CLEAN INFRASTRUCTURE

ROYALTY CREDIT PROGRAM

GUIDANCE DOCUMENT

REQUEST FOR APPLICATIONS PROCESS

Ministry of Natural Gas Development
Upstream Development Division
Policy and Royalty Branch

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1. Purpose of this document

This document is intended to provide guidance on the 2016 Clean Infrastructure Royalty Credit Program (the Program) and the Request for Applications (RFA) process for oil and gas producers and pipeline companies interested in submitting an application to the Program.

The new Program supports actions in the British Columbia Natural Gas Strategy to continue to implement emission reduction measures while allowing the natural gas sector to maintain its competitive position. The Program also complements new requirements for methane emission reductions under the 2016 Climate Leadership Plan by providing an incentive for early actions. This is accomplished by providing producers with a royalty deduction in respect of eligible costs to complete approved projects.

This document provides a general overview of the Program as well as more detailed information relevant to potential applicants, including:

- An overview of the Program and RFA process; information on what constitutes an eligible project and applicant for the Program;
- Information on how the royalty deductions for approved projects are released and deducted from oil and gas royalty payments due to the Province of British Columbia (the Province);
- Further information on greenhouse gas (GHG) estimation methods for the different eligible project types;
- An example of a completed Estimated Industry Payback Period calculation to assist applicants in completing the application package;
- And other tips to help applicants to be successful in the competitive RFA process.

The information in this document is for your convenience and guidance only and is not a replacement for associated legislation or regulations. If you require access to legislation and regulations you can go to http://www.bclaws.ca/.

2. Overview of the Clean Infrastructure Royalty Credit Program

The purpose of the Program is to advance clean technologies and solutions to reduce the environmental impact of oil and natural gas development in British Columbia. The Province has allocated up to $20 million for the Program in 2016 which may be available to applicants for eligible Projects. The primary focus of the Program in 2016 is to achieve cost-effective greenhouse gas (GHG) emissions reductions through retrofits, replacements, or conversions of venting source emissions.[1]

The Program may be expanded to include other types of environmental improvement projects in future years. Producers (or producers in partnership with pipeline companies) are able to apply for royalty deductions through a competitive RFA process.

3. The Request for Applications (RFA) process

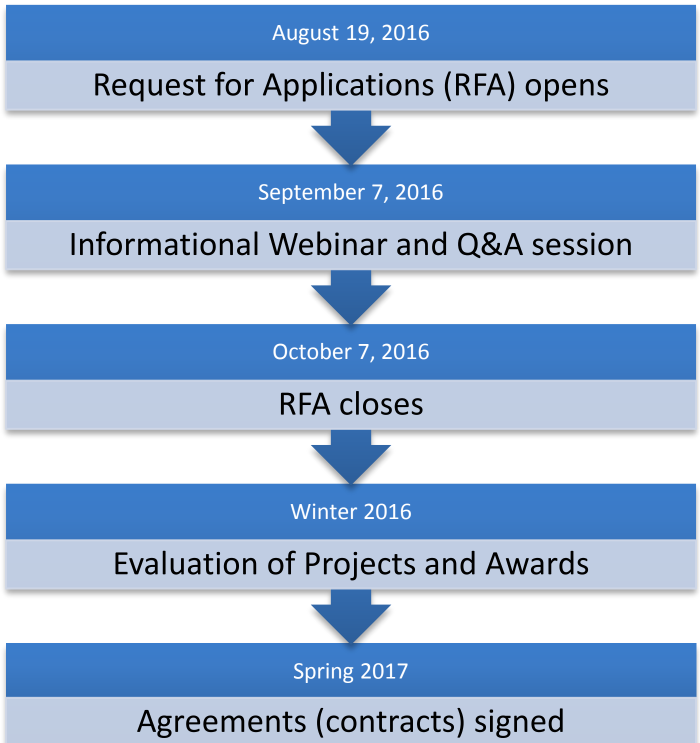
Overview of RFA process

- Proponents respond to the RFA by submitting a detailed and complete project application. See the Clean Infrastructure RFA 2016 on the Program website for the information required to complete an application.
- Each application undergoes a comprehensive review and evaluation process by an evaluation committee formed by the Province.
- Projects will be ranked based on a composite index of a set of evaluation criteria.
- The projects that achieve the highest evaluation scores in the competitive process are recommended for a royalty deduction allocation by evaluators.
- The Province advises each company in writing whether or not their project applications were successful in the RFA process.
- Successful applicants will be required to enter into an Agreement with the Province. Refer to the Program website to download an example of the Agreements.

Key target dates for the Clean Infrastructure RFA process

Key target dates for the Clean Infrastructure RFA 2016 process are presented in the following chart.

[1] Venting emissions is defined in Schedule A of the BC *Greenhouse Gas Emission Reporting Regulation.*



General Information on RFA Process

- The RFA process is expected to be very competitive. A similar program, the Infrastructure Royalty Credit Program (IRCP), which focuses on supporting the development of new roads and pipelines in the Province, has seen royalty deduction requests by companies exceeding the annual allocation of royalty deductions available.

- An applicant may request a level of royalty deductions required to support their GHG emissions reduction project. Deductions up to a maximum of 50% of the eligible project costs are allowable.

- "Legal Name of Applicant" on the RFA cover page refers to the company name that is registered in British Columbia, including partnership name, if applicable. This is also the name that will be used to confirm that the applicant has a client code as an oil and gas royalty payor with the British Columbia Ministry of Finance.

- The information the Ministry receives will be subject to the *Freedom of Information and Protection of Privacy Act*. However, Section 21 (Disclosure Harmful to Business Interests of a Third Party) is a mandatory exemption to the public's right to access information. It protects information which, if disclosed, would harm a third party's business interests. See also the Agreement Section XI Consent to Use and Disclose for further information on the Province's ability to utilize information provided.

Tips for Completing the Clean Infrastructure RFA 2016 Package

The Province has issued RFAs for various royalty deduction programs between 2004 to 2016. Though this is the first RFA for the Clean Infrastructure Royalty Credit Program, the Province has reviewed a large number of applications submitted by the oil and gas industry for the IRCP and has collected these tips to assist you when completing the package.

The table below highlights some common issues found in previous applications, with suggested solutions.

Companies are encouraged to carefully review the Clean Infrastructure RFA 2016 package prior to submission to ensure it is completed fully and correctly.

