PROJECT DESIGN DOCUMENT (PDD) FORM FOR ARTICLE 6.4 PROJECTS

(Version 02.0)

<table>
<tr><th colspan="4">BASIC INFORMATION</th></tr>
<tr><td>UNFCCC project reference number:</td><td colspan="3">10562</td></tr>
<tr><td>Project title:</td><td colspan="3">Reducing Gas Leakages within the Pashchimanchal Gas Distribution Network in Bangladesh</td></tr>
<tr><td>Host Party:</td><td colspan="3">Bangladesh</td></tr>
<tr><td>Other participating Parties:</td><td colspan="3">Choose a Party.</td></tr>
<tr><td rowspan="4">Activity participant(s):
(add rows if needed)</td><td>Type of Party</td><td>Name of activity participant(s)</td><td>Party that is to provide authorization</td></tr>
<tr><td>Choose a type of Party.</td><td>>> EcoGas Asia Limited</td><td>Choose a Party.</td></tr>
<tr><td>Choose a type of Party.</td><td>>>EcoEye Co. Ltd.</td><td>Choose a Party.</td></tr>
<tr><td>Choose a type of Party.</td><td>>></td><td>Choose a Party.</td></tr>
<tr><td>PDD version number:</td><td colspan="3">>> 1.0</td></tr>
<tr><td>PDD completion date:</td><td colspan="3">23/04/2026</td></tr>
<tr><td rowspan="4">Applied mechanism methodologies and standardised baselines, and their versions:</td><td>Reference number</td><td>Title</td><td>Version</td></tr>
<tr><td>Proposed</td><td>Leak detection and repair in natural gas transmission and distribution systems</td><td>Proposed</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Sectoral scope(s):</td><td colspan="3">Sectoral Scope 10 – Fugitive emissions from fuels (solid, oil and gas)</td></tr>
<tr><td>Type of the project:</td><td colspan="3">☒ Emission reductions activity
☐ Removals activity
☐ Combined emission reductions and removals activity</td></tr>
<tr><td rowspan="3">Estimated annual emission reductions and/or net removals over the crediting period (tCO₂e/year):</td><td>Emission reductions:</td><td colspan="2">306,140 tCO2e/year (average)</td></tr>
<tr><td>Net removals:</td><td colspan="2">N/A</td></tr>
<tr><td>Total emission reductions and net removals</td><td colspan="2">3,061,399 tCO2e (10-year crediting period)</td></tr>
</table>

SECTION A. Project description

A.1. Project purpose and general description

>> The project activity reduces gas leakages from components in the natural gas distribution system operated by Pashchimanchal Gas Company Limited (PGCL) in Bangladesh. Previously implemented under CDM (UNFCCC reference 10562), the project has now transitioned to Article 6.4 and seeks continued approval post-2025 under the proposed A6.4 methodology. The total length of the PGCL natural gas distribution system is approximately 1,635 km, constructed beginning in the 1960s and inadequately maintained in the years prior to project implementation. A significant percentage of the natural gas distributed throughout the system—which is more than 95% methane (CH_4)—was leaking from components and being released into the atmosphere.

The project boundary comprises the above-ground components where leaks were identified during the baseline study, documented in a comprehensive database with GPS coordinates, street addresses, and photographs. The project deploys advanced leak detection and repair (LDAR) procedures, including Hi-Flow™ Samplers and GMI Gasurveyor™ instruments, together with advanced repair materials (ePTFE, nitrile gaskets, sealing paste, membrane materials). Key project components in the baseline scenario included valves, insulating joints, pressure regulators, and other above-ground gas distribution infrastructure. Deviations from the CDM-era baseline methodology have been incorporated into the project boundary definition and BAU scenario under the proposed A6.4 mechanism methodology.

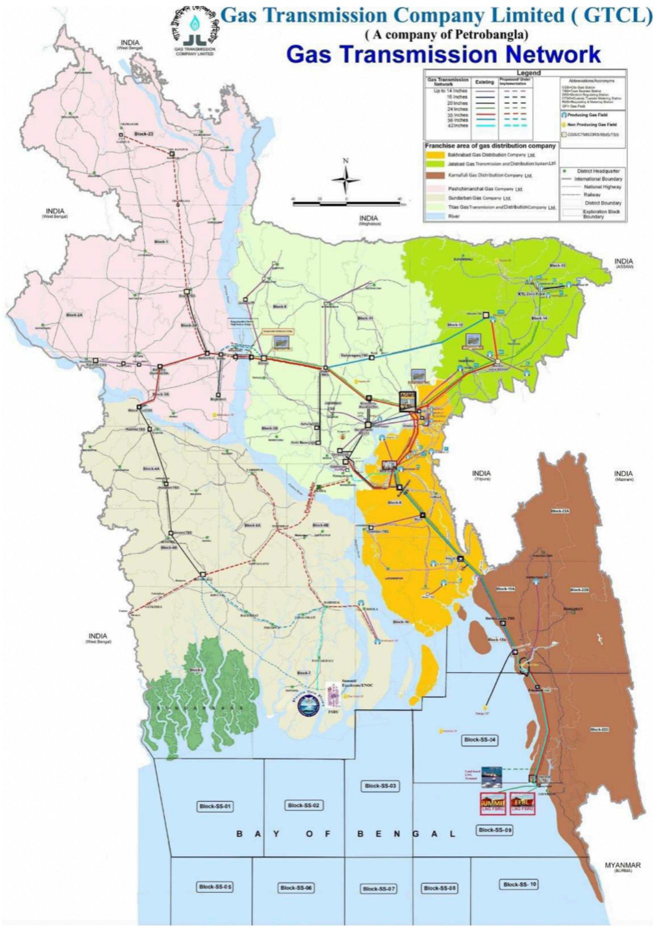
The project is located across western Bangladesh (Rajshahi, Sirajganj, Pabna, and Bogura Districts) in the service territory of PGCL. The project boundary is defined by the GPS coordinates of each leaking component in the system. The crediting period spans 31/07/2020 to 30/07/2030 (10 years). Estimated total emission reductions are 3,061,399 tCO_2e over the crediting period, with an annual average of 306,140 tCO_2e/year, after application of the downward adjustment factor. Note: as this project was originally registered and issued credits under CDM, the activity proponents only plan to issue post-2025 credits using the new methodology.

A.2. Confirmation that the project aligns with the A6.4 activity types indicated by the host Party

>> The possible mitigation actions in the Conditional Contribution section of the Bangladesh NDC of August 2021 specifically mentions Bangladesh's intention of supporting fugitive gas leak emission reduction projects using carbon finance. Therefore, the proposed activity is consistent with Bangladesh's approved activity types and the project is in full compliance with paragraph 26(e) of the Rules, Modalities and Procedures (RMPs).

A.3. Project geographical location

Host Party	Bangladesh
Region(s)/State(s)/Province(s)	Western Bangladesh, including Rajshahi District, Sirajganj District, Pabna District, and Bogura District
Cities/towns/communities	Nalka, Sirajganj District (Company Headquarters), and communities throughout the PGCL service territory
Geographic coordinates	N 24°25'18.1986", E 89°35'54.1602" (Headquarters of PGCL). GPS coordinates of each component within the project boundary are included in the excel spreadsheet calculating ERs.
Map of project location	
The pink shaded area of the relevant map indicates the service territory of PGCL where individual components with leak repairs are located, forming the project boundary.	



Physical delineation of the project boundary is provided in the form of GPS coordinates of all components in the database, covering the above-ground gas distribution infrastructure across the four districts listed above. The coordinates of each component constitute the geographic boundary in accordance with the applied mechanism methodology.

A.4. Technology/measures

A.4.1. Pre-activity scenario

Prior to project implementation, PGCL operated a conventional LDAR program that lacked the technical and financial resources to comprehensively and accurately detect, measure, and repair leaks. There was no systematic detection and repair program. Leak identification relied on smell and soap bubbles (no quantitative equipment), and repairs were performed using inadequate materials (polyethylene tape, simple tightening of fittings). In the absence of the project, baseline conditions consist of the continuation of this pre-activity approach, with no advanced LDAR practices.

Maintenance practice	Technology/approach before project (conventional LDAR)
Leak detection and measurement	No advanced leak detection equipment. Only odour and soap bubbles used; no quantitative capability.
Leak repair	Emergency/safety-driven repairs only, using polyethylene tape and simple tightening of fittings. No advanced repair materials available.

The above-ground components in the system (valves, insulating joints, pressure regulators, connectors) have been in service for 40+ years on average, with replacement only occurring in emergency situations under the Natural Gas Security Law (Prakitik Gas Nirapatta Bidhimala, 1991, Revised 2003). The baseline scenario also covers the conditions in the absence of policies that formally integrate the Article 6.4 mechanism.

A.4.2. Technologies and/or measures to be employed and/or implemented by the project

The project implements a systematic advanced LDAR program using best available techniques:

Maintenance practice	Equipment/technology implemented (advanced LDAR)
Leak detection	GMI Gasurveyor™ (500 Series) — portable electronic gas detector using catalytic oxidation/thermal conductivity detection, certified for hazardous areas.
Leak measurement	Hi-Flow™ Sampler — captures all emissions from a leaking component; measures leak rates up to 10.5 ft³/min (0.297 m³/min) with ±10% accuracy. A calibrated bag or other bagging technique may also be employed.
Leak repair	Advanced expanded PTFE (ePTFE) sealing materials, advanced nitrile rubber gaskets, conical connection sealing paste, and advanced membrane replacement materials.

Staff within PGCL have been trained and certified in advanced LDAR techniques. The project includes digital photography, GPS tagging, and a comprehensive database for all repaired components. Each repair team is equipped with Hi-Flow™ sampler, calibration standards, GMI Gasurveyor, smartphone (GPS/photos), tags, advanced repair materials, data sheets, toolkit, and vehicle.

A.5. Parties and activity participants

(Add/remove rows as necessary)

Type of Party	Name of the Party	Activity participant(s)
Choose a type of Party.	Choose a Party.	EcoGas Asia Limited (Private Entity)
Choose a type of Party.	Choose a Party.	EcoEye Co., Ltd.
Host Party	Bangladesh	>>

SECTION B. Application of mechanism methodologies, methodological tools and standardized baselines

B.1. References to mechanism methodologies, methodological tools and standardized baselines

>>

Reference number	Title	Version
Proposed new methodology (AM0023 lineage)	Leak detection and repair in natural gas transmission and distribution systems	Proposed / Pending UNFCCC Assignment

The above mechanism methodology was developed drawing upon experience from CDM methodology AM0023. No standardized baselines are applied. No host Party-specific methodological requirements have been formally specified under paragraph 27(a) of the RMPs as of the date of this PDD.

B.2. Applicability of mechanism methodologies, methodological tools and standardized baselines

Proposed new methodology: Leak detection and repair in natural gas transmission and distribution systems

(Insert the UNFCCC reference number, title and version of the mechanism methodology, other methodological regulatory documents including methodological tool, standardized baseline approved by the Supervisory Body, or the methodological requirements specified by the host Party)

Applicability condition in the methodological regulatory document or the methodological requirement specified by the host Party	Demonstration of compliance of the project with the applicability condition in the methodological regulatory document or the methodological requirement specified by the host Party
During the last three years prior to the implementation of the project activity, no advanced LDAR program was in place to address physical leakage from components included in the project boundary.	During the three years prior to project implementation, PGCL employed only odour and soap-bubble detection and used standard (non-advanced) repair materials. No advanced LDAR program was in place. OUTCOME: Project meets applicability condition.
New physical leaks that are detected at components during the crediting period are accountable only if the components were included in the project boundary at validation.	The project only addresses components included in the project boundary at validation. The project boundary does not include new sections of the distribution network. New leaks found on existing components share the same GPS coordinates, engineering schematic, and unique ID number. OUTCOME: Project meets applicability condition.
Physical leaks that would not occur as a result of any law or regulation, unless the law or regulation refers to or formally integrates the mechanism as an instrument for implementation.	National regulations (Natural Gas Security Law, Prakitik Gas Nirapatta Bidhimala 1991, Revised 2003) only address leaks presenting a safety concern and do not require or mandate advanced LDAR practices for above-ground components. OUTCOME: Project meets applicability condition.

