (including both days)	73,868 CERs

1.10 Other Forms of Credit

This Project is not covered under any other trading programs or binding limits and does not receive any other forms of environmental credits.

1.11 Sustainable Development Contributions

In addition to reducing greenhouse gas emissions, this project will also contribute to the People's Republic of Bangladesh's sustainable development goals by:

- Improving environmental quality and minimizing risks for employees and local communities due to the reduction of harmful pollutants (methane);
- Preserving a finite resource (natural gas).;
- Capacity building of the local staff in advanced LDAR techniques;
- Transferring advanced technology that have heretofore not been utilized in Bangladesh;
- Job creations through the hire of around 21 permanent staff;
- Strengthening human capital in the country through retention and employment of locals to support the project implementation.

Table 1: Sustainable Development Contributions

Row number	SDG Target	SDG Indicator	Net Impact on SDG Indicator	Current Project Contributions	Contributions Over Project Lifetime
Sequential row number	*SDG Target number*	*Number and text of SDG indicator or, if no official SDG indicator is applicable, user-defined indicator*	*Indicate the project's contribution to the SDG Indicator (implemented activities to increase or decrease)*	*Brief description of the quantifiable impact of the project's activities related to the SDG indicator, during the monitoring period.*	*Brief description of the cumulative quantifiable impact of the project's activities related to the SDG indicator, over the project lifetime.*
1)	7.1	7.1.2 Proportion of population with primary reliance on clean fuels and technology	Implemented activities to decrease natural gas losses from distribution pipeline. Improved availability of economically important fuel.	84,073.1 l/min of new leaks were found and repaired.	Found and eliminated gas leakage totaling more than 85,376 liters per minute
2)	9.4	9.4.1 CO_2 emission per unit of value added	Implemented activities to decrease natural gas per units of GDP	84,073.1 l/min of new leaks were found and repaired meaning increased GDP output is achieved with the same natural gas input as less methane is lost into the atmosphere and more methane goes toward useful economic purposes	Over 85,376 liters per minute of new leaks were found and repaired meaning increased GDP output is achieved with the same natural gas input as less methane is lost into the atmosphere and more methane goes toward useful economic purposes

3)	13.0	Tonnes of greenhouse gas emissions avoided or removed	Implemented activities to increase	Reducing methane emissions from pipeline from leaks by identifying and making repairs and undertaking regular monitoring. Prevented the release of 1,002,832 tonnes of carbon into the atmosphere	Prevented the release of over 2,166,000 tonnes of carbon into the atmosphere
4)	11.6	By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management	Reduce potentially dangerous and harmful methane leakage	84,073.1 l/min of new leaks were found and repaired eliminating possible dangerous and harmful local emissions	Over 85,376 liters per minute of new leaks were found and repaired eliminating possible dangerous and harmful local emissions
5)	8.5	By 2030, achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value	Creating well paid jobs with advanced technical training including entry level jobs for young people with chance of promotion	21 workers associated with this project continue to be employed	21 full time workers have been hired

2 SAFEGUARDS

2.1 No Net Harm

The project is focused on reducing natural gas losses from the distribution network of the People's Republic of Bangladesh. As such, the project does not require any infrastructure or components that would create any local or regional air/water/pollution impacts. In particular, materials and equipment used in this project do not emit harmful substances into the atmosphere, and are not a source of noise, vibration, or any other harmful physical impact.

2.2 Local Stakeholder Consultation

To undertake the monitoring activity, the monitoring teams attempt to visit every riser included in the database in each monitoring period. In the process of conducting the monitoring, they regularly meet the customer and explain that they are repairing and maintaining leaks. They receive regular feedback from customers. In addition, the gas company maintains a customer service line and any issues that arise are passed to the teams as needed. The feedback from all these sources can be summed up as "please find and repair more leaks and faster."

2.3 AFOLU-Specific Safeguards

This is not an AFOLU project.

3 IMPLEMENTATION STATUS

3.1 Implementation Status of the Project Activity

As part of the monitoring activity the monitoring team attempts to visit and check the integrity of each leak repair on the risers included in the project boundary. Every single visit and the result in included in the Emission Reduction Database. Furthermore, hardcopies, electronic copies, photos, and downloaded measurement files are also maintained. During these monitoring visits, if the teams find additional leaks on the risers, as per the methodology, they measure the leak rate, make repairs immediately and add the leaks to the project database. In addition, some risers are removed during the monitoring period during the normal course of development as old buildings are removed and new construction takes its place. These are tracked as well and "cut out" risers are removed from the database. Not every leak repair can be visited during the monitoring period as construction or other impediments prevent the team from taking the required measurements. To be conservative, no Emission Reductions are claimed in the monitoring period for those leak repairs that could not be monitored.

3.2 Deviations

2.1.1 Methodology Deviations

There have been no methodology deviations.

2.1.2 Project Description Deviations

There have been no project deviations.

3.3 Grouped Projects

This is not a grouped project.

4 DATA AND PARAMETERS

4.1 Data and Parameters Available at Validation

Data / Parameter	GWP_{CH4}
Data unit	tCO2e/tCH4
Description	Global warming potential
Source of data	The Fifth Assessment Report of the Intergovernmental Panel on Climate Change
Value applied	GWP_{CH4} = 28 for the commitment period
Justification of choice of data or description of measurement methods and procedures applied	5^{th} Assessment Report of the IPCC
Purpose of Data	Convert tCH_4 to tCO_{2e}
Comments	This value applies for the calculation of the baseline and project emissions.

Data / Parameter	ConvFactor
Data unit	tCH4/ Nm3 CH4
Description	The factor to convert Nm3 CH4 to tCH4
Source of data	-
Value applied	0.0007168

Justification of choice of data or description of measurement methods and procedures applied	The leak flow rate (FCH4,j) and conversion factor (ConvFactor) should be reduced to the same reference conditions. As noted from correspondence by Heath Consultants the Hi-Flow™ sampler automatically accounts for standard temperature and pressure (i.e., 0 degree Celsius and 101.3 kPa) in its leak flow rate (FCH4,j) measurements. As such, a conversion factor (ConvFactor) of 0.0007168 reflects the methane density at 0 degree Celsius and 101.3 kPa, which is derived by dividing the methane density at standard conditions by Avogadro constant (22.414 l/mol). This value is taken from literature, and is applied to convert Nm3 CH4 to tCH4
Purpose of Data	This value applies for the calculation of the baseline and project emissions
Comments	The Hi-Flow™ Sampler automatically adjusts readings to standard temperature and pressure (0°C and 101.3 kPa) so conversion rate for these conditions is applied.