DOCUMENT	ISSUE
RFA Cover Page **(Word document)**	• Missing from submission; • Not fully completed with information about the company or project; • Not signed.
Cover Letter(s) about the Project	• Missing; • Lack of information about the project provided; • Not on company letterhead;
Supporting Letter(s) (if a partner application)	• Missing or only one letter from one partner received; • Letter not signed; • Letter does not indicate each partner agrees to the joint project; • No royalty deduction percentage split for Producer partners assigned;
Proposed Construction Schedule **(Excel spreadsheet)**	• Missing from submission; • Not fully completed; • Format of spreadsheet changed (format must remain unchanged and in Excel);
Clean Infrastructure RFA Template **(Word document)**	• Legal company name not provided; • Partner company name not provided; • Vague description of project; • Questions unanswered; • Template Provided in PDF format (must be in Word). • Separate files not provided (Draft Verification Plan, Project and Equipment

	Estimated Cost Breakdown Tables, Estimated GHG Reductions Calculation, Estimated Industry Payback Calculation).
Mapping Requirements	• Shapefile format incorrect (see Section E-7 of the Clean Infrastructure RFA 2016 for details) • PDF of map missing; • Printed Map missing;
Flash Drive	• Not provided • Blank

4. Program eligibility

- Please refer to the Clean Infrastructure RFA 2016 Section D for definitions of eligible projects, eligible and ineligible costs, and other Program related definitions.
- The Program in 2016 is focused on reducing GHG emissions from vented sources by the retrofit, replacement, or conversion of equipment currently in operation in British Columbia.
- The Program is NOT intended to share costs of building infrastructure that has already been built or is under construction, nor is it intended to support the deployment of technologies that may be required to meet regulatory requirements.

Eligible Projects

- Eligible projects for 2016 include GHG emissions reduction projects focused on reductions from vented sources (upgrades and retrofits only), e.g., high-bleed to low-bleed pneumatic conversions, instrument gas to instrument air conversions, pump conversions, and vent gas capture projects. Greenfield infrastructure is not eligible for the 2016 Program.
- Leak detection and repair projects are not eligible projects for the 2016 Program.
- All projects must be located within British Columbia.
- Projects that were completed or substantially underway before the RFA closes are not eligible projects.
- There is no minimum GHG reduction required for the 2016 Program.
- Refer to the Clean Infrastructure RFA 2016 section D1 for more information.

Eligible Applicants

- Eligible applicants to the program include a producer or combination of producer(s) and pipeline company(ies), as defined in the *Petroleum and Natural Gas Royalty and Freehold Production Tax Regulation*.

- The Province will reject applications from applicants that have, in the Province's sole opinion, an unsatisfactory record of making royalty payments to the Province.

- In a joint application between two or more Producers, the amount of the royalty deduction requested overall and the percentage split between Producers must be clearly indicated in the submitted application. The Province has no involvement in the decision of the percentage split.

- Eligible applicants may choose to submit multiple applications to the Program. Applications can include any combination of eligible project types. Applicants that propose multiple project types must decide whether to submit one application or separate applications.

5. Evaluation of applications

- All information must be submitted as detailed in Section E of the Clean Infrastructure RFA 2016 in order to ensure the application meets the mandatory evaluation criteria.

- Section H of the Clean Infrastructure RFA 2016 outlines the Evaluation Process, Mandatory Criteria and Evaluation Criteria for the Program. The Evaluation Criteria includes: the royalty credit emission reduction ratio (i.e., the amount of the royalty deduction requested per the estimated amount of GHG emissions reduced), the construction timeline, and a project business case (including a description of any barriers to the project, industry payback period, the use of new/innovative technology, and potential project risks).
- The amount of royalty deduction requested will affect evaluation scoring. Further information is provided below and in Section H of the Clean Infrastructure RFA 2016.
- The Province does not have a preference for approving smaller projects over larger projects.
- Applicants can request less than 50% of their total project costs. A lower requested royalty deduction can improve an applicant's chance of getting their project approved, based on the evaluation criteria of the Program.

The following cases (Case 1 and Case 2) illustrate an example of where an applicant may choose to request less than the maximum 50% royalty deduction in their project application.

Example of the Royalty Credit Emission Reduction Ratio and deduction requests

Consider the following example project that includes the deployment of different GHG emission reductions technologies applicable under the Program.

- *Replace 100 Fisher 4150 high-bleed pneumatic devices with 100 Fisher C1 low-bleed pneumatic devices.*
- *Replace 40 generic diaphragm pumps with solar-powered pumps*
- *Install 10 vent gas capture systems*
- *Install 5 instrument air systems to replace gas-driven systems*

- *Assume a project start date of July 1, 2017. Project emissions will be estimated until December 31, 2021 (a 4.5 year estimation period) as stated in the requirements of the RFA.*

Table 1 below summarizes the estimated costs and GHG reductions from this example project. The total costs provided are estimates of eligible costs as defined in the Clean Infrastructure RFA 2016.

Table 1: Summary of Estimated Costs and GHG Reductions

Project activities	Number of activities	Total Eligible Costs	GHG reductions* – Between 07/01/2017 and 12/31/2021 (tCO_2e)
Replace 100 Fisher 4150 high-bleed pneumatic devices with 100 Fisher C1 low-bleed pneumatic devices.	100	\$250,000	23,125
Replace 40 generic diaphragm pumps with solar-powered pumps	40	\$360,000	21,914
Install 10 vent gas capture systems	10	\$1,100,000	65,348
Install 5 instrument air systems to replace gas-driven systems	5	\$1,250,000	77,821
Total (project)		**\$2,960,000**	**188,208**

*See Section 8 for further information on how estimated GHG reductions are to be calculated.

In this case, the total Project costs are \$2,960,000 and the Project is expected to achieve approximately 188,208 tonnes of carbon dioxide equivalent (CO_2e) reductions between 07/01/2017 and 12/31/2021 (the 4.5 year period chosen for the Program assessment).

Projects in the RFA process will be assessed in part based on the *Royalty Credit Emission Reduction Ratio* (RCERR) (see the Clean Infrastructure RFA 2016 for the weighting of evaluation criteria). The RCERR is calculated by taking the clean infrastructure royalty deduction requested in the application and dividing by the GHG emissions reduction estimate as described above. A higher point score will be assigned to projects that demonstrate a lower RCERR.

Case 1:

An applicant requests 50% of the total project costs:

Total Project Cost	$2,960,000
Estimated GHG reductions	188,208
Royalty deduction request (50%)	$1,480,000.0
Calculated RCERR	**$7.86**

Case 2:

An applicant requests 35% of the total project costs:

Total Project Cost	$2,960,000
Estimated GHG reductions	188,208
Royalty deduction request (35%)	$1,036,000.0
Calculated RCERR	**$5.50**

6. Potential schedule for approved projects

It is expected that eligible projects will follow a similar schedule as outlined in the chart below. Please refer to the Clean Infrastructure RFA 2016 and the provided sample Agreement for further information on specific timelines and information requirements.