Exclusion conditions (methodology NOT applicable to):	
Physical leaks detected and repaired under a conventional LDAR program.	Physical leaks detected and repaired under the current conventional maintenance program (emergency repairs) are excluded. Only leaks detected with advanced equipment and repaired with advanced materials are included. OUTCOME: Project does not trigger this exclusion.
Countries/jurisdictions where advanced LDAR practices are mandated by law.	Bangladesh does not mandate advanced LDAR practices for above-ground gas distribution components. OUTCOME: Project does not trigger this exclusion.
Physical leaks that can be repaired by tightening/re-greasing or by similar measures.	All leaks repairable by simple tightening are excluded from the project. Only leaks requiring advanced materials and techniques are included. OUTCOME: Project does not trigger this exclusion.
Physical leaks identified on components where scheduled replacement was delayed from its normal schedule.	No regularly scheduled component replacement program exists. Replacements are only performed in emergencies. Emergency repair team repairs are excluded from project activities. OUTCOME: Project does not trigger this exclusion.
Reductions in process venting.	The project addresses physical leaks from above-ground distribution components, not process venting. OUTCOME: Project does not trigger this exclusion.
Physical leaks occurring in new infrastructure or extensions of existing infrastructure in operation after the year of the project investment decision.	All components in the project boundary are existing facilities documented in the initial baseline study. No new infrastructure or extensions are included. OUTCOME: Project does not trigger this exclusion.
Gas extraction or processing facilities.	The project addresses distribution network components only—no extraction or processing facilities are included. OUTCOME: Project does not trigger this exclusion.

B.3. Addressing double counting due to overlapping claims between different Article 6.4 mechanism activities, due to overlap with domestic mitigation schemes and due to overlap with other frameworks or environmental markets

The project was previously registered under CDM (UNFCCC reference 10562) and has formally transitioned to Article 6.4. The project is registered as a VERRA project and issued credits in 2021 and 2022 through VERRA for sale to maintain the required revenue to keep the project funded. An legally binding attestation has been signed to ensure that in no case will credits from the same period be issued from more than one registry.

There are no overlapping Article 6.4 activities, registered programmes of activities, or other mandatory domestic or international GHG mitigation crediting schemes covering the same above-ground gas distribution components in the PGCL service territory. The project boundary database maintains unique component identifiers (GPS, photo, tag) ensuring no single component is claimed under more than one mechanism.

Bangladesh has no mandatory domestic emissions trading scheme or carbon pricing mechanism that would result in overlapping mitigation claims for fugitive gas distribution emissions. The NDC conditional contribution for fugitive gas reductions explicitly contemplates carbon finance mechanisms, further confirming the absence of double counting with domestic policy.

B.4. Project boundary, sources, sinks, greenhouse gases and reservoirs

The project boundary encompasses all above-ground components of the PGCL natural gas distribution system within the four-district service territory (Rajshahi, Sirajganj, Pabna, Bogura) where physical leaks were identified and documented in the baseline study database. The boundary is defined by the GPS coordinates of each component included in the project database. Physical delineation is provided via the project component database, which constitutes a polygon-equivalent geographic boundary defined by the set of component coordinates.

B.4.1. Baseline emissions/removals

Source/sink reservoir/pool	GHG		Type	Justification/Explanation
Leaks in gas transmission and/or distribution system	CO_2	☐ Included ☒ Not included	☐ Controlled ☐ Affected ☐ Related	>> The CO_2 content in natural gas is very low. Exclusion is conservative
	CH_4	☒ Included ☐ Not included	☒ Controlled ☐ Affected ☐ Related	>> Main source of emissions
	N_2O	☐ Included ☒ Not included	☐ Controlled ☐ Affected ☐ Related	>> The N_2O content in natural gas is negligible. Exclusion is conservative

B.4.2. Project emissions/removals

Source/sink reservoir/pool	GHG		Type	Justification/Explanation
Reappeared leaks that are not immediately re-repaired	CO_2	☐ Included ☒ Not included	☐ Controlled ☐ Affected ☐ Related	>> The CO_2 content in natural gas is very low. Exclusion is conservative
	CH_4	☒ Included ☐ Not included	☒ Controlled ☐ Affected ☐ Related	>> Main source of emissions
	N_2O	☐ Included ☒ Not included	☐ Controlled ☐ Affected ☐ Related	>> The N_2O content in natural gas is negligible. Exclusion is conservative

B.4.3. Leakage emissions

Source/sink/reservoir /pool	GHG		Type	Justification/Explanation
Gas distribution system — outside project	CO_2	☐ Included ☒ Not included	☐ Controlled ☐ Affected ☐ Related	>>
	CH_4	☐ Included ☒ Not included	☐ Controlled ☐ Affected ☐ Related	No leakage beyond the project boundary is attributed to the project activity. Leak reduction at project components does not displace leaks elsewhere in the system. Exclusion is justified and conservative.

B.5. Establishment and description of baseline scenario

B.5.1. Identification of the baseline scenario

The following two baseline scenarios are considered:

1. Continuation of the pre-activity scenario with existing BAU practices of leak detection and routine maintenance for each component included in the project boundary up until any relevant planned or ad hoc replacements of the particular component;
2. The proposed project activity undertaken without being registered as a A6.4 project activity.

The leaks that are included into the project as part of the baseline scenario are found as follows:

The activity developer needs to consider the following two pre-determined baseline scenarios:

Step1 Ensure the two alternative baseline scenarios comply with national regulation and targets

With regards to the expected time schedules for replacement of components that may be subject to leaks – there is no existing long-term component replacement schedule for above ground components in the regular budget. The replacement of components follows the «natural gas security law» called «Prakitik Gas Nirapatta Bidhimala, 1991 - Revised in 2003», which requires only ad-hoc replacement in case of emergencies, or if there has been significant component deterioration, which is impacting safety. Therefore, for most components of the system, no long-term replacement schedule/plan exists. The components will continue to be used until they cease to function or are no-longer needed.

Due to a lack of resources, the company does not have the option to retire the components in a planned manner and PGCL does not see the need to schedule additional replacements under current practice and Bangladesh regulations (e.g., «natural gas security law» called «Prakitik Gas Nirapatta Bidhimala, 1991 - Revised in 2003»). Replacements are done solely on an unforeseen emergency basis when the component has completely ceased to function, or if significant wear and tear has been reported. PGCL subsidiaries / departments develop annual plans for replacement/repair activities. These plans require approval from the Board of Directors; who allocate budgets based on system priorities (i.e., emergency repairs will take priority over planned maintenance) and available financial resources.

It should be noted that just because a component is leaking, this does not mean it is not capable of functioning – this is true in both developing and developed world as leaks are abound in all systems, which, in spite of the leakage, continue to function relatively safely and effectively. As such, the focus is repairs, with replacements only made when there is a complete breakdown of the component and it is not functioning. This is best illustrated by the current in-service lifetimes of surface facilities included in the project boundary (below). In particular, during the last 20 years, only minor repairs for maintenance have been undertaken at surface facilities. No major replacements have been made.

Therefore, both baseline scenarios comply with local regulation and policy.

Step 2 Determine the most plausible baseline scenario

1. As determined in section 5.3, the second option, the proposed project activity undertaken without being registered as a A6.4 project activity, is not plausible as per financial and barrier analyses making the “Continuation of the pre-activity scenario with existing BAU practices of leak detection and routine maintenance for each component included in the project boundary up until any relevant planned or ad hoc replacements of the particular component”;

Bangladesh will need to continue, for the foreseeable near future, to rely on natural gas as its main fuel. Millions of residents rely on natural gas for cooking and have only few alternatives that are often less climate friendly (coal, unsustainably harvested fuel wood, etc). It is also the main fuel source for electricity production. Bangladesh still highly subsidizes gas prices. Its importance as a fuel is growing rapidly and imports of LNG are just adding to the huge subsidy burden faced by Bangladesh.[1] This has become even more problematic as Bangladesh domestic supplies have dwindled and they have to import more LNG.[2] While they have tried to reduce the gas subsidies, they continue to designate hundreds of millions of dollars each year to covering gas subsidies and pay rising LNG import costs.[3] Therefore, it is clear that Bangladesh will continue to rely on natural gas as a fuel and will continue to rely on the gas distribution systems across the country. It is also evident that the continued dire financial situation among the gas companies, promulgated by gas subsidies, prevent significant investment in modernizing the gas distribution maintenance practices. This makes the continuation of the current situation with existing practices of leak detection and routine maintenance the baseline scenario.

As the first option is the most plausible, the BAU scenario will be considered the baseline scenario and baseline emissions will be calculated in the same manner as the BAU baseline emissions. The leaks included in the baseline scenario will be determined using the same approach as the BAU process outlined in. section 5.4.2. The Activity Participants will demonstrate additionality.

B.5.2. Identification of the Business-as-usual (BAU) scenario

The Business-as-usual scenario is identified in these following steps:

Step 1: Establishment of criteria to identify which types of physical leaks are included in the calculation of the BAU.

Step 2: Documentation that the replacement schedules for the components included have not been delayed until after the start date of the project.

Sept 3: A comprehensive leak detection and measurements campaign has been undertaken, taking actual measurements of each leak that would otherwise remain leaking in the BAU case for the duration of the project.

[1] https://www.iea.org/countries/bangladesh/natural-gas
[2] https://ieefa.org/resources/global-lng-outlooks-point-rough-waters-ahead-bangladesh
[3] https://www.spglobal.com/commodity-insights/en/news-research/latest-news/lng/030124-bangladesh-raises-domestic-natural-gas-and-electricity-prices

Step 4: Establishment of a database to manage all information related to the project activity including only the components with leaks and repairs included as part of the BAU.

1. Establishment of criteria to identify which types of physical leaks are eligible for crediting

In order to ensure as per the methodology, a clear distinction of leaks that would (“not included” in the project) and would not (“included”) have been identified and repaired under existing practices prior to the project implementation, it is first necessary to assess and describe current leak detection and repair practices in the company. Only those types of leaks that are not detected and repaired under current practices are considered in the calculation of emission reductions.

The following criteria are relevant for classification of leaks in the system:

Emergency/ safety repairs – PGCL makes some repairs and component replacements in direct response to safety concerns connected to outright emergency situations. According to regulations in Bangladesh, there is no specification on what exactly counts as a safety concern – this is left to the discretion of the gas company. However, safety concerns for above ground leaks are defined by operational staff as being cases where there is significant risk to public health and safety of the gas distribution system (e.g., explosion or inflammation risk, or where a high concentration of gas can accumulate in an enclosed space such as a risk of suffocation due to lack of oxygen). However, the majority of the above ground leaks in the PGCL network do not fall under this category (i.e., components are typically located outdoors, in well-ventilated open spaces).

In order to deal with emergencies, there is a separate emergency team that is dedicated 24 hours a day to the implementation of repairs in these more dangerous emergency situations (e.g., customer call-outs). The emergency services team that deals with these immediate safety concerns will continue to operate completely independently of the project team at PGCL, throughout the course of the project. **<u>None of the leaks identified or repaired by this team are included in the project. This is ensured since each project leak will require multiple Hi-Flow sampler readings to be included in the project and the separate emergency repair team will not have access to Hi-Flow Samplers.</u>**

Leaks detected by visibility, audibility and/or smell – In line with the «natural gas security law» called «Prakitik Gas Nirapatta Bidhimala, 1991 - Revised in 2003», PGCL has no “planned” inspection and maintenance (I&M) schedule for its above-ground facilities. Generally, staff identify leakage through odour and audio detection (i.e., hissing noise associated with leakage). This approach is in compliance with regulations governing the Bangladesh natural gas sector.