4.2 Data and Parameters Monitored

Tz and URz parameters are not reported here as there were no Project Emissions.

Data / Parameter	$T_{j,y}$
Data unit	Hours
Description	The time the relevant component, in which physical leak j, occurred, would leak in the baseline scenario and would be eligible for crediting during the crediting year y (hours)
Source of data	Operational logs. The repairs will be cross referenced with customer ID numbers which will require the involvement of local offices and their revenue personnel. The time period of any shutdown is subtracted from the emission reduction calculation.
Description of measurement methods and procedures to be applied	The dates of the various measurements are recorded directly by the operators on handwritten files and are captured electronically in the Hi-Flow Samplers and cameras. These dates are cross-referenced with operational logs to determine how many hours of operation the leak repair functioned during the monitoring period. Any shut-offs of equipment are deducted from the time of operation.
Frequency of monitoring/recording	The measuring is ongoing throughout the monitoring period.

Value monitored	Multiple Values for each leak 'j' (see Emission Reduction Calculation sheets for each leak including shut-offs where applicable)
Monitoring equipment	The dates of the various measurements are recorded directly by the operators on handwritten files and are captured electronically in the Hi-Flow Samplers and cameras.
QA/QC procedures to be applied	Any outages resulting from system repairs will be documented and logged in the project database in the form of a reduction in the time of operation. To be clear, if an unrelated activity requires the shut-down of an already repaired piece of component, the hours of operation for every piece of affected component with be reduced in the database for the entire duration of the shut-down. Any other unscheduled shutdown will also be timed and accounted for through a reduction of operating hours.
Purpose of the data	This value applies for the calculation of the baseline emissions
Calculation method	Hours of system operation are tabulated with any system shut offs affecting a leaking repair subtracted from the total hours of operation
Comments	To be conservative, it is assumed that any reappeared leak found in a given monitoring period occurred immediately after the previous monitoring period ended.

Data / Parameter	**Temperature and pressure of natural gas**
Data unit	°C and bar
Description	The temperature and pressure at the point at the time of measurement.
Source of data	Included in the HFS measurement.
Description of measurement methods and procedures to be applied	The Hi-Flow™ Sampler automatically adjusts readings to standard temperature and pressure (0°C and 101.3 kPa) and this is reflected in the machine's margin of error. Therefore, there is no need to monitor these parameters separately. They are integrated in the measurement results
Frequency of monitoring/recording	Done with each leak measurement.
Value monitored	Included in the HFS reading of leak-rate. (See the Emission Reduction calculation sheets). Temperature and pressure measurements are taken into account by the hi-flow sampler at

	the time of measurement and are integrated into the results from the hi-Flow sampler device.
Monitoring equipment	Included in the HFS measurement.
QA/QC procedures to be applied	The high flow sampler is calibrated and double checked every 30 days while in use with the date and signature of the person in-charge of the calibration recorded in a calibration log.
Purpose of the data	This value applies for the calculation of baseline and project emissions.
Calculation method	Values accounted for in the HFS measurement.
Comments	-

Data / Parameter	**UR_j**
Data unit	Fraction
Description	The uncertainty range for the measurement method applied to leak j
Source of data	Calculated using the manufacturer's documented margin of error ±10% per measurement and the data of each measurement.
Description of measurement methods and procedures to be applied	Estimated using a 95% confidence interval per guidance provided in Chapter 6 of the 2000 IPCC Good Practice Guidance. The URj is calculated using leakage flow rates and the respective UR of the Hi-Flow sampler used for the leak. The uncertainty calculations are included in the ER calculations spreadsheet.
Frequency of monitoring/recording	Measurements are taken regularly with the Uncertainty calculated from all the measurements
Value monitored	0.00151890 for the period 06 January 2019 to 30 July 2020 (see Emissions Reductions calculation sheets for complete calculations)
Monitoring equipment	Leaks are identified and measured using the Hi-Flow sampler. The serial numbers, calibration dates are listed above. The calibrations as per manufacturer's recommendation are valid for one month. The readings as per the operator's manual are ±10% accurate.
QA/QC procedures to be applied	The high flow sampler is calibrated and double checked every 30 days while in use with the date and signature of the person in-charge of the calibration recorded in a calibration log.

Purpose of the data	This value applies for the calculation of the baseline emissions
Calculation method	Leaks are identified and measured using the Hi-Flow sampler. The serial numbers, calibration dates are listed above. The calibrations as per manufacturer's recommendation are valid for one month. The readings as per the operator's manual are ±10% accurate.
Comments	Assures to a 95% level of confidence as per methodology that the measurement values used in the calculations are conservative.

Data / Parameter	$F_{CH4,j}$ / $F_{CH4,z}$
Data unit	m^3CH4/h
Description	The leak flow rate of methane for leak (j, z) from the leaking component
Source of data	From Hi-Flow™ sampler readings during on-site measurements and Gasurveyors
Description of measurement methods and procedures to be applied	Gasurveyors are used to detect any gas leakage and HFS are used to measure any leakage detected.
Frequency of monitoring/recording	At least once per monitoring period
Value monitored	See ER calculation sheet for the values of each j and z.
Monitoring equipment	Manufacturer procedures applied. Measurements with Hi-Flow™ Sampler are automatically adjusted to the methane content, temperature and pressure and, thus, will directly yield methane leak flow rates. Gasurveyors are used to check for any reemerged leakage.
QA/QC procedures to be applied	The high flow sampler is calibrated and double checked every 30 days as per manufacturers specifications while in use with the date and signature of the person in-charge of the calibration recorded in a calibration log. The Gasurveyor is calibrated as per manufacturer specifications at least once per year.
Purpose of the data	This value applies for the calculation of baseline and project emissions
Calculation method	Measurement devices
Comments	Values taken from Hi-Flow sampler measurements. In some small number of cases, access to the repaired equipment was

	blocked (construction sites, street repairs, etc.) preventing the monitoring teams from accessing leak repairs to monitor them. In order to ensure the results are conservative, no Emission Reductions were claimed in this period for those leaks that were not able to be monitored.