*as outlined in the Agreement

- The 2016 Program has two steps: Step 1 Construction and Step 2 Post-Project Verification. While other royalty deduction programs may allow additional intermediary steps, there are no intermediary steps for construction under the 2016 Program.
- The royalty deduction request for all Step 1 Construction costs must be submitted at one time (within 6 months of Step 1 Completion).
- Third party, post-project verification of GHG emissions reductions is required for the 2016 Program and is an eligible cost of the project. For further information refer to Section D of the Clean Infrastructure RFA 2016, and the Agreement.
- The Project must be completed within five years, as described in the Agreement.
- The Province may conduct audits during or after a project is complete. For further information refer to the Agreement Section VI. Inspections, Audits and Safety.

7. Royalty deduction information

- Each project approved under the Program is assigned a maximum amount of royalty deductions based on the cost estimate provided in the RFA application. The requested deduction can be as much as 50% of the project's estimated cost or final as built cost, whichever is less.
- An approval of a project as a result of the RFA application does not result in royalty deductions being automatically applied to the applicant's royalty payable account; the release process is described further in the 2016 Clean Infrastructure Royalty Credit Deduction Agreement.
- The royalty deduction will apply to the royalty payor's account as a whole and is not tied to specific production or wells.
- Half (50%) of the available royalty deduction associated with completing construction may be released within 6 months of construction completion once an Applicant completes the release process as described in the Agreement. The second half (50%) of the royalty deduction associated with completing construction, and 100% of the royalty deduction associated with completing verification, may be released with 6 months of Post-Project Verification. For further information refer to the Clean Infrastructure Royalty Credit Deduction Agreement section VII.3.c Application for Royalty Deduction.
- For further guidance on the royalty deduction release request, refer to the Infrastructure Royalty Credit Program's Guidance Document.

8. Guidance for the estimation of GHG emissions reductions

GHG quantification for emissions reduction projects can be complex as calculations are often based on estimations and hypothetical situations. The examples below and further information provided in Appendix A are based on the Western Climate Initiative (WCI) quantification methods for 2012 and 2013 as referenced in the *Greenhouse Gas Emission Reporting Regulation*, as well as various carbon offset protocols for oil and gas operations.

Applicants are required to use relevant Western Climate Initiative (WCI) quantification methods (WCI.363 and others) from the following sources to develop their emissions estimates for the RFA:

- **2012**: Final Essential Requirements for Mandatory Reporting – Amended for Canadian Harmonization
- **2013**: WCI Essential Requirements for Mandatory Reporting – 2013 Addendum to Canadian Harmonization Version

If the equipment type is not listed in the WCI quantification methods, an alternative quantification method may be proposed and must be approved by the Province. Applicants must obtain approval from the Province on any alternative procedures prior to the submission of their application.

Information provided in an application to the Program must match the equipment and associated information reported by producers under the *Greenhouse Gas Emission Reporting Regulation* (if applicable).

Estimating GHG Reductions

Potential GHG emissions reductions for proposed Projects must be estimated by comparing the project case to the baseline (or business as usual) case using the following equation:

$$Emissions_{Reduction} = Emissions_{Baseline} - Emissions_{Project}$$

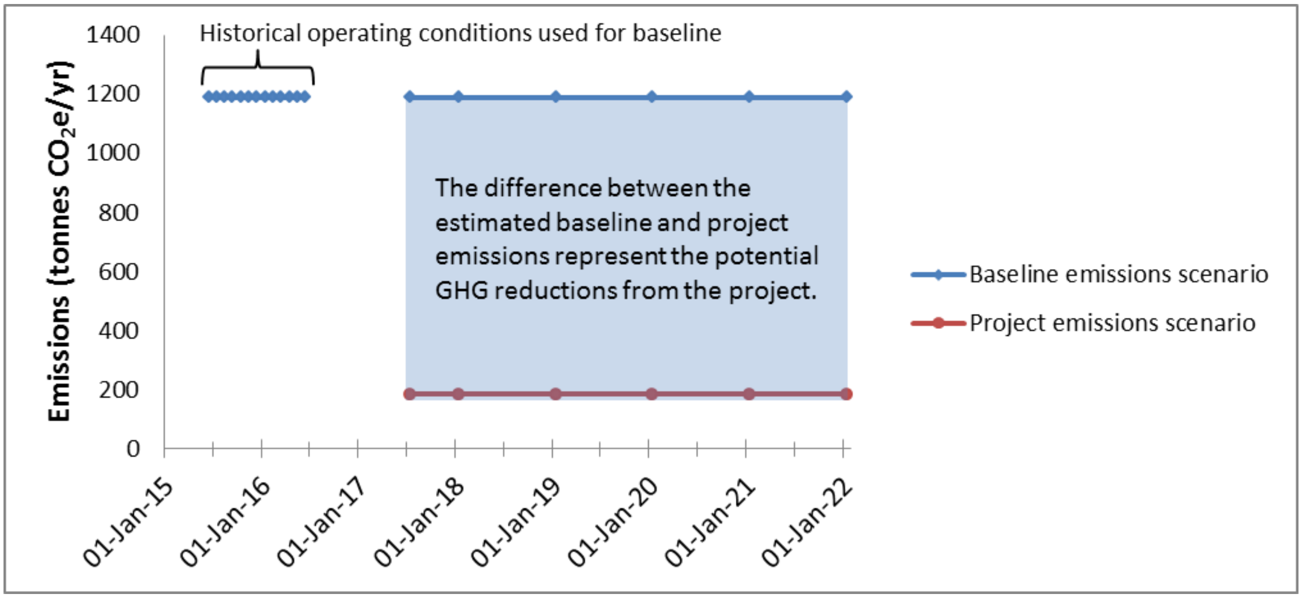
- The baseline is considered to be a reasonable representation of what likely would have occurred during the Project period had the Project not been implemented.
- The baseline is considered to be best represented by historical operating conditions of the specific equipment to be modified during the proposed project. Relevant monitoring data for the specific equipment from the most recent twelve (12) month period should be used to estimate the baseline.
- The implementation of a Project represents a change from this practice, and corresponding GHG reductions are estimated by comparing GHG emissions generated during the project to those estimated in the baseline.

If the previous year's information is not available for the specified equipment, other approaches may be considered, such as a comparison based approach using measurements from a representative sample group or a hybrid based approach. Alternative approaches must be confirmed with the Province to ensure their appropriateness for the purposes of the Program application.

Using the historical operating information, the $Emissions_{Baseline}$ scenario should be developed by forecasting emissions over the proposed project period, between the completion date of project construction for the specific equipment and December 31, 2021. If the completion date for project construction is prior to January 1, 2017, then January 1, 2017 should be used as the starting period for the purposes of this calculation.

The $Emissions_{Project}$ scenario must be calculated using the appropriate equations listed in WCI.363 and the same project period as above, using the appropriate emissions factors and operating conditions for the equipment subject to the Program application.

The diagram below displays how the baseline and project emissions should be estimated.