The lack of many of the basic tools and training required for proper leak identification, means that many leaks are missed. The fact that these leaks are not found and properly repaired illustrates the inadequate baseline approach by PGCL.

In addition, even when a leak is identified, there is no requirement that the leak be repaired using appropriate materials. According to interviews with managers of the PGCL team, the repair materials currently available to the repair teams (PE tape, clamps, and non-gas-rated Teflon tape) are ineffective at repairing leaks and repairs undertaken with these materials continue to have significant leak rates.

Without the Hi-Flow samplers or other similar technology, the PGCL staff has little opportunity to judge the size and importance of the leaks they find, and do not systematically repair all or even most leaks they identify. As a result, the <u>only leaks that can be effectively IDENTIFIED and REPAIRED under existing non-emergency practices</u> are those leaks that can be fixed by tightening connections and tightening thread fittings. These are the only types of leaks that can be both:

- IDENTIFIED using existing leak detection approach (smell and audio).
- REPAIRED using the only effective technology typically available to the staff – wrenches to tighten the fittings.

In order to be conservative, **ALL repairs composed of simply tightening loose fittings and connections (e.g., threaded fittings, unions) are excluded from the project as it is plausible that they could be detected and repaired under the current practices.** This type of leak is excluded from the project.

However, all other leaks (e.g., insulation joints, valve with conical connection, etc.) require more advanced technologies and practices to identify and repair. They require new advanced materials, components, seals, etc. and will therefore continue to leak as long as advanced equipment and materials are not part of the repair teams' toolkit.

The key facts documenting this assessment are to be demonstrated to the validator through:

1. Interviews with key staff,
2. Documentation on the current technologies used to measure leaks, and
3. Leak repair material used.

2. Documentation of the schedules for the replacement of components

With regards to the expected time schedules for replacement of components that may be subject to leaks – there is no existing long-term component replacement schedule for above ground components in the regular budget. The replacement of components follows the «natural gas security law» called «Prakitik Gas Nirapatta Bidhimala, 1991 - Revised in 2003», which requires only ad-hoc replacement in case of emergencies, or if there has been significant component deterioration, which is impacting safety. Therefore, for most components of the system, no long-term replacement schedule/plan exists. The components will continue to be used until they cease to function or are no-longer needed.

Due to a lack of resources, the company does not have the option to retire the components in a planned manner and PGCL does not see the need to schedule additional replacements under current practice and Bangladesh regulations (e.g., «natural gas security law» called «Prakitik Gas Nirapatta Bidhimala, 1991 - Revised in 2003»). Replacements are done solely on an unforeseen emergency basis when the component has completely ceased to function, or if significant wear and tear has been reported. PGCL subsidiaries / departments develop annual plans for replacement/repair activities. These plans require approval from the Board of Directors; who allocate budgets based on system priorities (i.e., emergency repairs will take priority over planned maintenance) and available financial resources.

It should be noted that just because a component is leaking, this does not mean it is not capable of functioning – this is true in both developing and developed world as leaks are abound in all systems, which, in spite of the leakage, continue to function relatively safely and effectively. As such, the focus is repairs, with replacements only made when there is a complete breakdown of the component and it is not functioning. This is best illustrated by the current in-service lifetimes of surface facilities included in the project boundary (below). In particular, during the last 20 years, only minor repairs for maintenance have been undertaken at surface facilities. No major replacements have been made.

The categories of surface facilities include commercial, industrial and residential gas regulators. These components have a theoretical lifetime of 20 of more years; however, this is generally not followed and most components have an average in-service life greater than 40 years. Consequently, the theoretical lifetime of the components is not relevant as existing components are expected to continue to be utilized a period greater than the project crediting period. Instead, replacement of components is only done in emergencies, or if the component's technical performance has deteriorated sufficiently to impact gas supply operations. Thus, if components are identified for repair, they are included in annual capital repair budgets and schedules.

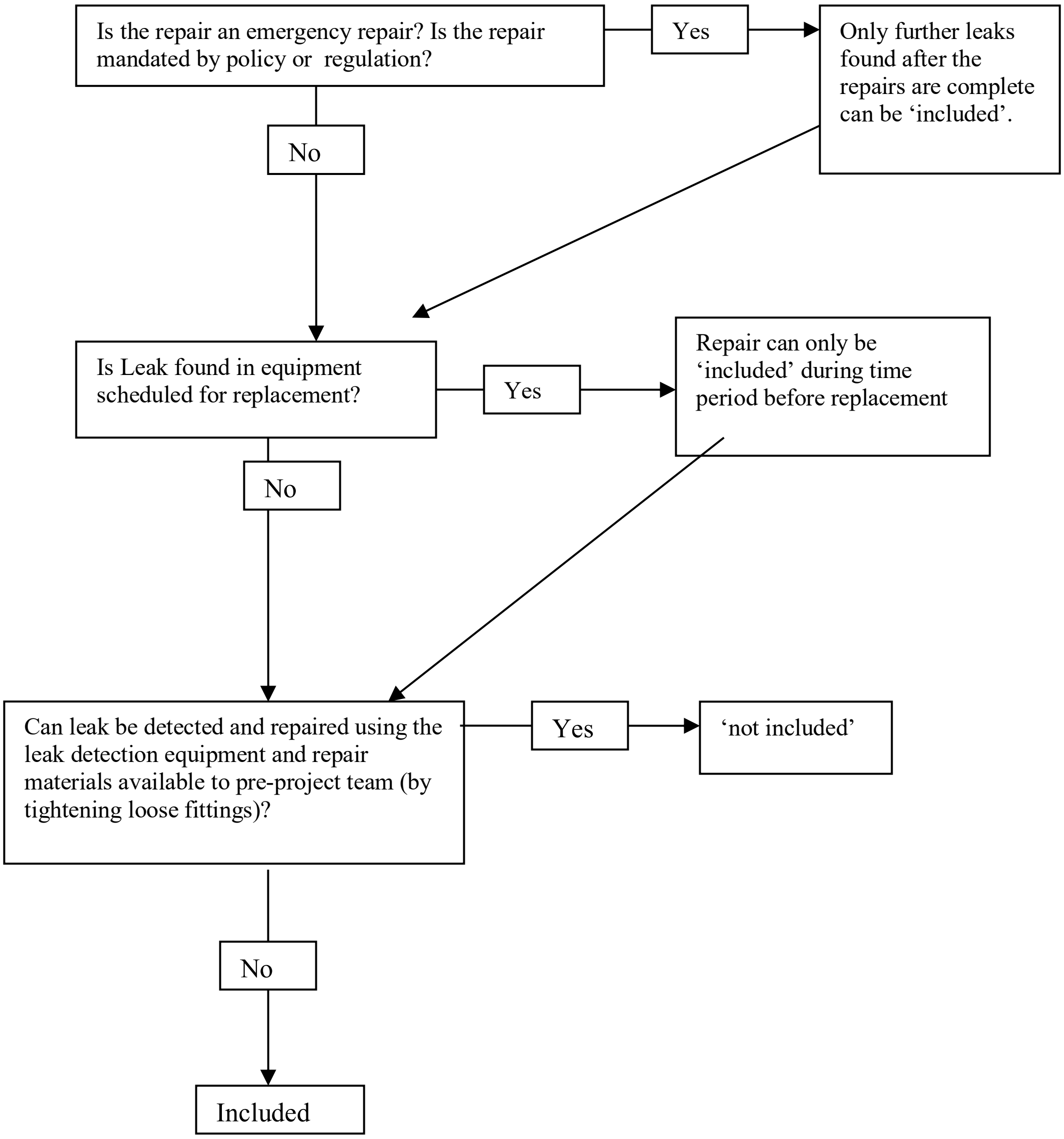
Thus, the two scenarios in which the component would have been replaced under normal practice are, as detailed above:

1. In emergency situations when the component has ceased to function; and
2. Those components in the priority list that can be replaced based on annual budget allocations as they are made known.

Therefore, leaks that are stopped due to replacement of component that has entirely ceased to function will not be included in the project, as it is assumed that this component would have been replaced under normal practice.

The project developer will follow the decision tree which corresponds with the criteria defined in the methodology for each leak, in order to determine if that particular leak reduction can be considered additional. To be completely clear, the purpose of this decision tree is to ensure that the existing teams, their findings, and their limited repair activities (i.e., as part of the conventional LDAR program) are not included in the project if they are considered part of the baseline.

- The first step of the decision tree determines if the leak was identified and repaired as part an emergency repair action as this is part of the current baseline case maintenance. Repairs made in this category are excluded. No scheduled maintenance is undertaken on the above ground components included in the project.
- All leaks being repaired are cross-referenced with the list of components that have been replaced. Leaks from components that, after repair, have been replaced are excluded from the project following their replacement.
- The following step pertains to checking if the leak can be repaired effectively by tightening loose fittings or connections. If so, then these leaks are excluded from the project activity.



Once the leaks have been found, measured, and repaired as per step 3, each repair case is entered into the leak database as per step 4. These records will ensure that there is clarity on which leaks have been repaired as part of the baseline, and which are additional as part of the project.

Step 3: A comprehensive leak detection and measurements campaign has been undertaken, taking actual measurements of each leak that would remain leaking in the BAU case for the duration of the project.

Project teams measure the flow rates of the physical leaks in PGCL through the use of a Hi-Flow Samplers^{TM}.

Step 4: Establishment of a database to manage all information related to the project activity

As part of an advanced LDAR program, a database was established to manage all relevant information related to the detection and repair of physical leaks that are to be included in the BAU scenario. All data collected during project implementation has been entered into this database. The database has, inter alia, include the following information on each physical leak:

(1) Data to clearly identify the component such as: unique ID number, type of component, location of the component, leak measurement number and serial number of the measurement machine, digital photo number, etc;

(2) Relevant information on the measurement of the flow from the physical leak such as: date of measurement, the measurement method applied, the measured leak rate (F_{CH4}), serial number of measurement equipment (along with calibration records) and the uncertainty value associated with the measurement equipment;

(3) Information regarding the time in which the physical leak is eligible for crediting in year *y* by calculating the hours during which the component is under pressure for natural gas service noting any hours of shut-off or the date a component has been removed, replaced, or scheduled for replacement;

(4) Information confirming the eligibility of the physical leak to be included in the project activity (information that is required to distinguish between leaks detected by the conventional LDAR program and the advanced LDAR program for example such as type of repair material used or identification of equipment used to find and measure the leak);

(5) Relevant information on the repair of the detected physical leak: date of physical leak repair.

In addition to the information that is required to be entered in the database, all of the following four redundant ways of tagging leak locations and tracking leak measurements have been applied to clearly identify each component and leak location and key measurement data:

(1) A digital photo of the leak itself is taken and this photograph is then documented together with the actual leakage rate and measurement date;

(2) The leak itself is physically tagged on-site and the leak rate and measurement date are written on the tag;

(3) The location of the leak is documented on a schematic of the facility itself, when the leak measurement and date are entered into the database; and

(4) The data from the memory of the measurement device is downloaded and cross referenced using the leak measurement ID with the measurement included in the database.

The database is continuously updated during the crediting period with information on the physical leaks repaired during the crediting period. The data in the database is included in each monitoring report. In the case that the four data sources for an individual leak are corrupted or lost, then the leak is excluded from the baseline.