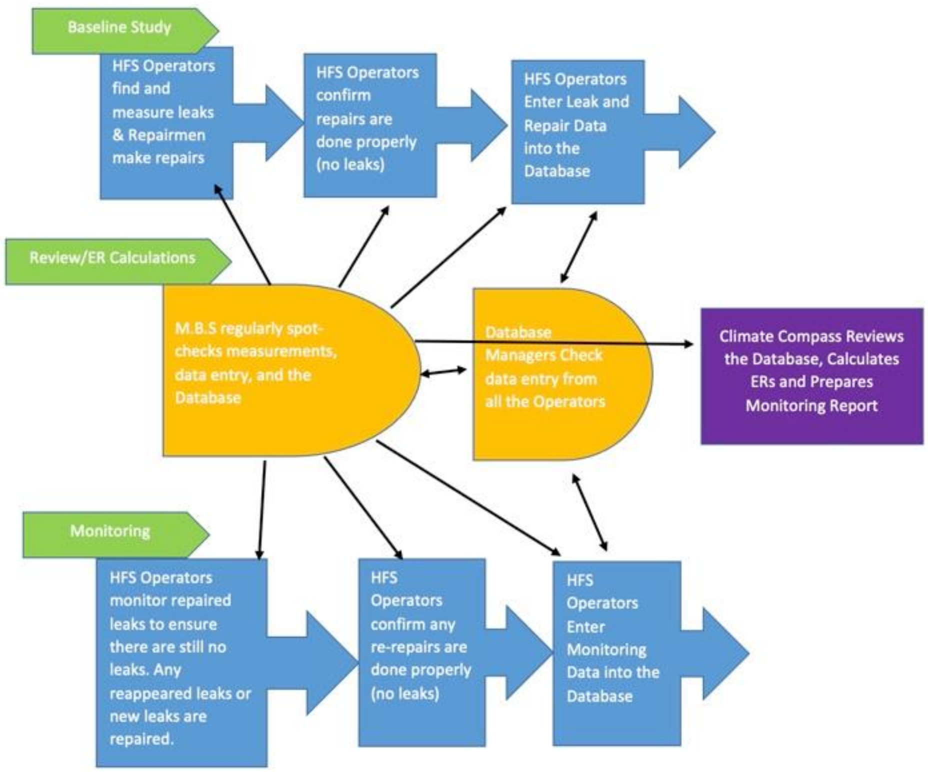
Data / Parameter	BE_{CAP}
Data unit	tCO2e
Description	Capped quantity of the baseline emissions, defined as the baseline emissions for the first year of the crediting period
Source of data	Measured and calculated based on baseline methane emission reductions reduced in first year
Description of measurement methods and procedures to be applied	Monitored baseline emissions during the first year of the first crediting period
Frequency of monitoring/recording	Once during baseline and calculated. Calculated after the baseline leak detection and repair period is completed
Value monitored	1,384,331 for the period 06 January 2019 to 30 July 2020 (see Emissions Reductions calculation sheets for complete calculations)
Monitoring equipment	Measurements of leaks taken with Hi-Flow Samplers
QA/QC procedures to be applied	Calculated from verified baseline methane emissions using appropriate GWP for methane from 5th Assessment of IPCC.
Purpose of the data	Capped quantity of emissions that can be claimed
Calculation method	Avoided methane emissions in the first year of the crediting period converted to reduction in tCO2e using GWP for methane from 5th Assessment of IPCC.
Comments	-

4.3 Monitoring Plan

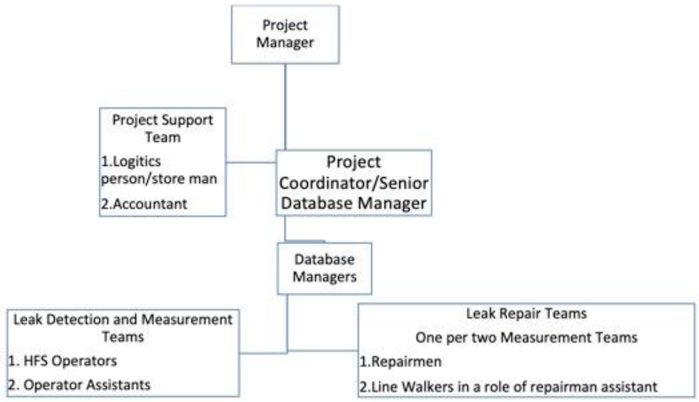
Summary of the Project Team and Roles

The project takes place on the gas distribution system of KGDCL. Ecoeye Co., Ltd and the Korea Midland Power Co. Ltd. (KOMIPO), two corporate entities in Republic of Korea, have provides all the funds required to implement the Project. The Project is overseen by EcoGas Asia, which has hired Climate Compass LLC. to manage the project implementation including providing the survey equipment, repair materials, transportation for the project, and compliance with the approved methodology. Climate Compass has hired MBS as a 3rd party technical consultant to help confirm through regular inspections that the project is compliant with the methodology. Climate Compass hired Brawa Consulting to assist in the local project management. Climate Compass has also hired the Dhaka based company Prokaushali Sangsad Limited (PSL), to do much of the project implementation work on a day-to-day basis. The PSL team includes project managers to direct the daily workflow, database managers to ensure the data gathered from the project is recorded correctly, operators in the field who take the appropriate measurements and log the data, and repairmen. The roles and responsibilities of each of these parties is described in more detail below.

The flow of data in the project occurs as follows:



Monitoring Team Structure



MONITORING TEAM

The CDM Project team consists of by key staff from the Dhaka based company Prokaushali Sangsad Limited (PSL).

The **Project Manager** responsible for PSL's CDM team is Mahbub Sarwar.

Another important role within the KGDCL CDM team is that of the **Senior Database Manager**. The Main Database Manager plays also role of the Project Coordinator. He is coordinating **Leak Detection and Measurement Team (LDMT)** activity with the Gas Company. He oversees the Project database, which includes all baseline, measurement, repair and monitoring data provided by the **LDMT** Hi-Flow Sampler Operators. The Senior Database Manager for the duration of this monitoring period was Tanvir Ahmed with support from Saifur Rahaman of PSL.
Climate Compass (CC) and MBS (third party consultants) have maintained their involvement and oversight during the entire monitoring period. In addition, both Climate Compass and MBS have undertaken a full review of the database.