Other General Information

- It is expected that any proposed Projects will provide an equal level of service or product (i.e. that functional equivalence is maintained) when compared to the baseline.[2]
- The accepted unit of measure for reporting GHGs in the application for the Program is tonnes of carbon dioxide equivalent.[3]
- Global warming potentials for various GHGs should be consistent with those specified in the Schedule of the *Carbon Neutral Government Regulation*.
- Emissions reductions from the proposed Project must be reported for a five year period, between January 1, 2017 and December 31, 2021. Projects that start after January 1, 2017 must use the equipment in-service date for estimating GHG emissions from the project.

The following sections provide a detailed example of estimated GHG emissions reductions for an example project.

Further details on estimation methods are provided in Appendix A.

Example GHG Emissions Reduction Calculation:

[2] Functional equivalence is defined in the "Meta-Protocol Introduction for Oil and Gas Emission Reduction Projects" (2011, as amended). Offset protocols in the Province are currently under review. A version of the previous protocol document is available online: http://dev.pacificcarbontrust.com/assets/Uploads/Protocols/Meta-Protocol-Oil-GasMarch-1-2011.pdf

[3] The estimation methodologies provide estimates of GHGs in kilograms of CO2e. To convert to tonnes CO_2e, the result must be divided by 1000.

Consider the following example project that includes the deployment of different GHG emissions reduction technologies eligible under the Program.

a) Replacing 100 high-bleed pneumatic devices with 100 low-bleed pneumatic devices.
b) Replacing 40 generic diaphragm pumps with solar-powered pumps
c) Installing 10 vent gas capture systems
d) Installing 5 instrument air systems to replace gas-driven systems

Project considerations

- Assume an equipment start date of July 1, 2017. *This should be the date when the equipment is expected to be in operation and will be different for each activity considered in the Project. Applicants are required to estimate when the equipment will be in service and use this date as the start date for the purpose of estimating emissions. Project emissions will be estimated until December 31, 2021 (in this case a 4.5 year estimation period) as per the requirements of the RFA.*
- Assume the make and model of the high-bleed and low-bleed pneumatic devices are available. In this example, 100 Fisher 4150 high-bleed devices will be replaced with 100 Fisher C1 low-bleed devices. *Applicants are required to provide information on which types of devices will be subject to retrofit or conversion during the Project, which may be confirmed through auditing procedures.*
- Assume the make and model of the pneumatic pumps are not known. *In the case where the make and model of equipment is unknown, applicants are required to use the generic emission factors for that equipment type as listed in WCI documents. If generic emission factors are used, a 20% discount factor must be applied to those emission estimates for the purpose of the Program Application.*
- Assume that metered information is available to determine the amount of natural gas subject to the vent gas capture projects. *Applicants are required to provide information on which types of devices will be subject to retrofit or conversion during the Project, which may be confirmed through auditing procedures.*
- Assume that metered information is available to determine the amount of natural gas used by the current operating equipment that will be converted to instrument air systems. *Applicants are required to provide information on which types of devices will be subject to retrofit or conversion during the Project, which may be confirmed through auditing procedures.*
- Assume that a gas analysis has been conducted to determine the constituents of the natural gas stream currently used by the pneumatic devices – for this example, assume a CH_4 content of 97% and CO_2 content of 2%. *Applicants are required to provide accurate gas analysis percentage breakdowns for the different vent gas streams associated with the Project.*

A) Estimating emissions from the replacement of 100 high-bleed pneumatic devices with low-bleed alternatives

Baseline emissions

Emissions$_{Baseline}$= *∑ (EF*$_{High\text{-}blled,i}$ *x Operating Hours,*$_i$ *x %*CH_4 *x ρ*CH_4 *x GWP*$_{CH4}$*); ∑ (EF*$_{High\text{-}bleed,i}$ *x Operating Hours,*$_I$ *x %*CO_2 *x ρ*CO_2*)*

Where:

EF$_{High\text{-}bleed,i}$	Bleed rate of High-bleed device *i* For this example, assume all devices are Fisher 4150 pressure controllers with a bleed rate of 0.4209 m^3/h, as listed in Table 360-6 of WCI.367
Operating Hours,$_i$	Operating hours of device *i* each year, based on historical operating information. For this example, assume 8760 hours per year for each device
%CH_4	Percentage of CH_4 in vent gas by volume, based on gas analysis. Assume 97%.
ρCH_4	Density of CH_4 = 0.678 kg/m^3
%CO_2	Percentage of CO_2 in vent gas by volume, based on gas analysis. Assume 2%.
ρCO_2	Density of CO_2 = 1.86 kg/m^3
GWP$_{CH4}$	Global warming potential of CH_4 = 25

Emissions$_{Baseline}$ =	100 x ((0.4209 m^3/hr x 8760 hr x 97% x 0.678 kg/m^3 x 25) + (0.4209 m^3/hr x 8760 hr x 2% x 1.86kg/m^3))
Emissions$_{Baseline}$ =	6,075,835 kg CO_2e/yr x 1 tonne/1000 kg x 4.5 years
Emissions$_{Baseline}$ =	27,341 tonnes CO_2e over the project period

Project emissions

Emissions$_{Project}$= *∑ (EF*$_{Low\text{-}blled,i}$ *x Operating Hours,*$_i$ *x %*CH_4 *x ρ*CH_4 *x GWP*$_{CH4}$*); ∑ (EF*$_{Low\text{-}bleed,i}$ *x Operating Hours,*$_I$ *x %*CO_2 *x ρ*CO_2*)*

EF$_{Low\text{-}bleed,i}$	Bleed rate of Low-bleed device *i* For this example, assume all devices are Fisher C1 pressure controllers, with a bleed rate of 0.0649 m^3/h, as listed in Table 360-6 of WCI.367

Operating Hours,$_i$	Operating hours of device *i* each year, based on historical operating information. For this example, assume 8760 hours per year
%CH_4	Percentage of CH_4 in vent gas by volume, based on gas analysis. Assume 97%.
ρCH_4	Density of CH_4 = 0.678 kg/m^3
%CO_2	Percentage of CO_2 in vent gas by volume, based on gas analysis. Assume 2%.
ρCO_2	Density of CO_2 = 1.86 kg/m^3
GWP_{CH4}	Global warming potential of CH_4 = 25

Where:

$Emissions_{Project}$ = 100 x ((0.0649 m^3/hr x 8760 hr x 97% x 0.678 kg/m^3 x 25) + (0.0649 m^3/hr x 8760 hr x 2% x 1.86kg/m^3))