B.6. Demonstration of additionality

B.6.1. Regulatory analysis

Continuation of the current situation with existing practices of leak detection and routine maintenance is consistent with all existing laws and regulations in the gas sector of Bangladesh, including the Natural Gas Security Law (Prakitik Gas Nirapatta Bidhimala, 1991, Revised 2003) and the Gas Marketing Law (Gas Bipanan Niyomaboli 2004). Under existing laws, there is no threshold above which leaks are illegal for above-ground distribution components, and activities included in the proposed project (systematic advanced LDAR) are neither prohibited nor required by existing mandatory law. The project therefore represents mitigation that exceeds any mitigation required by law or regulation.

B.6.2. Analysis of lock-in risk

Natural gas will remain a critical fuel in Bangladesh well beyond the project period, and the country will continue to rely on gas distribution systems. Making repairs on existing gas infrastructure does not lock in levels of emissions, technologies, or carbon-intensive practices incompatible with paragraph 33 of the RMPs. Specifically: (a) the project involves only repairs on existing above-ground components, not installation of new infrastructure; (b) no new sections of the gas system coming online after the project start date are included; (c) components are being repaired rather than replaced, consistent with Bangladesh's near-term energy realities; (d) the project does not create path dependencies that would prevent future transitions to lower-carbon alternatives. The technical and operational lifetime of the repairs is bounded by the existing component lifetimes. The scale of the project (repairs to existing components) and the emissions intensity (reduction of fugitive CH_4) are compatible with long-term climate goals.

B.6.3. Investment Analysis or Barrier analysis

☒ Investment analysis ☐ Barrier analysis

(Select one option)

PGCL was formed on November 1999 with an objective of transmitting and distributing natural gas in its service area. It is a company of PetraBangla -the Bangladesh Oil Gas and Mineral Corporation. Petrobangla operates as a public sector statutory body pursuant to Bangladesh Oil, Gas and Mineral Corporation Ordinance, 1985 and Bangladesh Oil, Gas and Mineral Corporation (Amendment) Act, 1989. The general direction and administration of the affairs and business of the corporation vest in its Board of Directors. It is the policy making and managing body of the corporation, with members from Energy, Finance and Planning Ministries. The corporation is under the administrative control of the Energy and Mineral Resources Division of the Ministry of Power, Energy and Mineral Resources.

Investment Analysis:

After accounting for the cost of gas purchases (i.e., payments to the government, and PetroBangla's subsidiaries for purchasing and transmitting the gas), as well as administrative expenses, interest payments, etc, PGCL had annual after-tax profits in 2018 of about 669 million BDT[4] about (€7.2 million). PGCL has an annual transmission and distribution maintenance budget of approximately 4.8 million BDT (slightly more than €51,460) to address reactive repairs and maintenance (i.e., emergency call outs).

Ongoing Costs of Advanced LDAR Implementation

1. 4 Hi-Flow samplers were purchased, at a cost of approximately €20,000 per device (i.e. more than €80,000 in total).
2. Leak detection devices (GMI Gasurveyor (500 series)) will cost on the order of €2,300 per unit. Although much cheaper than Hi-Flow samplers, all monitoring teams will need to be equipped with advanced equipment and 8 units will therefore also need to be purchased (i.e., more than €13,800 in total).
3. There is a consulting cost associated with training staff and participating in / managing / reviewing initial measurements, repair activities and subsequent yearly measurement activities. These costs are estimated to be around €20,000 per year on average.
4. Additional staff were hired, resulting in an annual cost of €265,000 on average.

[4] https://kgdcl.gov.bd/wp-content/uploads/2018/04/part-2.pdf (p.60)

5. IT equipment (hardware and software) had to be purchased to collect and store data (one-off cost of around €2,000).
6. Advanced repair materials have been purchased which will cost around €5,000 per year.

In addition, there is a cost associated with fixing each component. A significant number of valves/insulating joints continue to need repair during project implementation leading to costs on the order of €6,000.

In conclusion, it is estimated that a total of about **€432,000** for the baseline study and **€120,000** each year meaning about **€1.64 million** over 10 years is required to implement the project and address leaks. The baseline study alone would require about 837% of the entire annual maintenance budget, which currently covers required emergency workers and emergency operations. Assuming the maintenance budget remains similar each year, every annual monitoring event would require 232% of the yearly maintenance budget to implement. The distribution company could not continue to maintain its required emergency teams and implement the project given current budget limitations.

As such, the proposed project activity represents a significant investment for PGCL and would not be implemented under the baseline scenario given the budget constraints.

No private capital is available from domestic or international capital markets due to real or perceived risks associated with investments in Bangladesh as demonstrated by the credit rating of the country or other country investment reports of reputed origin.

In the case of Bangladesh and the PGCL project, the applicability of the above statement is demonstrated by the credit rating of Bangladesh provided by Fitch, which currently rates Bangladesh as B+[5]. This makes Bangladesh a country considered as highly speculative.

In addition, in spite of the gas savings from the project, the gas distribution company will not actually reap any additional revenue stream that could be used to help secure private financing. This is the case because in Bangladesh, natural gas consumption is highly subsidized and locally produced supply is dwindling and unable to meet demand. LNG is being imported to meet current demand. The sale price of gas is well below the import price. Therefore, any gas savings derived from the project will either reduce the losses from the subsidies as less imported LNG will be required to meet demand or allow for more subsidized sales at a loss.[6] In either case, there is no new revenue stream that could be shown to a bank or other investor in order to secure funds.

Consequently, PGCL lacks the financial resources and access to finance to implement the proposed project activity without external support/investment.

Technological barriers:

The technological barriers:
1. Skilled and/or properly trained labour to operate and maintain the technology is not available in the applicable geographical area, which leads to an unacceptably high risk of equipment disrepair, malfunctioning or another underperformance;
2. Lack of infrastructure for implementation and logistics for maintenance of the technology (e.g. natural gas cannot be used because of the lack of a gas transmission and distribution network);
3. Risk of technological failure: the process/technology failure risk in the local circumstances is significantly greater than for other technologies that provide services or outputs comparable to those of the proposed project activity, as demonstrated by relevant scientific literature or technology manufacturer information;
4. The particular technology used in the proposed project activity is not available in the applicable geographical area.

[5] https://www.investing.com/news/world-news/fitch-maintains-bangladeshs-b-rating-with-stable-outlook-93CH-4060333

[6] World Bank report submitted to the DoE.

Skilled and/or properly trained labour to operate and maintain the technology are not available in the applicable geographical area (i.e. People's Republic of Bangladesh):
The project activity involves the use of advanced technology and materials for leak detection and repair. To date, PGCL operators and management have not been familiar with advanced leak detection and measurement practices or other similar advanced technologies. In fact, their methods/equipment (e.g., visual / odour detection) are largely ineffective in detecting leaks and do not enable leak quantification, Also, the local staff is trained to use the cheap, ineffective materials found locally and have no experience using expandable PFTE and other advanced materials.

Through interviews with PGCL personnel, it was confirmed that there has been a lack of internal procedures and technical capacity to establish and implement advanced leak detection and repair (LDAR) activities in the natural gas distribution network. Therefore, considering that (a) the project company is a regional monopoly governing the natural gas distribution system and (b) the technology envisaged by the project activity has never been used in Bangladesh beforehand for a carbon credit activity; there is a lack of skilled and/or trained labour to operate and maintain the technology covered by this project activity.

In addition, given the scale of this project and the need to hire and manage a significant workforce, the project implementation is highly complex and requires important staff training activities.

In summary, without support from the carbon crediting mechanism, an advanced LDAR programme would not be implemented because of the lack of technical capacity and skills and the significant additional human resources necessary to implement the project.

Regarding the barrier of the particular technology used in the proposed project activity not being available in the applicable geographical area (i.e. People's Republic of Bangladesh):
The Hi-Flow™ Sampler has never been used in Bangladesh without the support from a carbon credit mechanism. The initial cost of €20,000 per unit is a significant impediment for a company like PGCL, especially when they have no direct experience with the operational benefits of the device in Bangladesh and it is not locally available from a supplier who could perform required maintenance. This is also true of the advanced repair materials required for an advanced LDAR program. Much of this material is not readily available from local shops and suppliers and must be purchased from abroad at significantly higher prices than cheaper local goods currently used.
The dearth of local experience and training with the types of leak measurement equipment and leak repair materials required for and advanced LDAR combined with the lack of local suppliers of advanced measurement kit and materials is a potent barrier making the implementation of an advanced LDAR system implausible for PGCL.

In summary, the type of leak detection, repair and monitoring activities, that are needed to be put in place in order to have emission reductions generated, will require a coordinated and well-funded program to train and certify staff in operating advanced measurement technologies and in repairing leaks using state-of-art materials. This entails not only incurring significant costs to procure the equipment from abroad, but also building managerial and technical capacity. The fact that no such extensive leak detection and repair program has been undertaken to date demonstrates that the opportunity for carbon credit-based project financing has been instrumental incentivizing PGCL to collaborate on such an intensive effort.

Furthermore, continuation of the current situation with existing practices of leak detection and routine maintenance (i.e. Business as Usual) does not lead to additional procurement costs (e.g., materials and/or monitoring equipment, staff training), and thus does not require PGCL to seek additional financing in the local or international markets. PGCL current maintenance programme is satisfactory from the company's operational and regulatory stand-point, and will continue to be primarily guided by personnel safety and operational maintenance concerns, not by leak reduction for economic and / or environmental reasons. Thus, only the development of an advanced LDAR system without carbon credit monetization is deemed implausible based on the aforementioned barriers. The continuation of the current business as usual (BAU) situation with existing practices of leak detection and routine maintenance is considered the baseline scenario.

Due to the opportunities presented by registering the project under the carbon crediting mechanism, PGCL has been able to secure the necessary financing based on the credit revenue to implement the project. This investment has allowed the development of the advanced LDAR infrastructure and provided an operational budget needed to purchase equipment/repair materials to conduct on-going leak measurements/ repairs, as well as undertake the necessary hiring, training and certification of staff to use the equipment. As such, the prospect of emission reduction credits attracted investors that would normally not finance this type of project, and allowed the project company to overcome the barriers identified above. Such support conditional to carbon credit program registration is confirmed in the signed Project Investment Agreement.

In conclusion, the carbon crediting mechanisms alleviated the identified barriers and overcame the lack of direct financial benefits from the project to PGCL.

Investment analysis approach selected. The project was not financially viable without Article 6.4 carbon credits due to the following:

PGCL's annual transmission and distribution maintenance budget is approximately 4.8 million BDT (~€51,460). The baseline study alone costs ~€432,000 (837% of the annual maintenance budget). Each annual monitoring event costs ~€120,000 (232% of the yearly maintenance budget). The total project implementation cost over 10 years is approximately €1.64 million. After-tax profits in 2018 were ~669 million BDT (~€7.2 million), but these profits are directed to core operations and gas subsidies. PGCL had no access to domestic or international capital markets for this type of project (Fitch credit rating: B+ for Bangladesh — highly speculative). Furthermore, gas savings from the project do not generate additional revenue: gas prices are heavily subsidized and below import LNG costs, so saved gas reduces subsidy losses rather than generating new income streams.

Equipment costs: 4 Hi-Flow Samplers at ~€20,000 each (~€80,000 total); 8 GMI Gasurveyor units at ~€2,300 each (~€13,800 total); additional staff ~€265,000/year; advanced repair materials ~€5,000/year; IT equipment ~€2,000; consulting support ~€20,000/year. The project is financially additional in the absence of carbon credit revenues.

B.6.4. Common practice analysis

(This section is to be filled if the financial additionality or barrier analysis in the previous sub-section is followed for demonstrating additionality)

The applicable geographical area for this analysis is the entire host country. In the case of this project activity this is the People’s Republic of Bangladesh.