The LDMT gather data for entry into the Project Database from their own field observations and input from the Repair Team. The LDMT are responsible for leak detection and measurement, subsequent measurement of repairs, and ongoing monitoring of repairs using sophisticated leak detection and measurement equipment – the Gas Surveyor and the Hi-Flow Sampler (HFS). Operators from the LDMT take written field notes, draw schematics and take pictures, which they then transcribe into excel format. The excel forms are delivered to the Database Managers, who review the data for errors before entering it into the Project Database.

The **Repair Team** was organized and trained for the purpose of executing the CDM Project. Members of the Repair Team are comprised, for the most part, of experienced KGDCL and PSL employees who were trained in the use of modern repair materials and repair techniques. While the numbers varied based on availability of staff across the project, the typical LDMT Cell was linked with repairmen tasked with completion of repairs. In addition, often local line walkers were temporarily included on the team to provide access in cases where cabinets were locked and at times these people served as repair assistants.

The inventory of modern repair materials supplied by EcoGas Asia, as well as secure storage of the expensive Hi-Flow Samplers, is the responsibility of the PSL Store Men, Tariqul Islam and Saidur Rahman.

RESPONSIBILITIES OF DIFFERENT PARTIES

The Leak Detection and Measurement Team

Responsibilities:

- **LDTM** units undertook an initial baseline study across the gas distribution system.
- Once a new leak was encountered and measured, thereby generating a baseline reading, operators from the LDMT informed the Repair Team whose responsibility was to repair the leak.
- Throughout the duration of the monitoring period of the Project, the LDMT has checked existing repairs for the re-appearance of leaks.

Certification of members of the LDMT by MBS

The following members of the LDMT are certified as competent to perform leak measurement using the Hi-Flow Sampler, Gasurveyor 500, and related techniques by MBS. All certificates are available upon request.

M.B.S certified as Operating Managers:

1. Mr. Tanvir Ahmed at April 2016
2. Md. Saifur Rahaman at November 2016
3. Md. Belayet Hossain at November 2016
4. Md. Abdul Barek at November 2016
5. Md. Mohi Uddin at April 2019
6. Md. Tanzilur Rahman at April 2019
7. Nasrullah Bin Anower at November 2016

Those 7 persons did Database Managers' job for this project.
M.B.S certified as Operating Manager:

8. Habib Sheikh at November 2016
9. Md. Kowser Ali at November 2016
10. Md. Salim Saharier at November 2016
11. Md. Hannan Kawsar at November 2016
12. Mostafizur Rahman at November 2016
13. Md. Sekendar Ali at November 2016
14. Md. Sazzad Hossain at November 2016
15. Md. Shakhowt Hoshain at November 2016
16. Md. Abdur Razzak Razu at November 2016
17. Md. Golam Mourtuza at November 2016
18. Shanta Roy at April 2019
19. Md. Ariful Islam at April 2019
20. Md. Mizanur Rahman at April 2019

21. Rasheduzzaman at April 2019
22. Mir Mustafizur Rahman at April 2019
23. Md. Atik Shahriar at April 2019
24. A.S.M. Saiem Solimullah at April 2019
25. Md. Galib Hassan at April 2019
26. Md. Sohanur Rahman at April 2019
27. Md. Rakib Hasan at April 2019
28. Md. Mahabubur Rahman at April 2019
29. Zahid Hasan at April 2019
30. Rayhan Ahmed Rahat at April 2019
31. Md. Rajon Ali at April 2019
32. Sayed Fazlay Rabby at April 2019
33. Tanvir Ahammad Hero at April 2016
34. Anwar Hossen Shomon at October 2019
35. Md. Kausar Ali at October 2019
36. Nazmul Hasan at October 2019
37. Abir Chowdhury at October 2019

Ongoing *Training by MBS and Experienced Operators*

Ongoing training in the use of the Hi-Flow Samplers is provided by MBS during remote inspections.

Table showing time spent by MBS staff for remote inspections during the 3rd monitoring period:

Date	MBS staff	Working Days
12-20/06/2019	V. Potapenko O. Potapenko A. Rudenko	9 9 9
Total MBS' days spent for inspecting the Project		27

Baseline Selection:

In selecting leaks to be included in the baseline, the LDMT followed the Decision Tree when deciding whether or not a leak could be added to the baseline, the LDMT first had to determine whether or not it constituted an Emergency Repair. If the repair involved equipment that had ceased to function altogether, then the repair was deemed an Emergency Repair, and therefore, the repair did not qualify to be included in the Project Database. To be clear, an emergency repair will not ever be added to the ER Master file used to calculate ERs. This is the case because this work is done by completely separate staff that has no access to the ER database.
Additionally, the KGDCL staff do not measure the leaks for an emergency repair and would have none of the accompanying paperwork that is required to upload the leak into the database and cross check the results (paper file, excel sheet with photos, etc). In fact, the emergency repair teams do not have Hi-Flow samplers and so no record of a measurement could ever be taken. Finally, if a piece of leaking equipment that is in the database is replaced on account

of an emergency leak at a later date, this would be noted during the subsequent monitoring visit (the equipment would be changed and not match the picture and technical drawings of the site) and any additional ER calculations would be terminated in the database as with any cut-off point. Therefore, the ER Master File database has no leaks that result from emergency repairs.

The next branch of the Decision Tree considers the schedule for equipment replacement. If the equipment has been scheduled for replacement, then the leak is only included up until the actual time of equipment replacement. The company maintains a record of all the equipment that has been replaced and the project's database of leak locations is checked against these records for the verification time period. During each monitoring visit the operator checks the current configuration of the equipment against the photographs and technical schematics completed during the baseline study. Database entries representing leaks that have been shut off are no longer used to calculate ERs. KGDCL does not replace equipment based on age. In fact, as was confirmed during validation, there is no average lifetime of equipment as most of the equipment is still in use as during the last 20 years no major replacements have occurred. Therefore, the expected lifetime of non-replaced equipment will exceed the crediting period.