$Emissions_{Project}$= 936,854 kg CO_2e/yr x 1 tonne/1000 kg x 4.5 years

$Emissions_{Project}$ = 4,216 tonnes CO_2e over the project period

Estimated reductions

$Emissions_{Reduction} = Emissions_{Baseline} - Emissions_{Project}$

$Emissions_{Reduction}$ = 27,341 tonnes CO_2e - 4,216 tonnes CO_2e

$Emissions_{Reduction}$ = 23,125 tonnes CO_2e

B) Estimating emissions from the replacement of 40 pneumatic pumps with solar powered pumps

Baseline emissions

$Emissions_{Baseline} = \sum(EF_{Pump,\,i} \times Operating\ Hours,_i \times \%CH_4 \times \rho CH_4 \times GWP_{CH4}); \sum(EF_{Pump,\,i} \times Operating\ Hours,_i \times \%CO_2 \times \rho CO_2)$

Where:

$EF_{Pump,\,i}$	Emission factor for pneumatic pump *i* For this example, assume the specific devices are unknown. In this case, use the attributes for a generic diaphragm pump and a bleed rate of 1.0542 m^3/h, as listed in Table 360-6 of WCI.367 A discount factor of 20% will be applied for using the generic emission factor.
$Operating\ Hours,_i$	Operating hours of device *i* each year, based on historical operating information. For this example, assume 8760 hours per year
$\%CH_4$	Percentage of CH_4 in vent gas by volume, based on gas analysis. Assume 97%.
ρCH_4	Density of CH_4 = 0.678 kg/m^3
$\%CO_2$	Percentage of CO_2 in vent gas by volume, based on gas analysis. Assume 2%.
ρCO_2	Density of CO_2 = 1.86 kg/m^3
GWP_{CH4}	Global warming potential of CH_4 = 25

$Emissions_{Baseline}$ = 40 x ((1.0542 m^3/hr x 8760 hr x 97% x 0.678 kg/m^3 x 25) + (1.0542 m^3/hr x 8760 hr x 2% x 1.86kg/m^3))

$Emissions_{Baseline}$ = 6,087,095 kg CO_2e/yr x 1 tonne/1000 kg x 4.5 years

$Emissions_{Baseline}$ = 27,392 tonnes CO_2e over the project period x (1-0.2)

$Emissions_{Baseline}$ = 21,914 tonnes CO_2e (**including discount factor of 20% for using generic emission factor**)

Project emissions

$Emissions_{Project} = \sum(EF_{Pump,\,i} \times Operating\ Hours,_i \times \%CH_4 \times \rho CH_4 \times GWP_{CH4}); \sum(EF_{Pump,\,i} \times Operating\ Hours,_i \times \%CO_2 \times \rho CO_2)$

Where:

$EF_{Pump, i}$	Emission factor for pneumatic pump *i* For this project, assume solar pump – 0 m^3/h
$Operating\ Hours,_i$	Operating hours of device *i* each year, based on historical operating information. For this example, assume 8760 hours per year
$\%CH_4$	Percentage of CH_4 in vent gas by volume, based on gas analysis. Assume 97%.
ρCH_4	Density of CH_4 = 0.678 kg/m^3
$\%CO_2$	Percentage of CO_2 in vent gas by volume, based on gas analysis. Assume 2%.
ρCO_2	Density of CO_2 = 1.86 kg/m^3
GWP_{CH4}	Global warming potential of CH_4 = 25

$Emissions_{Project}$ = 40 x ((0 m^3/hr x 8760 hr x 97% x 0.678 kg/m^3 x 25) + (0 m^3/hr x 8760 hr x 2% x 1.86kg/m^3))

$Emissions_{Project}$ = 0 tonnes CO_2e over the project period

Estimated reductions

$Emissions_{Reduction} = Emissions_{Baseline} - Emissions_{Project}$

$Emissions_{Reduction}$ = 21,914 tonnes CO_2e - 0 tonnes CO_2e

$Emissions_{Reduction}$ = 21,914 tonnes CO_2e

C) Estimating emissions from the installation of 10 vent gas capture systems

Baseline emissions

$Emissions_{Baseline} = \sum(Vented_i \times \%CH_4 \times \rho CH_4 \times GWP_{CH4}); \sum(Vented_i \times \%CO_2 \times \rho CO_2)$

Where:

$Vented_i$	Natural gas vented by device *i* Based on metered readings of applicable devices: System 1 – 80,000 m^3/yr System 2 – 100,000 m^3/yr, System 3 – 120,000 m^3/yr, System 4 – 60,000 m^3/yr, System 5 – 90,000 m^3/yr, System 6 – 110,000 m^3/yr, System 7 – 75,000 m^3/yr, System 8 – 60,000 m^3/yr, System 9 – 115,000 m^3/yr, System 10 – 85,000 m^3/yr
$\%CH_4$	Percentage of CH_4 in vent gas by volume, based on gas analysis. Assume 97%.
ρCH_4	Density of CH_4 = 0.678 kg/ m^3
$\%CO_2$	Percentage of CO_2 in vent gas by volume, based on gas analysis. Assume 2%.
ρCO_2	Density of CO_2 = 1.86 kg/ m^3
GWP_{CH4}	Global warming potential of CH_4 = 25

$Emissions_{Baseline}$= (80,000 + 100,000 + 120,000 + 60,000 + 90,000 + 110,000 + 75,000 + 60,000 + 115,000 + 85,000)

= (895,000 m^3/yr x 97% x 0.678 kg/m^3 x 25) + (895,000 m^3/yr x 2% x 1.86kg/ m^3))

$Emissions_{Baseline}$ = 14,748,437 kg CO_2e/yr x 1 tonne/1000 kg x 4.5 years

$Emissions_{Baseline}$ = 66,368 tonnes CO_2e over the project period

Project emissions

$Emissions_{Project} = \sum(Captured_i \times \%CH_4 \times \rho CH_4 \times [1 - DE] \times GWP_{CH4}); \sum(Captured_i \times EF_{CO2,\,i}); \sum(Captured_i \times EF_{N2O,\,i})$

Where:

$Captured_i$	Natural gas by device *i* captured. From baseline calculation = 895,000 m^3/yr.
DE	Destruction efficiency. Assume 98.5% as captured gas will be sent to a flare.
$EF_{CO2,\,i}$	Emission Factor for device *i.* Assume 0.0065 kg/ m^3
$EF_{N2O,\,i}$	Emission Factor for device *i.* Assume 0.00006 kg/ m^3
$\%CH_4$	Percentage of CH_4 in vent gas by volume, based on gas analysis. Assume 97%.
ρCH_4	Density of CH_4 = 0.678 kg/ m^3
GWP_{N2O}	Global warming potential of N_2O = 298
GWP_{CH4}	Global warming potential of CH_4 = 25

$Emissions_{Project}$ = (895,000 m^3/yr x 97% x 0.678 kg/ m^3 x [1-0.985] x 25) + (895,000 m^3/yr x 0.0065 kg/ m^3) + (895,000 m^3/yr x 0.00006 kg/ m^3)