The project has been implemented in components found across the PGCL distribution network.

Advanced LDAR practices, utilising tools described by in the methodology have not been implemented by PGCL or any of the 3 years prior to the project start date, as the local gas distribution companies lacks the technical and financial resources to implement an advanced LDAR program. In addition, in the identified applicable geographical area, an advanced LDAR program – similar to the one implemented through project activity – has never been developed or introduced without support from the sale of carbon emission reduction credits.

Furthermore, the key components of the LDAR, advanced measurement devices, advanced repair materials, and advanced training in implementation of an LDAR have not been found in Bangladesh heretofore without support from the sale of carbon emission reduction credits.

Outcome Therefore, zero percent of the gas components across the country were covered under an advanced LDAR system in the three years prior to the start date of the project was zero percent and the project is not regarded as "common practice".

B.6.5. Performance-based approach

>> NA

B.7. Addressing non-permanence and risks of reversals

B.7.1. Reversals risk assessment

This project consists entirely of emission reductions (avoidance of fugitive methane from gas distribution leaks) and does not involve GHG removals. Physical repairs to gas distribution infrastructure do not create reversals in the same sense as carbon stocks — a repaired leak that later re-leaks is addressed in the project monitoring plan and project emission calculations, and does not constitute a reversal of previously credited reductions. There is no risk of reversal as defined for removal projects.

B.7.2. Reversals risk mitigation plan

Not applicable. This is an emission reduction (avoidance) project with no removals and no reversal risk. Reappeared leaks are accounted for as project emissions in the ER calculation.

B.7.3. Calculation of an overall percentage-based risk

Not applicable — this is an emission reduction project with no reversal risk requiring a percentage-based calculation.

B.7.4. Remediation of reversals

NA

B.8. Estimation of emission reductions and/or net removals

B.8.1. Calculation of baseline emissions and/or removals

B.8.1.1. Calculation of unadjusted baseline emissions and/or removals

Baseline emissions are calculated as follows:

$$BE_{Act,y} = \left\{ConvFactor\ x\ \sum_j [F_{CH4,j}\ \ x\ T_{j,y}\ x\ \left(1 - UR_j\right)]\ x\ GWP_{CH4}\right\} \quad \textbf{(1)}$$

Where:

$BE_{Act,y}$	=	Actual Measured Baseline emissions for crediting year *y* (t CO_2e)
ConvFactor	=	Conversion factor to convert Nm^3 CH_4 into t CH_4

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 (m^3 CH_4 / h)
UR_j	=	Uncertainty range for the flow rate measurement method applied to physical leak *j*
$T_{j,y}$	=	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 of methane valid for the commitment period (t CO_2e / t CH_4)
y	=	Project year

The uncertainty related to the conversion factor is zero, as this is a well-known chemical unit conversion. In addition, the GWP is a given factor determined by the best science available from the IPCC and also has minimal uncertainty. The uncertainty related to the variable of time is also negligible as the hours of operation are typically well know and tracked. However, the measurements of the flow rate of methane are subject to the uncertainty given the stated accuracy of the equipment itself. This is mitigated by ensuring the equipment remains calibrated within the manufacturer's recommended period prior to measurement. It is addressed as follows to ensure a to a 95% confidence interval that the calculation of the baseline is conservative.

The uncertainty of the measurement is taken into account conservatively by using the flow rate at the lower end of the uncertainty range of the measurement at a 95% confidence interval for baseline emissions from leaks. For example, if the measured flow rate is 1 m^3/h and the uncertainty range of the measurement method is ±10%, emissions reductions shall be calculated based on a flow rate of 0.9 m^3/h. Given the large quantity of measurements potentially involved in the baseline study, calculation methods provided in the 2006 IPCC Guidelines to calculate UR using the combined uncertainties of all measurements can be used.

The following assumption should be made in the calculation of baseline emissions:

- For parts of components where no physical leaks were detected at the initial survey and where a leak or leaks were detected during a subsequent survey, baseline emissions shall be accounted from the moment when the leak was detected and measured;
- Baseline emissions from a specific leak *j* or a specific component *r* are included in the calculations until whichever of the following occurs first:
  (a) The equipment concerned is replaced for a non-leak related reason (i.e. it breaks down); or
  (b) The end of the crediting period of the overall project activity.

Ex-ante **Baseline Calculation**

- The first step was to calculate leak flow rate ($F_{CH4,j}$)

Total leakage repaired, lpm	Convert from l/m to m^3/h ((60)/1000)	($F_{CH4,j}$)
35329	0.06	2120

- Since the Hi-Flow™ sampler results are given for standard temperature and pressure in data readings and margin of error, the conversion factor (ConvFactor) of 0.0007168tCH_4/Nm^3 CH_4 was used.
- Since the distribution system is in continuous operation, time ($T_{j,y}$) was considered to be 8760 for the purpose of this estimate. However, actual emissions will incorporate real operational hours.
- The uncertainty range (UR_j) was calculated, as per formula below, using guidance of the IPCC "Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories" Chapter 6, page 12, which provides an approach for combining uncertain quantities. (Please note that "U" and "U_{total}" used in the IPCC document have been replaced by "UR" and "UR_j" respectively to make it consistent with the acronyms used in the

$$UR_j = \frac{\sqrt{(UR_1 * x_1)^2 + (UR_2 * x_2)^2 + \ldots + (UR_n * x_n)^2}}{x_1 + x_2 + \ldots + x_n} \qquad (6)$$

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)

Firstly, the "sum of the squares' has been calculated, using the results of the feasibility study (i.e. each recorded leak rate of each component surveyed, x_n) and multiplying each by 10% (i.e. at 95% confidence interval as per IPCC Guidance, UR_n). Then, the square root of the resulting sum has been derived, and divided by the sum of recorded leak rate of each component surveyed.

35557.9	Total x
6245.7751	total sum of all pertinent measurements of (u*x)^2
79.0302164	Square root of sum of (u*x)^2
0.00222258	Square root of sum of (u*x)^2/total x

Conversion Factor tCH_4/Nm^3CH_4	Leak flow rate $F_{CH4,j}$ m^3/h	Time of use (estimated) $T_{j,y}$; h	Uncertainty range UR_j	GWP_{CH4} tCO_{2e}/tCH_4	Baseline emissions, BE_y tCO_2e	Project emissions, PE_y tCO_2e	Emission reductions ER_y tCO_2e
0.0007168	2120	8,760	0.00222258	28	371,903	0	371,903

B.8.1.2. Calculation of downward adjusted baseline emissions and/or removals

B.8.1.2.1. Downward adjustment at the calendar year of the start date of the first crediting period

Downward adjustment in the calendar year of the start date of the first crediting period:

$$BE_{adj,UNC,y} = BE_{Act,y} * (1 - UNC_{BE\ act,CP1}) \quad \textbf{(3)}$$

$$BE_{adj,UNC,y} = BE_{Act,y} * (1 - 0) = BE_{Act,y}$$

$BE_{adj,UNC,y}$	=	371,903
$BE_{Act,y}$	=	371,903
$UNC_{BE\ act,CP1}$	=	0 There are no uncertainties beyond the uncertainty from the measurements already captured in $BE_{Act,y}$
y	=	Calendar year of the start date of the first crediting period

iii. Determine the minimum downward adjusted baseline emissions and/or removals for the calendar year of the start date of the first crediting period $BE_{adj,min,y}$ as follows[7];

$$BE_{adj,min,y} = BE_{Act,y} - (BE_{Act,y} - AE_y) * 0.1 \quad \textbf{(4)}$$

$BE_{adj,min,y} = BE_{Act,y} - (BE_{Act,y} - 0) * 0.1 =$
$BE_{Act,y}$ -0.1($BE_{Act,y}$) =0.9$BE_{Act,y}$

0.9* 371,903= 334,712

$BE_{adj,min,y}$	=	334,712
$BE_{Act,y}$	=	371,903
AE_y	=	0
y	=	Calendar year of the start date of the first crediting period

$$BE_{adj,y} = min(BE_{adj,min,y}, BE_{adj,UNC,y}) \quad \textbf{(5)}$$

$BE_{adj,y} = min(BE_{Act,y}, 0.9BE_{Act,y}) = 0.9BE_{Act,y}$ =min(334,712, 371,903) = 334,712

$BE_{adj,y}$	=	334,712
y	=	Calendar year of the start date of the first crediting period

[7] As $BE_{Act,y}$ includes the measurement uncertainty, this value will be even more conservative than the guidance.

B.8.1.2.1.1. Downward adjustment at the subsequent years

Bangladesh’s does not have an unconditional target for reductions in its natural gas transmission and distribution sector.

Therefore:

$$AF_y = 100\% - \max\{[(PY-1)*2\%],[(PY-1)*\ (HCR \div TRGY)]\} \quad \textbf{(6)}$$

Where:

AF_y	=	Adjustment Factor for the crediting year *y* of the crediting period (%)
HCR	=	Host Country gas transmission/distribution reduction goal as stated in the Host Country NDC (%)
TRGY	=	Total Reduction Goal Year is the number of years the Host Country has delineated to meet its Reduction Goals in its NDC.
PY	=	The numeric year of the project as calculated on the last day of the monitoring period (day 365 of the crediting period shall be PY=1 where day 366 of the crediting period shall be PY=2)

HCR	=	0	No unconditional NDC Goal in sector
TRGY	=	9 years	2021-2030
PY	=	Year y	To be determined each project year
AF	=	100%-(PY-1 *2%)	Approach 2

$$AF_y = 100\% - \max\{[(PY-1)*2\%],[(PY-1)*\ (0 \div 9)]\} = 100\% - ((\mathrm{PY}-1)*2\%)$$

B.8.1.2.1.2. Calculation of downward adjusted baseline emissions and/or removals

Downward adjusted baseline emissions for each year y: BE_DA,y = BE_Act,y × (1 - AF_y) This calculation is applied for each year of the crediting period. Ex-ante values are provided in the summary table (B.8.6). Ex-post values will be calculated using monitored Tj,y values.

B.8.1.3. Determination of conservative BAU baseline emissions and/or removals

>>

BAU emissions are determined based on the quantity of CH_4 emitted through physical leaks that are detected prior to being repaired as part of the project activity (i.e., by the advanced LDAR program).

BAU Baseline emissions are calculated as follows:

$$BAU_y = \{ConvFactor\ x\ \textstyle\sum_j [F_{CH4,j}\ \ x\ T_{j,y}\ x\ (1 - UR_j)]x\ GWP_{CH4}\} \quad \textbf{(2)}$$

Where:

BAU_y	=	Baseline emissions for crediting year *y* (t CO_2e)
ConvFactor	=	Conversion factor to convert Nm^3 CH_4 into t CH_4

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 (m^3 CH_4 / h)
UR_j	=	Uncertainty range for the flow rate measurement method applied to physical leak *j*
$T_{j,y}$	=	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 of methane valid for the commitment period (t CO_2e / t CH_4)

The uncertainty related to the conversion factor is zero, as this is a well-known chemical unit conversion. In addition, the GWP is a given factor determined by the best science available from the IPCC and also has minimal uncertainty. The uncertainty related to the variable of time is also negligible as the hours of operation are typically well know and tracked. However, the measurements of the flow rate of methane are subject to the uncertainty given the stated accuracy of the equipment itself. This is mitigated by ensuring the equipment remains calibrated within the manufacturer's recommended period prior to measurement. It is addressed as follows to ensure a to a 95% confidence interval that the calculation of the baseline is conservative.