Lastly, if the leak can be identified and repaired with materials and know-how available prior to the Project-such as a simple tightening of a loose fitting or connection-then such a leak has not been included in the Project Database. The decision process described above was implemented through intensive training given to all operators before they collected baseline data. To be clear, the operator who has identified and measured the leak with the Gas Surveyors and Hi-Flow Samplers only includes the leak in the database if the leak could not be immediately repaired in the field by simply tightening the fittings. The repair team that is then sent out to fix the leak uses advanced repair materials provided though the Project to make the repairs.

Recording of Leaks

For each leak that satisfied the test for inclusion in the Project Database, the LDMT recorded the information as follows:

- The date of leak detection (dd-mm-yyyy)
- The date of leak repair (dd-mm-yyyy)
- The exact location of the leak including GPS coordinates
- The leak flow rate prior to repair (l/m)
- The measurement method (Leaks may have been initially detected using soap solution and Gas Surveyors. Once a leak was detected, all measurements for leak flow rate were taken using Hi-Flow Samplers, each Hi-Flow Sampler unit was assigned a number and the unit responsible for each measurement was thereby recorded. Furthermore, Hi-Flow Samplers recorded each measurement with a number between 1 and 999; the number corresponding to each measurement of leak flow rate is recorded in the Project Database. After the leak was repaired, the Repair Team used a soap solution to check the quality of the repair.
- The nature of the repair made (whether or not it involved replacement of equipment, use of advance repair material or another method).

  The LDMT followed additional quality control and assurance measures to better record and permit future rigorous monitoring of each leak. These measures were:

- A weatherproof tag was attached to each leak with the measurement date, the Hi-Flow Sampler number, the name of the measured point and the leak flow rate all recorded on the tag.

▪ It should be noted that many of these tags have been stolen or removed by a member of the curious public. There is an ongoing effort to replace tags that have been removed. As envisioned, however, the other back-up methods have proved sufficient for the purpose of recording and identifying leak locations.

- Digital photos were taken of the tag and immediate area of the leak to permit future identification of both the leak and its location. Digital photos have been numbered, time stamped and recorded. Smartphones with cameras were supplied.
- A schematic was drawn in the **Excel Form** (Described below), showing the location of the leak on a raiser and the method used to repair it, which serves to simplify the detail shown on the photographic record.

Field observations were recorded using common format written field reports. The field reports include details on the location and date, the readings from the Hi-Flow sampler, the Hi-Flow sampler serial number, a schematic drawing of where the leak was found on the equipment, notes on the repair required and other key details described above. These reports are kept on file and can be easily cross referenced by the operators at any time with electronic files.

Members of the LDMT are responsible for transcribing all details noted above from the hard copies into a common format Excel Form and inserting the aforementioned photographs, schematics. The Excel sheets include the information that is included on the hard copy reports and are saved in multiple places to ensure their continued safety.

These Hi-Flow Sampler readings transcribed onto the Excel sheets are cross referenced with the actual Excel data files that are generated by the Hi-Flow Samplers to ensure accuracy. The data files from the Hi-Flow Samplers contain up to 999 measurements and are downloaded before they exceed this number. The data is cross-referenced using the Hi-Flow Sampler serial number and date of measurement with the manually input spreadsheet.

Once all the information above is transcribed into an Excel Form and checked, this Excel Form is sent to a Database Manager, who is responsible for entering the data into the Project Database. A column in the Project Database is devoted to each of the data fields noted above. This master database provides the ER calculations and the data can be transparently traced back through each of the other data records.

Monitoring of Repaired Leaks

The task of monitoring leaks requires the LDMT to perform the following steps:

- Finding the repaired leak: The HFS Operator returned to the address of a repaired leak using primarily the GPS coordinates and the leak tag to locate and identify the leak (The precise location of each repaired leak is indicated by a tag; and contained on the Excel Form are a schematic diagram, and a digital photograph). In a number of instances, the leak tag was absent, presumably removed by children (Much of the gas infrastructure is within easy reach of children). In such instances, the schematic diagram and photograph served as a precise record for the location of the repaired leak and a new tag was attached to the site of the leak. Replacement tags have been supplied.
- Once the repaired leak was located, the following information was recorded:

▪ Date of monitoring (dd-mm-yyyy)
▪ Measurement method (Initially the LDMT used Gas Surveyors to establish whether a leak in the Project Database had begun leaking again, if it was shown to be leaking, then it

employed a Hi-Flow Sampler to measure the leak flow rate and the responsible Hi-Flow Sampler's unit number was recorded)

- Leak flow rate (if any) (l/m)
- Measurement number in the Hi-Flow Sampler memory
- If the leak required re-repair, then a repair team was dispatched and the following was recorded:
- Date of re-repair (dd-mm-yyyy)
- The repair materials

The LDMT recorded the information above on common form Field Notes and transcribed the data into the same Excel spreadsheet that was used when the leak was entered into the Project Database.

In a small number of cases, the repaired leaks were inaccessible to the monitoring teams (construction sites, road repairs, etc.). In order to be conservative, these leak repairs were not counted towards the calculation of ERs. The teams will attempt to visit them in subsequent monitoring periods to include them in those ER calculations.

Equipment Provided to Leak Detection and Measurement Team

Each unit of two HFS operators was supplied, with the following equipment). The equipment provided proved sufficient for the LDMT to perform all of its aforementioned tasks.

- Hi-Flow Sampler
- Rental cars
- Smartphone with GPS
- Gas Surveyor
- Tags
- Personal computer

Quality Control and Quality Assurance

- **Hi-Flow Sampler Digital Records:** All leak flow rate measurements present in the Project Database were compared by members of the LDMT against the Hi-Flow Sampler record to double check them for accuracy. In all instances when a Leak Flow Rate measurement in the Excel Notes taken by the LDMT differed from the downloaded data taken from the Hi-Flow Sampler, the measurement's record in both the Project Database and the Excel Forms was changed to reflect the download taken from the memory of the Hi-Flow Sampler. The step was taken because the data downloaded from the Hi-Flow Sampler is not subject to manual transcription error. As a final check we ran an electronic cross-reference search between the Hi-Flow Sampler records and the master datasheets to confirm consistency between the two separate data repositories. Any discrepancies were manually checked and errors corrected.

- It should be noted that some of the Hi-Flow Sampler Records were corrupted during the download from the machine to a PC. We have been working with the LDMT staff to eliminate human error factors in the download process but as a result we have some problems with data quality during data transfer that were recorded. Some records contained a minor error such as dates or HFS number being entered incorrectly. While these missing records are inconvenient, we still have all the other pertinent sources of data (manual hard-copy, photo, tags, excel file copies and master data logs) to confirm and cross check data as per the monitoring plan.