$Emissions_{Project}$= 226,598 kg CO_2e/yr x 1 tonne/1000 kg x 4.5 years

$Emissions_{Project}$ = 1,020 tonnes CO_2e over the project period

Estimated reductions

$Emissions_{Reduction} = Emissions_{Baseline} - Emissions_{Project}$

$Emissions_{Reduction}$ = 66,368 tonnes CO_2e – 1,020 tonnes CO_2e

$Emissions_{Reduction}$ = 65,348 tonnes CO_2e

D) Estimating emissions from the installation of 5 instrument air systems

Baseline emissions

Emissions$_{Baseline}$ = $\sum(Vented_i \times \%CH_4 \times \rho CH_4 \times GWP_{CH4})$; $\sum(Vented_i \times \%CO_2 \times \rho CO_2)$

Where:

$Vented_i$	Natural gas vented by device *i* Based on metered readings of applicable devices: System 1 – 150,000 m^3/yr System 2 – 200,000 m^3/yr, System 3 – 220,000 m^3/yr, System 4 – 180,000 m^3/yr, System 5 – 300,000 m^3/yr,
$\%CH_4$	Percentage of CH_4 in vent gas by volume, based on gas analysis. Assume 97%.
ρCH_4	Density of CH_4 = 0.678 kg/ m^3
$\%CO_2$	Percentage of CO_2 in vent gas by volume, based on gas analysis. Assume 2%.
ρCO_2	Density of CO_2 = 1.86 kg/ m^3
GWP_{CH4}	Global warming potential of CH_4 = 25

Emissions$_{Baseline}$= (150,000 + 200,000 + 220,000 + 180,000 + 300,000)

= (1,050,000 m^3/yr x 97% x 0.678 kg/m^3 x 25) + (1,050,000 m^3/yr x 2% x 1.86kg/ m^3))

Emissions$_{Baseline}$ = 17,302,635 kg CO_2e/yr x 1 tonne/1000 kg x 4.5 years

Emissions$_{Baseline}$ = 77,862 tonnes CO_2e over the project period

Project emissions

Emissions$_{Project}$ = $\sum(EC_i \times EF_{Elec} \times Managed\ Air_i) / \sum(Total\ Managed\ Air_i)$

Where:

EC_i	Electricity consumed by the air management system. For this example, assume a 50 HP compressor for each site that operates 50% of the time per year. This amounts to: 50 HP x 4,380 hr x 0.75 kW/HP x 5 sites = 821,250 kWh per year
EF_{Elec}	Emission Factor for electricity generation = 0.011 kg/kWh
$Managed\ Air_i$	The amount of air used in the system for related control systems and in engine starters. Assume 100% of air is used for this example
$Total\ Managed\ Air_i$	The total amount of air being managed by the system

$Emissions_{Project}$ = (821,250 kWh x 0.011 kg/kWh x 100%)

$Emissions_{Project}$= 9,034 kg CO_2e/yr x 1 tonne/1000 kg x 4.5 years

$Emissions_{Project}$ = 41 tonnes CO_2e over the project period

<u>Estimated reductions</u>

$Emissions_{Reduction} = Emissions_{Baseline} - Emissions_{Project}$

$Emissions_{Reduction}$ = 77,862 tonnes CO_2e – 41 tonnes CO_2e

$Emissions_{Reduction}$ = 77,821 tonnes CO_2e

Table 2 Total Estimated Emissions Reductions from the Project

Project activities	Number of activities	GHG reductions Between 2017 and 2022 (tCO_2e)
Replace 100 Fisher 4150 high-bleed pneumatic devices with 100 Fisher C1 low-bleed pneumatic devices.	100	23,125
Replace 40 generic diaphragm pumps with solar-powered pumps	40	21,914
Install 10 vent gas capture systems	10	65,348
Install 5 instrument air systems to replace gas-driven systems	5	77,821
Total (project)		**188,208**

9. Guidance for the completing the Business Case

Description of Barriers

The Clean Infrastructure Royalty Credit Program is not intended to support projects that a Producer (as such term is used in the *Petroleum and Natural Gas Royalty and Freehold Tax Regulation*) would be required to undertake for the purpose of meeting regulatory requirements, or in the case of "business as usual" retrofits.

In describing the business case for Program support (Clean Infrastructure RFA 2016 Template section 6.1), applicants should demonstrate that there are financial, technological or other barriers that may exist such that the project would not proceed without support. The following examples of barriers are provided for informational purposes and it is expected that applicants provide an inclusive list specific to the projects being proposed.[4]

Financial barriers:

- Natural gas prices may not support project economics to implement the initiative (project capital and operating expenditures result in a rate of return that is below typical industry hurdle rates or payback periods).
- Insufficient resources may be available to allocate funds for the Project, as these projects have to compete for the same resources as potentially higher return drilling and exploration projects.

Technological barriers:

- Project monitoring requires adaptation of common practice (e.g. typical practice of measuring total plant natural gas consumption, rather than individual engine consumption).
- Risk or perceived risk of increased shutdowns/operational problems from use of less proven technology.

Other barriers:

- Limited access to infrastructure (e.g. instrument air systems and electrification projects require access to electricity, which is often not available at many remote sites).
- Multiple working interests in an operating facility could easily thwart efforts to change to more environmentally-minded system.

Project proponents should use the business case to identify and define the potential barriers to the proposed project activity, and show how support from the Program could help reduce those barriers.

[4] Based on "Meta-Protocol Introduction for Oil and Gas Emission Reduction Projects, v. 1.1", May 2011, Developed by Blue Source Canada for the Pacific Carbon Trust

Industry Payback Period

A simple payback period for the project should be estimated based on total project costs as estimated by the applicant. It is not necessary to complete the tables below for each equipment type. An excel file containing the following tables is available on the Program website and must be used for the application.

Complete the table by filling in the shaded cells using the estimated project costs and estimated natural gas savings. Costs should be input in the year they will be incurred, and estimated gas savings (in thousand cubic meters per year, e3m3/year) should be based on the amount of methane (CH_4) that would not be vented due to the project. For projects involving multiple equipment types, the total estimated project costs and total estimated gas savings for all equipment and project types, should be reported in the table.

The 'Producer value of gas' ($/e3m3) is provided based on forecasts developed by the Province and should not be modified.

The payback **in months** should be reported in the business case and the Excel file should be included with the application.

An example of a completed table is presented below for a project that converts a high-bleed pneumatic device to a low-bleed device. The estimated gas savings is based on the amount of gas saved as estimated and reported in the application.

In this case, the requested royalty deduction is 50%, and the payback period is 66 months after the royalty deduction is taken into account.