The uncertainty of the measurement is taken into account conservatively by using the flow rate at the lower end of the uncertainty range of the measurement at a 95% confidence interval for baseline emissions from leaks. For example, if the measured flow rate is 1 m^3/h and the uncertainty range of the measurement method is ±10%, emissions reductions shall be calculated based on a flow rate of 0.9 m^3/h. Given the large quantity of measurements potentially involved in the baseline study, calculation methods provided in the 2006 IPCC Guidelines to calculate UR using the combined uncertainties of all measurements can be used.

The following assumption should be made in the calculation of baseline emissions:

- For parts of components where no physical leaks were detected at the initial survey and where a leak or leaks were detected during a subsequent survey, baseline emissions shall be accounted from the moment when the leak was detected and measured;
- Baseline emissions from a specific leak *j* or a specific component *r* are included in the calculations until whichever of the following occurs first:
  - (a) The equipment concerned is replaced for a non-leak related reason (i.e. it breaks down); or
  - (b) The end of the crediting period of the overall project activity.

Ex-ante **BAU Calculation**

- The first step was to calculate leak flow rate ($F_{CH4,j}$)

Total leakage repaired, lpm	Convert from l/m to m^3/h ((60)/1000)	($F_{CH4,j}$)
35,329	0.06	2120

- Since the Hi-Flow™ sampler results are given for standard temperature and pressure in data readings and margin of error, the conversion factor (ConvFactor) of 0.0007168tCH_4/Nm^3 CH_4 was used.
- Since the distribution system is in continuous operation, time ($T_{j,y}$) was considered to be 8760 for the purpose of this estimate. However, actual emissions will incorporate real operational hours.
- The uncertainty range (UR_j) was calculated, as per formula below, using guidance of the IPCC "Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories" Chapter 6, page 12, which provides an approach for combining uncertain quantities.
  (Please note that "U" and "U_{total}" used in the IPCC document have been replaced by "UR" and "UR_j" respectively to make it consistent with the acronyms used in the

$$UR_j = \frac{\sqrt{(UR_1 * x_1)^2 + (UR_2 * x_2)^2 + ... + (UR_n * x_n)^2}}{x_1 + x_2 + ... + x_n} \quad (6)$$

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)

Firstly, the "sum of the squares' has been calculated, using the results of the feasibility study (i.e. each recorded leak rate of each component surveyed, x_n) and multiplying each by 10% (i.e. at 95% confidence interval as per IPCC Guidance, UR_n). Then, the square root of the resulting sum has been derived, and divided by the sum of recorded leak rate of each component surveyed.

35557.9	Total x
6245.7751	total sum of all pertinent measurements of (u*x)^2
79.0302164	Square root of sum of (u*x)^2
0.00222258	Square root of sum of (u*x)^2/total x

Conversion Factor tCH_4/ Nm^3CH_4	Leak flow rate $F_{CH4,j}$ m^3/h	Time of use (estimated) $T_{j,y}$; h	Uncertainty range UR_j	GWP_{CH4} tCO_{2e}/ tCH_4	Baseline emissions, BE_y tCO_2e	Project emissions, PE_y tCO_2e	Emission reductions ER_y tCO_2e
0.0007168	2120	8,760	0.00222258	28	371,903	0	371,903

B.8.1.4. Comparison between the downward adjusted baseline and the conservative BAU baseline emissions and/or removals

The ex-ante downward adjusted baseline is lower than the conservative BAU baseline for each year and cumulatively over the crediting period, confirming compliance with methodology requirements.

B.8.2. Calculation of project emissions and/or removals

Bangladesh's does not have an unconditional target for reductions in its natural gas transmission and distribution sector.

Therefore:

$$AF_y = 100\% - \max\{[(PY-1)*2\%], [(PY-1)*\ (HCR \div TRGY)]\} \quad \textbf{(6)}$$

Where:

AF_y	=	Adjustment Factor for the crediting year *y* of the crediting period (%)
HCR	=	Host Country gas transmission/distribution reduction goal as stated in the Host Country NDC (%)
TRGY	=	Total Reduction Goal Year is the number of years the Host Country has delineated to meet its Reduction Goals in its NDC.
PY	=	The numeric year of the project as calculated on the last day of the monitoring period (day 365 of the crediting period shall be PY=1 where day 366 of the crediting period shall be PY=2)

HCR	=	0	No unconditional NDC Goal in sector
TRGY	=	9 years	2021-2030
PY	=	Year y	To be determined each project year
AF	=	100%-(PY-1 *2%)	Approach 2

$$AF_y = 100\% - \max\{[(PY-1)*2\%], [(PY-1)*\ (0 \div 9)]\} = 100\% - ((\mathrm{PY}-1)*2\%)$$

B.8.3. Addressing of leakage

B.8.3.1. Sources of leakage

>>

No significant sources of leakage have been identified. The project involves repair of leaks within the existing PGCL service territory. Repair activities do not displace leaks to outside the project boundary, do not cause emissions increases elsewhere in the gas system, and do not create leakage in other sectors. Leakage is therefore not applicable to this project and is set to zero.

B.8.3.2. Description of how leakage is avoided, minimized or addressed

>>

As no sources of leakage have been identified, no leakage quantification is required. The project activity is fully contained within the above-ground PGCL distribution system, and its scope (leak repair) does not create displacement effects outside the project boundary.

B.8.3.3. Calculation of leakage emissions

>>

Leakage emissions = 0 tCO2e for all years in the crediting period. No leakage sources apply to this project.

B.8.4. Calculation of emission reductions and/or net removals

>>

Emission reductions are calculated as follows:

$$ER_y = (AR_y * BE_y) - PE_y) \quad (5)$$

Where:

ER_y	=	Emission reductions for crediting year *y* (tCO_2e)
AR_y		Adjustment Factor (%)
BE_y	=	Baseline emissions for crediting year *y* (tCO_2e)
PE_y	=	Project emissions for crediting year *y* (tCO_2e)

B.8.5. Data and parameters fixed ex ante

(Copy this table for each piece of data or parameter)

Data/parameter	**GWP_{CH4}**
Description	Global warming potential Methane
Data unit	tCO_{2e}/tCH_4
Equations referred	1,2,7
Purpose of data	☒ Baseline emissions/removals ☐ Project emissions/removals ☐ Leakage emissions
Value(s) applied	GWPs will be updated according to any decisions by the CMP. GWP_{CH4} = 28
Source of data	☐ Measured ☒Other sources
Treatment of uncertainty	latest UN report is used.
Choice of data or measurement methods and procedures	>>5th Assessment Report of the IPCC
Additional comments	>>

Data/parameter	**ConvFactor**
Description	The factor to convert Nm^3 CH_4 to tCH_4
Data unit	tCH_4/ Nm^3 CH_4

Equations referred	1,2,7
Purpose of data	☒ Baseline emissions/removals ☐ Project emissions/removals ☐ Leakage emissions
Value(s) applied	0.0007168
Source of data	☐ Measured ☒Other sources
Treatment of uncertainty	No uncertainty as basic chemistry conversion factor.
Choice of data or measurement methods and procedures	>>
Additional comments	>> The leak flow rate ($F_{CH4,j}$) and conversion factor (*ConvFactor*) should be reduced to the same reference conditions. 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 ($F_{CH4,j}$) 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 ACM001 v2 p.3 [8], and is applied to convert Nm^3 CH_4 to tCH_4.

B.8.6. Summary of ex-ante estimates of emission reductions and/or net removals

Year	Baseline emissions/removals (tCO_2e) w AF	Project emissions/removals (tCO_2e)	Leakage emissions (tCO_2e)	Emission reductions/Net removals (tCO_2e)
31/07/2020 -30/07/2021	334,712	0	0	334,712
31/07/2021 -30/07/2022	328,018	0	0	328,018
31/07/2022 -30/07/2023	321,458	0	0	321,458
31/07/2023 -30/07/2024	315,029	0	0	315,029
31/07/2024 -30/07/2025	308,728	0	0	308,728
31/07/2025 -30/07/2026	302,553	0	0	302,553
31/07/2026 -30/07/2027	296,502	0	0	296,502
31/07/2027-30/07/2028	290,572	0	0	290,572
31/07/2028 -30/07/2029	284,761	0	0	284,761

[8] https://cdm.unfccc.int/filestorage/C/D/M/CDMWF_AM_JIVCJD2PTI9976ZOV4A8KRO8T9QUWW/EB21_repan9_ACM0001_Revision_clean.pdf?t=MjV8cHhrcWg4fDC6dRbN5ancjxZcTJ0m7_Zg

31/07/2029 -30/07/2030	279,066	0	0	279,066
Total	3,061,399	0	0	3,061,399
Total number of years in the crediting period	10			
Annual average over the crediting period	306,140	0	0	306,140

B.9. Monitoring Plan

B.9.1. Data and parameters to be monitored

(Copy this table for each piece of data or parameter)

Data/parameter	**Tj,y**	
Description	Time (hours) the relevant component j would leak in the baseline scenario and is eligible for crediting in year y	
Data unit	Hours	
Equations referred	Equations 1, 2	
Purpose of data	☒ Baseline emissions / removals ☐ Project emissions / removals ☐ Leakage emissions	
Measurement methods and procedures	Outages and interruptions tracked in the project database. Any unscheduled shutdowns timed and recorded as reductions in operating hours.	
Entity/person responsible for the measurement	PGCL gas utility — database manager	
Measuring instrument(s)	*Type of instrument*	NA
	Accuracy class	NA
	Calibration requirements	NA
	Location	NA
Measurement intervals	Continuous (tracked in database)	
QA/QC procedures	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 equipment, the hours of operation for every piece of affected equipment 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
Treatment of uncertainty	N/A for this parameter.
Additional comment	Continuous (tracked in database)

Data/parameter	**Tj,z**	
Description	The time the relevant previously repaired component has continued leaking after monitoring measurement during the crediting year *y* (hours)	
Data unit	Hours	
Equations referred	Equation 7	
Purpose of data	☐ Baseline emissions / removals ☒ Project emissions / removals ☐ Leakage emissions	
Measurement methods and procedures	Outages and interruptions tracked in the project database. Any unscheduled shutdowns timed and recorded as reductions in operating hours.	
Entity/person responsible for the measurement	The Gas Utility will track and record any outages that reduce the hours of operation for components within the project boundary.	
Measuring instrument(s)	*Type of instrument*	NA
	Accuracy class	NA
	Calibration requirements	NA
	Location	NA
Measurement intervals	Continuous (tracked in database)	
QA/QC procedures	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 equipment, the hours of operation for every piece of affected equipment 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	
Treatment of uncertainty	N/A for this parameter.	
Additional comment	Continuous (tracked in database)	

Data/parameter	**Temperature and pressure of natural gas**
Description	Temperature (°C) and pressure (kPa) of natural gas at measurement point (automatically corrected in Hi-Flow readings)
Data unit	°C and kPa
Equations referred	Equations 1, 2, 7 (automatically included in the measurements from the device)

Purpose of data	☒ Baseline emissions / removals ☒ Project emissions / removals ☐ Leakage emissions	
Measurement methods and procedures	Two measurements taken with the lowest of the two used.	
Entity/person responsible for the measurement	Done by operator taking measurements.	
Measuring instrument(s)	*Type of instrument*	Hi Flow Sampler, LMD or other volumetric methane measuring device
	Accuracy class	+,- 10%
	Calibration requirements	As per the operation manual every 30 days
	Location	Portable
Measurement intervals	At the time of each leak measurement	
QA/QC procedures	Data measurement equipment will be calibrated and double checked on a regular basis. The manufacturer's recommended calibration procedures shall be applied	
Treatment of uncertainty	N/A for this parameter as it is addressed in the measurement of flow by the equipment using UR.	
Additional comment	The typical volumetric methane flow measurement equipment used to measure leakage provides results already established at standard temperature and pressure (0 degree Celsius and 101.3 kPa) so no separate measurements would be needed in this case.	