Unfortunately, there is not much that can be done to fix this technical issue. The Hi-Flow Sampler is no longer being sold and there are no spare parts available to fix this fault. The team worked with a computer expert to determine that the time/date chip in these particular HFS units is malfunctioning. However, no replacement's part or service is available from the HFS manufacturer to solve this problem, as it no longer is supporting this product.

The methodology, however, clearly envisaged situations exactly like this where one source of data is corrupted as it asks for redundant data recording techniques to be applied just in case such an error in one data source is found. The leak data for every individual leak is included: in the electronic database by the operator, on unique hard copies created by the operator at the time of measurement, within the downloadable electronic memory of the HFS, and on tags attached at the site of each leak. In this case, due to an unrepairable system error in these particular machines, the downloadable electronic database is simply providing the wrong year. This error is easily recognized and the other, redundant data sources, can confirm the correct date. As a further source of accurate data, all errors are kept in an error log that documents all the data errors found, explains the reason for the errors, and explains the action taken to address the problem. In this case, going forward, we will attempt to use other HFSs with operational date/time functions to monitor results whenever possible, as the monitoring requires fewer HFSs.

HFS memory files for some reason due to coding error are found in both the following date format mm/dd/yyyy or mm.dd.yyyy or mix of those two formats. Both types of dates convert into Excel improperly. Excel also does not recognize date as a date after the conversion. Edits were made, and these date formatting errors now conform to the format dd.mm.yyyy.

Database Managers

Responsibilities
The Senior Database Manager and Database Manager are responsible for entering all baseline, measurement, repair and monitoring data into an excel spreadsheet, known as the Project Database. In addition, the Senior Database Manager performs a Quality Assurance and Quality Control function. They check for reasonableness and accuracy of all data they enter into the Project Database using Excel Forms transcribed by members of the LDMT from their Field Notes.

Detailed Description of the Work Performed by Database Managers

Data entry
Most of the Senior Database Managers' information was supplied by the LDMT. The information was contained within an Excel form transcribed from a Field Report. For the purpose of recording a leak and its ongoing monitoring, data for the following fields was entered into the Project Database:

- Number and location of the regulator system (street address and building number & GPS Coordinates)
- Region
- Name of operator in Leak Detection and Technical Measurement Team.
- Name of responsible person on the Repair Team
- Leak number (code)
- Type of facility surveyed (Residential or Commercial Gas Metering System)

- Component that was leaking
- The leak flow rate
- Hi-Flow Sampler instrument number
- Leak record number in the Hi-Flow Sampler memory (1-999)
- Date and time of measurement / repair (dd-mm-yyyy)
- Digital photo number(s)
- The date of leak detection (dd-mm-yyyy)
- The date of leak repair (dd-mm-yyyy)
- The date of each monitoring action (dd-mm-yyyy)
- The date of leak re-repair (If necessary) (dd-mm-yyyy)
- The measurement method (Leaks were first sought using a Gas Surveyor. When leaks were present, all measurements of actual leak flow rates were taken using Hi-Flow Samplers. The HFS number responsible for each measurement was recorded)
- The nature of the repair made (Whether or not it involved replacement of equipment, usage of PTFE tape or another method)
- Form of re-repair (If necessary)
- Note about any removal of equipment with leaks and any shut off occurrences.

As the average lifetime of the equipment was determined during validation to be beyond the duration of the crediting period, all non-replaced equipment is eligible for credits from repairs.

Quality Control and Quality Assurance

- **Reasonableness:** The Senior Database Manager and Database Manager checked all data for reasonableness before it was entered into the Project Database. For example, if an operator entered a date incorrectly, such as an illogical time series, then the Senior Database Manager spotted the error and asked the operator to check his field notes for manual transcription error. The minor error caused by inconsistent date conventions was quickly caught and addressed through the QA/QC steps.
- **Materiality:** All baseline leak flow rate measurements that were recorded in excess of 20 liters CH_4 per minute were subject to additional scrutiny: The Database Managers requested that members from the LDMT check all data fields for any transcription error before adding such data to the Project Database.
- **Tracking by HFS and LDMT unit:** Each measurement of a leak flow rate entered into the Project Database can be associated with a given unit from the LDMT and a given Hi-Flow Sampler unit. Such granularity helps the Database Managers isolate problems in data entry to one two-person unit or associate faulty measurements with one Hi-Flow Sampler unit. The Database Management Team did not identify any systemic problems with any particular unit or Hi-Flow Sampler unit.

Data Protection and Storage

The protection of data is vital to the Project. Parties involved in the Project have followed the three guidelines described, namely:

- MBS maintains digital copies of Project Data. All the data was stored in PSL as well. Then the data was kept on individual computers at the in the PSL offices. Climate Compass has also stored backup files.

Repair Team

Responsibilities

The Repair Team, created to serve each of the three cells, was responsible for repairing leaks identified by the LDMT. All members of the Repair Team were trained in the use of modern repair materials and techniques. The Repair Team was in place during the initial repair period and continues to be available to redo repairs that have started to leak again during part of the measurement period.

Training

The project manager and his deputies trained each member of the Repair Team, with assistance from MBS. Members from the Repair Team were forbidden to use anything other than the modern repair materials listed below.

Modern Repair Materials and other equipment supplied to the Repair Teams

- Rental car
- Tags (To replace missing tags and indicate repair information on tags)
- Modern Repair Materials such as:
  - **Tangit thread** – Thin synthetic thread absorbed by silicon for sealing pipe threads of 15-25 mm diameter.
  - **O-rings –** Made of high quality nitrile rubber for replacement in leaky gaskets made of rubber
  - **Paste** – High quality made for sealing conical connections of low pressure valves
  - **Valves** – For replacement broken high and low pressure valves
  - **Pressure regulators** - to replace broken bodies of such regulators
  - **Membrane material sheets** – For making new membranes
  - **Teflon tape –** High density Gas PTFE tape for sealing pipe threads (Pipe diameter – 15-50 mm).
  - **Fittings and pieces of pipes with gas threads** – for replacement broken components
  - **Insulating Joints** – to replace broken leaky IJ
  - **Repair tools** – good quality gas wrenches to do repair

Description of Repair Process and Interaction with Leak Detection and Measurement Team

Once a qualifying leak was detected by the LDMT (Regardless of whether it was a leak that qualified to be added to the Project Database or a re-appearance of a leak already present in the Project Database), a LDMT unit interacted with a Repair Team unit by first recording the leak's location, exact description, and other relevant information in a Field Report and upon its return to the office, submitting a copy of its Field Report to the Repair Team unit. Each Cell from the LDMT were typically assigned to the same unit of the Repair Team to facilitate communication, familiarity with a given district of the gas system, as well as fulfil a QA/QC function (described below). The Repair Team unit subsequently visited the leak described in the Field Report and was responsible for implementing the repair and recording its work.