Project		**Example**		**Without Credit**												
	Year	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31
Equipment Cost ($C)		-$800.00														
Labour and other costs ($C)		-$1,500.00														
Estimated Gas Savings (e3m3/yr)		3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Producer value of Gas ($C/e3m3)		$42.34	$54.36	$65.25	$74.48	$81.10	$86.92	$92.49	$98.00	$102.74	$106.29	$110.37	$124.94	$127.44	$129.99	$132.59
Estimated Value of Gas Savings ($C/yr)		$135.49	$173.95	$208.80	$238.33	$259.53	$278.15	$295.98	$313.59	$328.77	$340.12	$353.19	$399.81	$407.80	$415.96	$424.28
Discount Rate	12%															
Cash Flow - annual ($C)		-$2,164.51	$173.95	$208.80	$238.33	$259.53	$278.15	$295.98	$313.59	$328.77	$340.12	$353.19	$399.81	$407.80	$415.96	$424.28
Cash Flow - cumulative ($C)		-$2,164.51	-$1,990.56	-$1,781.75	-$1,543.42	-$1,283.90	-$1,005.74	-$709.77	-$396.18	-$67.40	$272.72	$625.91	$1,025.72	$1,433.52	$1,849.48	$2,273.76
Net Present Value ($C)	-$256.81															
Industry Payback (years)	9.2															
Industry Payback (months)	110															

Project		**Example**		**With Credit =**		50	%									
	Year	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31
Equipment Cost ($C)		-$400.00	$0.00	$0.00	$0.00											
Labour and other costs ($C)		-$750.00	$0.00	$0.00	$0.00											
Estimated Gas Savings (e3m3/yr)		3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Producer value of Gas ($C/e3m3)		$42.34	$54.36	$65.25	$74.48	$81.10	$86.92	$92.49	$98.00	$102.74	$106.29	$110.37	$124.94	$127.44	$129.99	$132.59
Estimated Value of Gas Savings ($C/yr)		$135.49	$173.95	$208.80	$238.33	$259.53	$278.15	$295.98	$313.59	$328.77	$340.12	$353.19	$399.81	$407.80	$415.96	$424.28
Discount Rate	12%															
Cash Flow - annual ($C)		-$1,014.51	$173.95	$208.80	$238.33	$259.53	$278.15	$295.98	$313.59	$328.77	$340.12	$353.19	$399.81	$407.80	$415.96	$424.28
Cash Flow - cumulative ($C)		-$1,014.51	-$840.56	-$631.75	-$393.42	-$133.90	$144.26	$440.23	$753.82	$1,082.60	$1,422.72	$1,775.91	$2,175.72	$2,583.52	$2,999.48	$3,423.76
Net Present Value ($C)	$769.98															
Industry Payback (years)	5.5															
Industry Payback (months)	66															

10. Further information

Further information can be found on the on the Clean Infrastructure Royalty Credit Program website:

https://www2.gov.bc.ca/gov/content/industry/natural-gas-oil/oil-gas-royalties/clean-infrastructure-royalty-credit-program

If you have any additional questions regarding the Clean Infrastructure RFA 2016, please contact by email:

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Appendix A. Project GHG emissions estimation methods

The Clean Infrastructure Royalty Credit Program is focused on the reduction of greenhouse gas emissions (in particular methane emissions) from vented sources in upstream natural gas development. The projects below are considered eligible project types under the Program for the 2016 year. Other projects that focus on reducing methane emissions in the upstream may be considered, however applicants must discuss project types not listed below with the Province prior to the submission of their application. The projects are discussed in more detail in the following sections.

Project type	Description/example
High-to-low bleed instrument conversions	High bleed pneumatic instruments are converted to low bleed devices.
Pump system conversions	Pumps (normally gas-driven) are converted to solar powered pumps or are 'right-sized' for appropriate use.
Vent gas capture	Gas that would normally be vented is captured and combusted on site.
Instrument gas to instrument air conversions	Air compressors (instead of on-site gas) are used to supply pneumatic power to devices.

The following sections provide more detail on how GHGs should be estimated for different eligible project types for the Program.

High-to-Low Bleed Instrument Conversions

Oil and natural gas facilities often use pneumatic power for operational needs. Pressurized natural gas is readily available on site and is the most common pneumatic power source for a variety of devices (e.g. pressure controllers, temperature controllers, transducers, regulators, and chemical injection pumps). Typically, pneumatic devices can be considered as either high-bleed or low-bleed based on the bleed rate of the device. The Western Climate Initiative (WCI) defines high-bleed devices as those "which continuously bleed at a rate greater than 0.17 m^3/hr". Replacing or retrofitting high-bleed pneumatic devices with low-bleed (or no-bleed) equivalents will result in lower GHG emissions from the device.

The baseline in this case consists of emissions estimated for a set of high-bleed pneumatic devices based on historical operating characteristics, while the project assumes the conversion to a low-bleed pneumatic device.

GHG emissions reductions from a proposed high-to-low bleed pneumatic instrument conversion project should be estimated as follows:

$$Emissions_{Reduction} = Emissions_{Baseline} - Emissions_{Project}$$

Where:

Factor	Equation reference
$Emissions_{Baseline}$	Eqn 360-1 (for metered devices) Eqn 360-2, 360-2a, 360-5, 360-5a (for unmetered devices)
$Emissions_{Project}$	Eqn 360-4
Note: Equation references are from the following WCI methodology documents: **Final Essential Requirements for Mandatory Reporting – Amended for Canadian Harmonization (2012)** **WCI Essential Requirements for Mandatory Reporting – 2013 Addendum to Canadian Harmonization Version (2013)**	

Both CH_4 and CO_2 emissions should be estimated. The equations referenced will provide estimates of volumetric emissions. To convert to mass emissions (in tonnes CO_2e), use equations 360-41 and 360-42 in the WCI methods documents. Note the Global Warming Potential for methane (CH_4) should be 25, as listed in the Schedule of the *Carbon Neutral Government Regulation*.

Emission factors and supply pressure coefficients for various pneumatic devices are provided in the WCI documents (Tables 360-5 and 360-6). If the device, or equivalent device, is not listed in Table 360-6 of the WCI documents, the generic high bleed emission factor for all high bleed controllers must be used. If a generic emission factor is used, a discount factor of 20% must be applied to the estimated GHG emissions reductions for that specific equipment.

Pump System Conversions

Chemical injection pumps and circulation pumps in glycol dehydration units vent GHGs during normal operations. The conversion of a gas-driven pump to one powered by electricity (either on or off-grid) and/or the 'right-sizing' of pumps for current operating conditions can result in significant reductions of GHGs.

The baseline in this case consists of emissions estimated for a set of pneumatic pumps based on historical operating characteristics, while the project assumes the pumps have been modified to be powered by on-site electricity.