Data/parameter	**URj**	
Description	Uncertainty range for the measurement method applied to baseline leak j (fraction, 95% confidence)	
Data unit	Fraction	
Equations referred	Equations 1, 2	
Purpose of data	☒ Baseline emissions / removals ☐ Project emissions / removals ☐ Leakage emissions	
Measurement methods and procedures	Estimated at 95% confidence per Chapter 6 of IPCC 2000 Good Practice Guidance. Manufacturer-reported uncertainty assumed at 95% if not specified.	
Entity/person responsible for the measurement	Climate Compass	
Measuring instrument(s)	*Type of instrument*	NA
	Accuracy class	NA
	Calibration requirements	NA

	Location	NA
Measurement intervals	Periodically, each monitoring period	
QA/QC procedures	NA	
Treatment of uncertainty	Uncertainty estimated at 95% confidence. Applied conservatively: measurement uncertainties reduce baseline (1-URj) and increase project emissions (1+URz).	
Additional comment	—	

Data/parameter	**URz**	
Description	Uncertainty range for the measurement method applied to leak z (fraction, 95% confidence)	
Data unit	Fraction	
Equations referred	Equations 7	
Purpose of data	☒ Baseline emissions / removals ☐ Project emissions / removals ☐ Leakage emissions	
Measurement methods and procedures	Estimated at 95% confidence per Chapter 6 of IPCC 2000 Good Practice Guidance. Manufacturer-reported uncertainty assumed at 95% if not specified.	
Entity/person responsible for the measurement	Climate Compass	
Measuring instrument(s)	*Type of instrument*	NA
	Accuracy class	NA
	Calibration requirements	NA
	Location	NA
Measurement intervals	Periodically, each monitoring period	
QA/QC procedures	NA	
Treatment of uncertainty	Uncertainty estimated at 95% confidence. Applied conservatively: measurement uncertainties reduce baseline (1-URj) and increase project emissions (1+URz).	
Additional comment	—	

Data/parameter	**FCH4,j**
Description	Leak flow rate of methane for baseline leak j (m^3CH4/h)
Data unit	m^3CH4/h
Equations referred	Equations 1, 2, 9, 10
Purpose of data	Baseline emissions
Measurement methods and procedures	Procedures required by manufactures of the equipment used to measure leak flow rates should be followed
Entity/person responsible	*A trained project implementor will take the measurements required.*

<table>
<tr><td rowspan="4">Measuring instrument(s)</td><td>Type of instrument</td><td>>> Not specified at methodological level but options listed in Section B12.3.</td></tr>
<tr><td>Accuracy class</td><td>>> Not specified at methodological level</td></tr>
<tr><td>Calibration requirements</td><td>>> The calibration procedures and frequency as recommended by the measurement equipment manufacturer shall be followed.</td></tr>
<tr><td>Location</td><td>>> Not specified at methodological level</td></tr>
<tr><td>Measurement intervals</td><td colspan="2">At least annually</td></tr>
<tr><td>QA/QC procedures</td><td colspan="2">>> Two measurements will be taken for every leak and the more conservative of the two (the lower measurement) will be used in the calculations.</td></tr>
<tr><td>Treatment of uncertainty</td><td colspan="2">The uncertainty of this measurement is dealt with to a 95% level of confidence through the addition of the UR uncertainty factor.</td></tr>
<tr><td>Additional comment</td><td colspan="2">The leak flow rate ($F_{CH4,j}$) and conversion factor (ConvFactor) should be corrected to the same reference temperature and pressure conditions. For example, if value of 0.00067 (IPCC 2006 Vol.2, p. 4.12) is used to convert from m^3 CH_4 into t CH_4, then the flow rate should be corrected to reference conditions of 20 degree Celsius and 101.3 kPa</td></tr>
</table>

<table>
<tr><td>Data/parameter</td><td colspan="2">FCH4,j</td></tr>
<tr><td>Description</td><td colspan="2">Leak flow rate of methane for baseline leak j (m^3CH4/h)</td></tr>
<tr><td>Data unit</td><td colspan="2">m^3CH4/h</td></tr>
<tr><td>Equations referred</td><td colspan="2">Equations 1, 2, 9, 10</td></tr>
<tr><td>Purpose of data</td><td colspan="2">☒ Baseline emissions / removals ☐ Project emissions / removals ☐ Leakage emissions</td></tr>
<tr><td>Measurement methods and procedures</td><td colspan="2">>> Procedures required by manufactures of the equipment used to measure leak flow rates should be followed</td></tr>
<tr><td>Entity/person responsible for the measurement</td><td colspan="2">>> A trained project implementor will take the measurements required.</td></tr>
<tr><td rowspan="4">Measuring instrument(s)</td><td>Type of instrument</td><td>Hi Flow Sampler, LMD or other volumetric methane measuring device</td></tr>
<tr><td>Accuracy class</td><td>+,- 10%</td></tr>
<tr><td>Calibration requirements</td><td>As per the operation manual every 30 days</td></tr>
<tr><td>Location</td><td>Portable</td></tr>
<tr><td>Measurement intervals</td><td colspan="2">At least annually</td></tr>
<tr><td>QA/QC procedures</td><td colspan="2">>> Two measurements will be taken for every leak and the more conservative of the two (the lower measurement) will be used in the calculations.</td></tr>
<tr><td>Treatment of uncertainty</td><td colspan="2">The uncertainty of this measurement is dealt with to a 95% level of confidence through the addition of the UR uncertainty factor.</td></tr>
</table>

Additional comment	The leak flow rate ($F_{CH4,j}$) and conversion factor (*ConvFactor*) should be corrected to the same reference temperature and pressure conditions. For example, if value of 0.00067 (IPCC 2006 Vol.2, p. 4.12) is used to convert from m³ CH_4 into t CH_4, then the flow rate should be corrected to reference conditions of 20 degree Celsius and 101.3 kPa

Data/parameter	**FCH4,z**		
Description	Leak flow rate of methane for leak z (m³CH4/h)		
Data unit	m³CH4/h		
Equations referred	Equations 7		
Purpose of data	☐ Baseline emissions / removals	☒ Project emissions / removals	☐ Leakage emissions
Measurement methods and procedures	>> Procedures required by manufactures of the equipment used to measure leak flow rates should be followed		
Entity/person responsible for the measurement	>> *A trained project implementor will take the measurements required.*		
Measuring instrument(s)	*Type of instrument*	Hi Flow Sampler, LMD or other volumetric methane measuring device	
	Accuracy class	+,- 10%	
	Calibration requirements	As per the operation manual every 30 days	
	Location	Portable	
Measurement intervals	At least annually		
QA/QC procedures	>> Two measurements will be taken for every leak and the more conservative of the two (the higher measurement) will be used in the calculations.		
Treatment of uncertainty	The uncertainty of this measurement is dealt with to a 95% level of confidence through the addition of the UR uncertainty factor.		
Additional comment	The leak flow rate ($F_{CH4,j}$) and conversion factor (*ConvFactor*) should be corrected to the same reference temperature and pressure conditions. For example, if value of 0.00067 (IPCC 2006 Vol.2, p. 4.12) is used to convert from m³ CH_4 into t CH_4, then the flow rate should be corrected to reference conditions of 20 degree Celsius and 101.3 kPa		

Data/parameter	**AFy**		
Description	Downward adjustment factor applied to the baseline in project year y (percentage)		
Data unit	Percentage		
Equations referred	Equation 6		
Purpose of data	☒ Baseline emissions / removals	☐ Project emissions / removals	☐ Leakage emissions
Measurement methods and procedures	Calculated		

Entity/person responsible for the measurement	Climate Compass	
Measuring instrument(s)	*Type of instrument*	NA
	Accuracy class	NA
	Calibration requirements	NA
	Location	NA
Measurement intervals	At least annually	
QA/QC procedures		
Treatment of uncertainty	NA	
Additional comment		

Data/parameter	**PY**	
Description	Numeric year of the project as calculated on the last day of the monitoring period	
Data unit	Year number	
Equations referred	Equation 6	
Purpose of data	☒ Baseline emissions / removals ☐ Project emissions / removals ☐ Leakage emissions	
Measurement methods and procedures	NA	
Entity/person responsible for the measurement	NA	
Measuring instrument(s)	*Type of instrument*	NA
	Accuracy class	NA
	Calibration requirements	NA
	Location	NA
Measurement intervals	*Annually*	
QA/QC procedures	>>	
Treatment of uncertainty	-	
Additional comment	February 29 will be equal to February 28 in case of a leap year for the sake of calculations	

Data/parameter		**UNCBE_act,CP1**
Description		>> Uncertainty that impact the baseline $BE_{Act,y}$ based on the data and calculation methods used not including measurement uncertainties as these are already conservatively accounted for in the measurement of the pre downward adjustment factor baseline.
Data unit		Fraction
Equations referred		Equation 3
Purpose of data		☒ Baseline emissions / removals ☐ Project emissions / removals ☐ Leakage emissions
Measurement methods and procedures		>> Estimated, where possible, at a 95% confidence interval.
Entity/person responsible for the measurement		Climate Compass
Measuring instrument(s)	*Type of instrument*	NA
	Accuracy class	NA
	Calibration requirements	NA
	Location	NA
Measurement intervals		*Periodically calculated for each monitoring period using the manufacturer's specified uncertainty range for the volumetric leak flow measurements taken.*
QA/QC procedures		*NA*
Treatment of uncertainty		NA
Additional comment		>> It is expected that based on the approach outlined in the methodology, the only uncertainty that will affect the baseline calculation is the uncertainty related to leak measurements. The combined uncertainty UR_j however is already conservatively accounted for in the $BE_{Act,y}$ calculation. In the case another project specific uncertainty is identified by the project developer after assessing all causes of uncertainty as per paragraph 13 of section 4 in Appendix 1, the activity developer will assess that uncertainty and quantify the uncertainty to a 95% level of confidence. The value will be taken at the lower bound of the uncertainty interval relative to the central estimate of the ex-ante quantified unadjusted net baseline emissions during the first crediting period for any other project uncertainty identified.

Data/parameter	**HCR**
Description	Host Country gas transmission/distribution reduction goal as stated in the NDC (% reduction)
Data unit	% reduction
Equations referred	Equation 6
Purpose of data	☒ Baseline emissions / removals ☐ Project emissions / removals ☐ Leakage emissions
Measurement methods and procedures	Taken from NDC

Entity/person responsible for the measurement	Host Country	
Measuring instrument(s)	*Type of instrument*	NA
	Accuracy class	NA
	Calibration requirements	NA
	Location	NA
Measurement intervals	Each crediting period	
QA/QC procedures	*NA*	
Treatment of uncertainty	N/A for this parameter.	
Additional comment	—	

Data/parameter	**TRGY**	
Description	Total Reduction Goal Year — number of years Host Country has delineated to meet its NDC reduction goals	
Data unit	Number of years	
Equations referred	Equation 6	
Purpose of data	☒ Baseline emissions / removals ☐ Project emissions / removals ☐ Leakage emissions	
Measurement methods and procedures	From NDC	
Entity/person responsible for the measurement	Host COuntry	
Measuring instrument(s)	*Type of instrument*	NA
	Accuracy class	NA
	Calibration requirements	NA
	Location	NA
Measurement intervals	Each crediting period	
QA/QC procedures	*NA*	
Treatment of uncertainty	N/A for this parameter.	
Additional comment	—	

B.9.2. Sampling plan

No sampling is required. All eligible leaking components are individually measured using Hi-Flow™ Samplers. A complete census approach is applied — every component in the project database is surveyed at least annually. No statistical sampling is necessary.