Rental Car Service

KGDCL lacks appropriate transportation for the CDM Project. Hence, for the duration of the Baseline Study and monitoring period, PSL hired vehicles, complete with drivers, of sufficient size and specification to allow members of the Repair Team and LDMT to fulfil its roles.

EcoGas Asia Project Team

Ecoeye Co., Ltd., and KOMIPO through EcoGas Asia have provided the capital necessary via Climate Compass to purchase equipment used to implement the Project, including purchasing modern repair materials, provided training in the use of modern repair materials and measurement equipment, rented vehicles, and purchased computers and software for the Project Database.

Climate Compass with its partners MBS Services and Brawa Consulting, provide project management, quality control and ongoing training of PSL Employees.

MBS

MBS Ltd., a Ukraine-based technical consultancy, has significant experience and expertise concerning the preparation and execution of gas leak reduction projects in transmission and distribution systems. MBS Ltd. has more than 6 fully trained and certified staff able to operate, calibrate, and manage the data outputs of Hi-Flow Samplers and other leak detection tools such as the Gas Surveyor. Certification was attested to by Heath Consultants the sole distributor of the Hi Flow Sampler.

MBS ltd. staff have logged thousands of hours taking leak measurements, assisting in database development and management and directing the day-to-day management of leak detection and repair programs. It has hands on experience working with many of the advanced repair materials required to eliminate leaks. Its team has surveyed gas systems and compressor stations for companies in Ukraine, Uzbekistan, Georgia, Egypt, Bangladesh and Pakistan.

MBS Ltd. was responsible during the monitoring period for quality control of the Project. MBS Ltd. was present in the field during parts of the monitoring period.
During its visits MBS:

- Verified that maintenance and monitoring of leaks was being conducted in accordance with the monitoring plan.
    - MBS found that maintenance and monitoring of leaks was in compliance with the monitoring plan.
- Observed the project database manager work to ensure that data was being recorded and handled as per the requirements of the monitoring plan.
    - MBS found that the database manager's work was in compliance with the monitoring plan.
- Conducted audits of the data to ensure that adequate records were being kept, and that leaks found and leaks repaired were accurately documented in the database.
    - MBS concluded that adequate records were being kept and that leaks found and repaired were documented in hard form and then after some delay were transferred to the electronic database.
- Observed technical teams to ensure that they operated equipment and conducted leak detection, monitoring and repair work in the correct manner, and advised on any training needs required.
    - MBS concluded that the LDMT operated equipment and conducted leak detection and monitoring in the correct manner.
- Conducted on-the-ground assessments to verify that project implementation was on schedule and highlighted any risks of delay.
    - MBS tracked progress on-the-ground as the Project developed. Its presence ensured that members of the LDMT understood that their work was being externally audited.
- Verified repair/replacement schedule of any regulators that are due to be replaced or repaired for the coming year.
    - MBS verified historical data about replacements that corresponded to leaks in the Database.

Calibration of Monitoring Instruments

Calibration of Hi-Flow Sampler Equipment

PSL was provided with made-for-purpose calibration kits purchased from the Calibration Gas supplier Ukrmetrteststandard. The kit was used in conjunction with two specially manufactured gas mixtures at highly accurate known concentrations of methane (high and low concentrations) according to the HFS manual. Using the calibration kits and known methane concentrations in air inside the gas mixture cylinders to control the variable parameters, the operators enter into the Hi-Flow Sampler all the controlled and known parameters. Then they separately allow the known CH_4/air mixture at both high and low concentrations to flow into each Hi-Flow Sampler device. The device then automatically calibrates both of the hydrocarbon detectors (main and background) based on the entered input parameters. The readings as per the operator's manual of a properly calibrated HFS are ±10% accurate.

The Hi-Flow Samplers supplied by EcoGas Asia were regularly calibrated while in use to ensure accurate measurements and to conform to the QA/QC procedure described in Appendix 5. All the measurements taken during the monitoring period were supported by the calibration efforts of Tuhin Shuvra Ghosh, Saifur Rahaman and Hossain Belayet. They have been fully trained in calibration techniques and logbook management by MBS. MBS confirmed their qualifications for this task as part of their training function and the performance of the calibration supervisor is regularly checked as part of MBS's ongoing project review. They performed this task every month during the monitoring period when the units were in use, as is suggested by the Hi-Flow Sampler manual. In cases where use of the HFS was not needed for more than a month, they recalibrated the unit immediately prior to the equipment being used for the project. No measurements this monitoring period were taken by an HFS outside the manufacturers recommended calibration schedule. In the case where the Hi-Flow Sampler fell out of calibration, it remained unused during the impacted period. The date on which each Hi-Flow Sampler was calibrated is shown in the separate Calibration Log file that also demonstrates that every Hi-Flow Sampler measurement was taken with a unit that was calibrated within at least 30 days prior to that measurement.