GHG emissions reductions from a proposed pump system conversion project should be estimated as follows:

$Emissions_{Reduction} = Emissions_{Baseline} - Emissions_{Project}$

Where:

Factor	Equation reference
Emissions**<sub> $\textit{Emissions}_{Baseline}$	Eqn 360-1 (for metered devices) Eqn 360-3, 360-3a, 360-3b (for unmetered devices)
$\textit{Emissions}_{Project}$	Eqn 360-3, 360-3a, 360-3b (for unmetered devices)
Note: Equation references are from the following WCI methodology documents: **Final Essential Requirements for Mandatory Reporting – Amended for Canadian Harmonization (2012)** **WCI Essential Requirements for Mandatory Reporting – 2013 Addendum to Canadian Harmonization Version (2013)**	

If the proposed project is to convert gas-powered pumps to ones that are powered by solar power, the expected emissions in the project case are zero.

Both CH_4 and CO_2 emissions should be estimated. The equations referenced will provide estimates of volumetric emissions. To convert to mass emissions (in tonnes CO_2e), use equations 360-41 and 360-42 in the WCI methods documents. Note the Global Warming Potential for methane (CH_4) should be 25, as listed in the Schedule of the *Carbon Neutral Government Regulation*.

Emission factors and supply pressure, discharge pressure and the 'strokes per minute' coefficients for various pumps are provided in the WCI documents (Tables 360-5 and 360-6). If the device, or equivalent device, is not listed in Table 360-6, the generic high bleed emission factor for pumps must be used. If a generic emission factor is used, a discount factor of 20% must be applied to the estimated GHG emissions reductions.

Vent Gas Capture

Certain process control instrumentation and pumps commonly vent natural gas or fuel gas during normal operations. It is possible to capture vented gas from these sources to be combusted in a flare or incinerator. If the destruction of this vented gas is not required by applicable gas conservation directives (such as the BC Oil and Gas Commission's *Flaring and Venting Reduction Guideline*), a project that captures these gases and combusts them would be considered an eligible project type for the Program.

The baseline in this case consists of emissions estimated for a generic set of pneumatic devices that vent gas, based on historical operating characteristics, while the project assumes the gas that was previously vented is now captured and combusted on-site.

GHG emissions reductions from a proposed vent gas capture project should be estimated as follows:

$Emissions_{Reduction} = Emissions_{Baseline} - Emissions_{Project}$

Where:

Factor	Equation reference
$\boldsymbol{Emissions_{Baseline}}$	Eqn 360-1 (for metered devices) Eqn 360-2, 360-2a, 360-3, 360-3a, 360-3b, 360-5, 360-5a or others that may be applicable (for unmetered devices)
$\boldsymbol{Emissions_{Project}}$	Eqn 360-27, 360-28, 360-29, 360-30 (for vent capture projects sent to a flare) These equations may also be used if emissions are sent to an incinerator (use a combustion efficiency of 99.5%) For other uses of uses of the vented gas (such as general combustion), use Eqn 20-1, 20-1a, 20-2
Note: Equation references are from the following WCI methodology documents: **Final Essential Requirements for Mandatory Reporting – Amended for Canadian Harmonization (2012)** **WCI Essential Requirements for Mandatory Reporting – 2013 Addendum to Canadian Harmonization Version (2013)**	

Both CH_4 and CO_2 emissions should be estimated (N_2O emissions should also be estimated for project-related emissions from flaring). The equations referenced will provide estimates of volumetric emissions. To convert to mass emissions (in tonnes CO_2e), use equations 360-41 and 360-42 in the WCI methods documents. Note the Global Warming Potential for methane (CH_4) should be 25 and nitrous oxide (N_2O) is 298, as listed in the Schedule of the *Carbon Neutral Government Regulation*.

Emission factors and relevant coefficients for various devices are provided in the WCI documents (Tables 360-5 and 360-6). If the device, or equivalent device, is not listed in Table 360-6, the generic high bleed emission factor must be used. If a generic emission factor is used, a discount factor of 20% must be applied to the estimated GHG emissions reductions.

Instrument Gas to Instrument Air Conversions

Various process control devices in the sector, including pressure, temperature, liquid level, and flow rate regulation are powered by natural gas. It is possible to convert these instrument systems from using gas to using compressed air, which maintains the functionality of the system while reducing GHGs. Compressed air systems require on-site electricity, which could be supplied by the grid or from an off-grid source. The gas that has been conserved because of the conversion to an instrument air system is assumed to be combusted downstream of the operation by an end-user.

The baseline in this case consists of emissions estimated for a set of gas-powered control devices based on historical operating characteristics, while the project assumes the conversion to a compressed air system operated by electricity.

GHG emissions reductions from a proposed instrument gas to air conversion project should be estimated as follows:

$Emissions_{Reduction} = Emissions_{Baseline} - Emissions_{Project}$

Where:

Factor	Equation reference
$Emissions_{Baseline}$	Eqn 360-1 (for metered devices) Eqn 360-2, 360-2a, 360-3, 360-3a, 360-3b, 360-5, 360-5a or others that may be applicable (for unmetered devices)
Note: Equation references are from the following WCI methodology documents: [Final Essential Requirements for Mandatory Reporting – Amended for Canadian Harmonization (2012)] [WCI Essential Requirements for Mandatory Reporting – 2013 Addendum to Canadian Harmonization Version (2013)]	

And where:

$Emissions_{Project} = \sum(EC_i \times EF_{Elec} \times Managed\ Air_i) / \sum(Total\ Managed\ Air_i)$

Variable	Description	Units	Measurement method
$Emissions_{Project}$	Emissions from the air management system	kg of CO_{2e}	Calculated
EC_i	Electricity consumed by the air	kWh	Direct measurement

	management system		or use of manufacturer specifications.
EF_{Elec}	Emission Factor for electricity generation	kg CO_2e/kWh	Site specific emission factor based on gas composition analysis. If gas composition is not available, the established emission factor for Producer Consumption may be used. Emission Factor for electricity generation from BC Hydro grid is 0.011 kg CO_2e/kWh
Managed Air_i	The amount of air used in the system for related control systems and in engine starters	m^3	Direct measurement or use of manufacturer specifications.
Total Managed Air_i	The total amount of air being managed by the system	m^3	Direct measurement or use of manufacturer specifications.

Both CH_4 and CO_2 emissions should be estimated. The equations referenced will provide estimates of volumetric emissions. To convert to mass emissions (in tonnes CO_2e), use equations 360-41 and 360-42 in the WCI methods documents. Note the Global Warming Potential for methane (CH_4) should be 25, as listed in the Schedule of the *Carbon Neutral Government Regulation*.

Emission factors and relevant coefficients for various devices are provided in the WCI documents (Tables 360-5 and 360-6)**.** If the device, or equivalent device, is not listed in Table 360-6, the generic high bleed emission factor must be used. If a generic emission factor is used, a discount factor of 20% must be applied to the estimated GHG emissions reductions.