B.9.3. Monitoring management system

>>

Staff within PGDCL and Prokaushali Sangsad LTD (PSL) are undertaking the project operations and monitoring activities. These specially trained staff are performing the advanced LDAR activities (detection, measurement, repair and documentation of leaks) throughout the crediting period. EcoGas Asia and its technical partners Climate Compass and Brawa Consulting provide methodological supervision and support to the PGDCL team. Ecoeye Co., Ltd and the Korea Midland Power Co. Ltd. (KOMIPO), two corporate entities in the Republic of Korea, provide all the funds required to implement the project. The project implementation management and execution is completely separated in time and space from conventional LDAR and emergency/capital repairs implemented by PGDCL. Project leak detection and repair crews are dispatched to facilities at different times from the regular conventional LDAR program crews. There is no data sharing between two types of crews to prevent possible bias, which could impact project implementation.

The following monitoring procedures have been implemented:

Establishment of a database

All data collected during project implementation is entered into a database. The database is continuously updated during the crediting period. The data in the database are also included in each monitoring report. Section B.6.1, Step 2 provides a summary of the information that is collected and tracked in the database during the project.

Data collection during the project implementation

The implementation of the project involved an initial baseline survey and regular subsequent surveys of each component within the project boundary.

During the project activity, data are collected and collated by the project leak detection and repair teams, the PGDCL database manager reviews the data and checks that it has been recorded correctly. Procedures include: 1) tracing data from individual spreadsheets to the collated spreadsheet; 2) identifying outliers and verifying the measurement with the responsible technical operator to double check the number; and 3) reviewing measurements by each individual Hi-Flow™, to ensure that no Hi-Flow™ in particular is making measurements that appear to be outliers on a constant basis. If such discrepancies are found, the Hi-Flow™ is recalibrated and checked immediately, and any erroneous leaks is re-measured.

Additionally, to ensure data is not lost if leak tags are damaged or lost, or digital photos are accidently deleted, etc., three concurrent ways of tagging leak locations and tracking leak measurements have been implemented: 1) a digital photo of the leak has been taken with the tag filled out; 2) a physical tag is placed on-site and the leak rate and measurement date written on the tag; and 3) when the leak measurement and date are entered into the database the original Hi Flow records is saved..

The project utilizes an independent third-party consulting firm, to provide QA/QC oversight for the project. Their role and responsibilities include: 1) verify that maintenance and monitoring of leaks is being conducted in accordance with the Monitoring Plan; 2) observe PGDCL database team to ensure that data is being recorded and handled as per the requirements of this Monitoring Plan; and 3) conduct audits of the data to ensure that adequate records are being kept, and that leaks found and leaks repaired have been accurately documented in the database.

Monitoring

All teams conducting leak surveys are formally trained and certified by technical experts in leak detection and measurement techniques, and advanced repair techniques. The training program is described in more detail below.

Training Program
A training program was conducted to train local staff at PGDCL on how to use advanced LDAR techniques, such as how to use advanced detection and measurement equipment, how to execute effective repairs, and how to document the leaks found in an effective manner. The training was conducted by technical experts with experience in advanced gas leak detection and measurement, and advanced repair materials to be used in the project. These experts provided detailed instructions and written materials on how to conduct the leak detection, measurements and repairs.

Each project leak detection and repair team (made of 2 people) is equipped with the following equipment:

1. Hi-flow™ sampler/Leak Measurement Device
2. Calibration standards: low concentration ~2.5% methane in air concentration; and high concentration ~97%% methane
3. GMI Gasurveyor™ (500 Series) (or similar electronic gas detector)
4. Smartphone with possibility to get GPS coordinates and make photos of leaky facilities
5. Tags
6. Advanced Repair materials as required for particular repairs
7. Data sheets with draft schematics for data input on-site
8. Toolkit
9. Car

Monitoring requirements

For each component where a physical leak has occurred, the following procedures are undertaken and information collected:

Leak Detection and Measurement
The project leak detection and repair teams survey the components in the project boundary using advanced leak detection instruments, such as the GMI Gasurveyor (500 series), which is an electronic gas detector. Once identified, the leaks are tagged, and numbered. The flow rate for each leak is then be quantified using the Hi-Flow™ sampler. A digital photograph is taken of the leaking component and tag. These photographs are archived by the Database Management Team. In addition, the type of repair expected given the nature of the leak and its location is categorised for future repair planning.

After leaks have been detected and measured, they are repaired. Before each repair is made, another Hi-Flow™ sampler measurement is taken. In case there is any discrepancy between the final measurement and the original measurement, a third measurement is taken to confirm the change. Discrepancy between the first two measurements must be 15% or less. The lower of the two, confirmed leak rate is used to determine baseline leakage as per the methodology, regardless of whether the leak rate is lower or higher than the original leak measurement. After the repair, a new leak measurement is carried out to ensure that the leak was properly repaired. If required, additional repairs are made until no further leak can be detected. The date of the repair (or discovery of remaining leak) is recorded in the Project Database.

Monitoring Repaired Leaks
All leaks that have been subject to repair are monitored – using the same leak detection technologies (Gasurveror 500 or Hi-Flow™ sampler/Leak Measurement Device) on each leak identified in the baseline – to ensure they are maintained, on an annual basis. Where a leak repair fails, it is conservatively assumed that the leak resumed the day after the last inspection, or in the case of the first inspection, the day after the repair has taken place. Emission reductions are counted from the date of subsequent repair of that same leak, and are measured using the same type of equipment as in the initial baseline survey. Such reappeared leaks are repaired again followed by new leak measurements. Data collected is included in the periodic monitoring reports stored in the Database.

In summary, for each component where a physical leak has occurred, the following information is collected during regular monitoring checks:

- Date of monitoring;
- An assessment whether the relevant component has been replaced after the repair of the leak;
- The number of hours during which the component is in pressurized natural gas service;
- An assessment whether the repair of the leak functions appropriately.

All information is added to the database and be included in the monitoring reports.

B.9.4. Post-crediting period monitoring plan

>>

Not applicable. This project involves only emission reductions (fugitive methane avoidance), not carbon removals. No post-crediting period monitoring is required under the standard for activities involving removals.

SECTION C. Start date, crediting period type and duration

C.1. Project start date

>>

11/11/2019 – the project investor signed a contract on this date procuring the services, equipment and repair materials required to implement the project. As per the definition of Start Date, the start date is the date that the contract to procure such goods and services was signed.

C.2. Expected operational lifetime of the project

>>

10-years

The project will continue its work to monitor leak repairs and find new leakages across the components in the project boundary for 10 years

C.3. Project crediting period

C.3.1. Type of crediting period approved by the host Party

☐ Renewable ☒ Fixed

C.3.2. Start date of the crediting period

>>

31/07/2020

C.3.3. Duration of the crediting period

>>

10 years

SECTION D. Environmental impacts, social impacts and sustainable development impacts

D.1. Environmental and social impacts and sustainable development impacts as per the Article 6.4 sustainable development tool

D.1.1. Summary of the environmental and social risk analysis and applicable mitigation measures

>>

The environmental and social risk assessment has been conducted per the Article 6.4 Sustainable Development Tool. The project's primary positive environmental impact is the reduction of methane emissions — a potent greenhouse gas — contributing to climate change mitigation. Secondary environmental benefits include improved local air quality in areas near leaking components.

Potential environmental and social risks identified include: minor disruption to communities during repair activities (addressed through scheduling and advance notice); minor risk of temporary gas interruption (managed through coordination with PGCL operations); occupational health and safety risks for field teams (mitigated through training, PPE, and certification requirements). No significant negative environmental or social risks have been identified.

D.1.2. Summary of the sustainable development impacts evaluation

>>

The project generates positive sustainable development impacts across multiple SDG dimensions: (SDG 13) Climate Action — direct contribution through 3+ million tonnes of CH4 reductions over the crediting period; (SDG 7) Affordable and Clean Energy — improved gas system efficiency reduces waste, supporting affordable energy access; (SDG 8) Decent Work — creation of skilled employment for LDAR technicians and database staff; (SDG 9) Industry, Innovation, and Infrastructure — introduction of advanced LDAR technology to Bangladesh's gas sector.

D.2. Environmental and social impacts as per the host Party regulations

D.2.1. Summary of host Party requirements

>>

Bangladesh's Environmental Conservation Act (1995) and Environmental Conservation Rules (1997) govern environmental impact assessments. The project activity (repair and maintenance of existing above-ground gas distribution components) does not trigger mandatory EIA requirements under these regulations, as it involves maintenance of existing infrastructure rather than new construction or major modifications. No social impact assessment is mandated for this type of maintenance activity under Bangladesh law.

D.2.2. Summary and conclusion of the assessment

>>

Given that the project involves repair and maintenance of existing infrastructure (no new construction, no land-use change, no significant physical modifications), no mandatory EIA or SIA is required under Bangladeshi law. The activity is consistent with the operational mandate of PGCL and poses no significant negative environmental or social impacts under applicable host Party regulations.

SECTION E. Local stakeholder consultation

E.1. Scope of the consultation

>>

E.2. Stakeholders invited

>>

E.3. Modalities for the consultation

>>

E.4. Summary of comments received

>>

E.5. Consideration of comments received

>>

SECTION F. Double or revived registration

F.1.1. Declaration related to the existence of a former project in the same geographical location

>>

F.1.2. Declaration related to registration under the A6.4 mechanism or other crediting schemes

A 6.4 mechanism	☐ **The proposed A6.4 project has not been already registered as an A6.4 project.**
	☐ **The proposed A6.4 project has not been already included as a component project (CP) in a registered Article 6.4 mechanism programme of activities (A6.4 PoA).**
	☐ **The proposed A6.4 project has not been previously deregistered from the Article 6.4 mechanism.**

	>> *Tick all the three boxes above as a confirmation of compliance with mandatory requirements.*
	☐ **The proposed A6.4 project has not been excluded from a registered A6.4 PoA.** >>*Tick the box if applicable.*
Other	☐ **The proposed A6.4 project is not currently registered or pursuing registration, or covered by a programme, under any other international, regional, national, subnational or sector-wide GHG mitigation crediting scheme.** ☐ **The proposed A6.4 project was previously registered under or covered by a programme under any other international, regional, national, or subnational or sector-wide GHG mitigation crediting scheme but deregistered or excluded from the other crediting scheme before fully exhausting the crediting period under the other crediting scheme.** ☐ **The proposed A6.4 project is currently registered or covered by other international, regional, national, subnational or sector-wide GHG mitigation crediting scheme.** >> *Tick only one applicable box.*

Appendix 1. Contact information of activity participants

(Copy this table for each activity participant)

Organization name	>>
Legal entity identifier	>>
Country	Choose an item.
Address	>>
Telephone	>>
Mobile	>>
E-mail	>>
Website	>>
Contact person	>>

Appendix 2. Applicability of mechanism methodologies and standardized baselines

>>

Appendix 3. Further background information on ex ante calculation of emission reductions and/or net removals

>>

Appendix 4. Summary of post-registration changes

>>

Appendix 5. Further background information on monitoring plan

>>

Appendix 6. A6.4 Environmental and Social Safeguards Risk Assessment Form (A6.4-FORM-AC-015)

>>

Appendix 7. A6.4 Environmental and Social Management Plan Form (A6.4-FORM-AC-016)

>>

Appendix 8. A6.4 Sustainable Development Impact Form (A6.4-FORM-AC-017)

>>

- - - - -

Document information

Version	*Date*	*Description*
02.0	1 April 2026	Revision to align with the provisions of the “Standard: Article 6.4 activity standard for projects” (version 03.0) (A6.4-STAN-AC-002) and respective methodological documents.
01.0	11 December 2024	Initial publication of form template.

Decision Class: Regulatory
Document Type: Form
Business Function: A6.4 activity cycle
Keywords: A6.4 mechanism, A6.4 projects, project implementation, project design document