Serial Numbers of the Hi-Flow Samplers used in this project and dates of calibration:

LP1002: 25/04/2019, 22/05/2019, 20/06/2019, 11/07/2019
LX1011: 25/04/2019, 22/05/2019, 20/06/2019, 03/03/2020
MN1018: 25/04/2019, 22/05/2019, 21/06/2019, 11/07/2019
MN1032: 25/04/2019, 22/05/2019, 20/06/2019, 02/11/2020
MP1006: 25/04/2019, 22/05/2019, 21/06/2019
MP1032: 25/04/2019, 22/05/2019, 20/06/2019, 03/03/2020, 02/11/2020
NQ1000: 27/04/2019, 22/05/2019, 18/06/2019, 11/07/2019
NQ1002: 03/01/2019, 25/04/2019, 22/05/2019, 11/07/2019, 02/11/2020
NQ1003: 27/04/2019, 22/05/2019, 20/06/2019, 03/03/2020, 02/11/2020
NQ1005: 03/01/2019, 27/04/2019, 22/05/2019, 20/06/2019
NQ1007: 27/04/2019, 22/05/2019, 18/06/2019
NQ1008: 25/04/2019, 22/05/2019, 20/06/2019, 03/03/2020, 02/11/2020
NQ1009: 03/01/2019, 27/04/2019, 22/05/2019, 20/06/2019, 02/11/2020
NQ1011: 27/04/2019, 22/05/2019, 20/06/2019

LU1001: 05/03/2021, 03/04/2021, 01/05/2021, 29/05/2021, 11/08/2021, 05/11/2021, 03/12/2021, 30/12/2021, 27/01/2022
LX1011: 05/03/2021, 03/04/2021, 01/05/2021, 29/05/2021
MN1018: 05/03/2021, 03/04/2021, 01/05/2021, 29/05/2021, 11/08/2021

NQ1007: 05/03/2021, 03/04/2021, 01/05/2021, 29/05/2021, 11/08/2021, 03/12/2021, 30/12/2021, 27/01/2022

Serial Numbers of the Gasurveyors, which require annual calibration according to the manufacturer's recommendation, used during this monitoring period and relevant dates of calibration:

508332: 12/12//2018 09/12/2019

508393: 12/12//2018 09/12/2019

509268: 12/12//2018 09/12/2019

509379: 12/12//2018 09/12/2019

509624: 12/12//2018 09/12/2019

509984: 12/12//2018 09/12/2019

510421: 12/12//2018 09/12/2019

510433: 12/12//2018 09/12/2019

510581: 12/12//2018 09/12/2019

510641: 12/12//2018 09/12/2019

510764: 12/12//2018 09/12/2019

511041: 12/12//2018 09/12/2019

508332: 08/01/2021

509268: 08/01/2021

509624: 08/01/2021

510421: 08/01/2021

510433: 08/01/2021

510641: 08/01/2021

510764: 08/01/2021

5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

See the calculations in the ER calculation spreadsheet attached.

The fundamental calculation of baseline ERs for every leak as per the methodology is as follows:

The baseline leak flow rate (F_{CH4}) is measured using a HiFlow Sampler or Leak Measurement Device (LMD) and converted from litres of CH_4 / minute to m³ CH_4 / h (ConvFactor) for each leak included in the baseline (j). Any reappeared leakage found during the subsequent monitoring is measured using the HiFlow Sampler or LMD in the same way and subtracted from the initial measurement. The calculated uncertainty (UR) of the measurement using the guidelines in the methodology is deducted from this leak rate to ensure a conservative result. This conservative leak rate value for each leak during the monitoring period is then multiplied by the hours of operation (t) of the same leak between the baseline measurement and the monitoring measurement taking into account any temporary shut-offs of the equipment. Finally, the number of tonnes of CO2e emission reductions generated in the monitoring period by each leak is calculated using the GWP of methane. The values for all the leaks monitored are then added together to get the ER amount. The calculations are found in more detail in the ER calculation spreadsheet provided. The formulas that the baseline calculations are based on are as follows:

$$BE_y = \min\left\{BE_1, ConvFactor \times \sum_j \left[F_{CH4,j} \times T_{j,y} \times \left(1 - UR_j\right)\right] \times GWP_{CH4}\right\}$$

With,

$$BE_1 = ConvFactor \times \sum_j \left[F_{CH4,j} \times T_{j,y=1} \times \left(1 - UR_j\right)\right] \times GWP_{CH4}$$

Where:

BE_1	=	Baseline emissions for the first crediting year of the crediting period (tCO_2e).
BE_y	=	Baseline emissions for crediting year *y* (tCO_2e)
ConvFactor	=	Conversion factor to convert Nm³ CH_4 into tCH_4. The Hi-Flow sampler automatically accounts for standard temperature and pressure in data readings; as such this factor amounts to 0.0007168tCH_4/Nm³ CH_4 (i.e., 0 degree Celsius and 101.3 kPa).
j	=	All physical leaks that are included in the project activity for which physical leaks were detected and repaired and which would leak in the baseline scenario during the crediting year *y*.
$F_{CH4,j}$	=	Measured flow rate of methane for the physical leak *j* from the leaking component (Nm³ CH_4/h)
UR_j	=	Uncertainty range for the flow rate measurement method applied to physical leak *j*. The uncertainty of the measurement is taken into account by using the flow rate at the lower end of the uncertainty

		range for the measurement at a 95% confidence interval for baseline emissions from leaks
$T_{j,y}$	=	The time the relevant component, in which physical leak *j* occurred, would leak in the baseline scenario and would be eligible for crediting during the crediting year *y* (hours)
GWP_{CH4}	=	The global warming potential for methane valid for the commitment period (tCO_2e/tCH_4). After the commitment period, this value may be revised based on any decision by the CMP.

Uncertainty is calculated using the following formula:

$$UR_j = \frac{\sqrt{(UR_1 * x_1)^2 + (UR_2 * x_2)^2 + \ldots + (UR_n * x_n)^2}}{x_1 + x_2 + \ldots + x_n}$$

Where
UR_j = the percentage uncertainty in the sum of the quantities (half the 95% confidence interval divided by the total (i.e. mean) and expressed as a percentage);
x_n and UR_n = the uncertain quantities and the percentage uncertainties associated with them, respectively.
(Note: “n” in this case refers to each recorded leak rate of each component surveyed)

5.2 Project Emissions

There are no project emissions as finding and repairing gas leaks does not create Project Emissions. Any new leaks or leaks that reappear are immediately repaired.

5.3 Leakage

As per applied methodology, no significant leakage is expected to occur in these types of projects.

5.4 Net GHG Emission Reductions and Removals

Year	Baseline emissions or removals (tCO_2e)	Project emissions or removals (tCO_2e)	Leakage emissions (tCO_2e)	Net GHG emission reductions or removals (tCO_2e)
2019	495,490	0	0	495,490
2020	507,342	0	0	507,342
Total	**1,002,832**	**0**	**0**	**1,002,832**