



CLIMATE CHANGE

Canadian GHG Challenge Registry[©]

GHG Registries
formerly VCR Inc.







CANADIAN GHG CHALLENGE REGISTRY GUIDE TO ENTITY & FACILITY-BASED REPORTING

Version 4.3

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CSA Climate Change, GHG Registries

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Q: Why should I register a comprehensive Action Plan when my organization is reporting emissions under a mandatory program?

A: Mandatory reporting systems have a limited point of view, documenting only historical direct emissions from certain facilities. A comprehensive Action Plan allows you to document your entity's entire emissions footprint, and illustrate your GHG emissions reduction best practices on a broader scale. It includes a contextual setting: rather than just reporting static, historical numbers, you can explain how the emissions have changed over time, how you think your actions will affect future emissions and how you got to where you are today through innovation and perseverance. A registered Action Plan is a more insightful and valued document for public edification.



Q: Mandatory reporting schemes do not include indirect GHG emissions. Why is reporting indirect GHG emissions encouraged in a registered Action Plan?

A: Mandatory reporting schemes are focused on direct emissions from specific facilities and do not describe your entity's entire emissions profile. A registered Action Plan is much more comprehensive, including all facilities and both direct and indirect emissions. By including indirect emissions, you can pinpoint opportunities for reducing all sources of emissions. A registered Action Plan documents a more meaningful corporate emissions profile.



Q: How will posting an Action Plan help focus efforts within my organization to encourage actions to reduce GHG emissions?

A: A registered Action Plan encourages you to identify your business as usual emissions, set targets, and to devise actions to achieve your goals. GHG management is primarily energy management which provides the opportunity to reduce your bottom line costs. An Action Plan helps the organization to focus on a plan to reduce costs internally while providing a public motive for doing so. It engages all of your employees in a win-win scenario.



Q: How can a publicly held company benefit from registering an Action Plan in addition to mandatory reporting?

A: A publicly held company can exhibit good corporate citizenship by reporting to their current and prospective shareholders that they not only meet the current mandatory GHG emission reporting requirements but ALSO that they have submitted a champion-level action plan for posting in the [Canadian GHG Challenge Registry](#)[®].



Q: What do we get for our registration fee?

A: The registration fee covers the administration and processing for the evaluation and registration of your action plan submission. The advantages include:

- *Entities that have a registered champion-level GHG action plan in their [Canadian GHG Challenge Registry](#)[®] online profile receive positive market recognition and exposure,*
- *The evaluation process means that the submission undergoes a thorough and accurate review of your quantification methodology. We are leading experts in managing, reporting, and measuring greenhouse gas emissions,*
- *The development of the GHG Action Plan requires you to track and monitor energy and emission and also provides you with the opportunity to help focus corporate efforts on savings, and*
- *Allows for the comparison and publishing of best practices in a publicly accessible forum.*

Introduction

This guideline is version 4.3 of our [Canadian GHG Challenge Registry Guide](#). It is intended as a generic handbook for submitting an Action Plan for posting in the [Canadian GHG Challenge Registry](#)[®] utilizing our Champion Level Reporting system.

Embodied within this guide is our judgement of current best practice in the measurement and reporting of Greenhouse Gas emissions. It reflects the evolutionary work of technical bodies throughout Canada and around the world in the development of standard measurement protocols. We are an active member of the *Canadian Advisory Committee* which is supporting the creation of ISO Guidelines for Measuring, Reporting and Verifying Entity- and Project-Level Greenhouse Gas Emissions and have incorporated identified "best practice" into this document as these studies progressed. The re-draft of our Guide has already been influenced by the comprehensive work of the [World Business Council for Sustainable Development \(WBCSD\)](#) and the [World Resources Institute \(WRI\)](#) published in their GHG Protocol.

We have been deliberately conservative in the magnitude of estimated emission reductions in order to provide a default approach to calculation for those who do not have specific emissions data to support a more accurate methodology.

We have made a significant change to the posting requirements for the [Canadian GHG Challenge Registry](#)[®] that will enhance its status as a measure of true performance in GHG emissions management. The posted files of entities with Action Plans that were significantly below the Bronze level of reporting have been removed from the Registry and the proponents have been notified. In order to be posted, an Action Plan meeting a minimum of Bronze-level reporting is required.

In addition to this document, there are guidelines and reporting templates available on our website which have been developed for specific industry sectors and GHG management programs. These include sector-specific calculation methodologies and industry intensity values. For information concerning our project-based [Canadian GHG Reductions Registry](#)[®], and the [Canadian GHG Credit Registry](#)[®], visit our website at www.ghgregistries.ca.

This living document will benefit greatly from your input and comment. Your continued commitment to this important initiative is greatly appreciated.

Our [Canadian GHG Challenge Registry Guide](#) contains new information to assist you in the development of your plan. You may also find that our [Standardized Reporting Template](#) serves to simplify the preparation of your action plan. In order to facilitate a quick and accurate review and rating of your plan please submit a completed [Transmittal Form](#), along with your report and the registration fee.

Should you have any questions or suggestions for improvement please contact our office by telephone at (613) 565-5151 or by e-mail at: info@ghgregistries.ca.



In order to foster consistency in the measurement, reporting and verification of GHG emissions, reductions, and avoidance we have adopted "best practice" text from a broad range of sources and have attempted to give due credit throughout the text.

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Appendix 1 — Canadian GHG Challenge Registry Transmittal Form

http://www.ghgregistries.ca/assets/rtf/Challenge_Transmittal_form_E.rtf

Appendix 2 — Canadian GHG Challenge Registry Standardized Reporting Template

http://www.ghgregistries.ca/assets/rtf/Challenge_Reporting_Template_E.rtf

1. What is the Registration Procedure?

When our office first receives an Action Plan and Transmittal form, we begin by acknowledging its receipt and posting the plan in our Challenge Registry as received, provided the self assessment embodied in the [Transmittal Form](#) indicates a minimum of bronze-level reporting and that the registration fee has been paid. All plans are posted publicly on our web site in the [Canadian GHG Challenge Registry](#)[®]. Anyone with access to the Internet may read them. Confidential elements specifically identified by the proponent may be registered, but are not posted.



Should you choose to entrust us with confidential information, it is up to you to bring this requirement to our attention. It is our practice to post all reports in their entirety unless instructed to do otherwise.

Once the initial posting has been completed we compare the elements included in the report against the Champion Reporting Checklist found in Section 5 of this guide. We assess whether or not the report qualifies to be awarded Bronze, Silver or Gold Champion Level Reporting status. You will be notified of the results of our review by e-mail. A secure on-line registration feature is available on our web site, which allows you to review your records in the Canadian GHG Challenge Registry. In the near future, this service will be upgraded to allow you to file action plans on-line. Champion Level Reporters are recognized in the Registry by including the appropriate logo on the front page of their electronic file.

We register all entity and/or facility-based reports, whether they are from a single operation or from an integrated corporation. Several large organizations have chosen to delegate Challenge Registry reporting to individual subsidiaries, business units or facilities to create an internal challenge among them to 'Go for Gold!' and have provided appropriate internal incentives to those who achieve this level. We will recognize Bronze, Silver or Gold status reports regardless of the boundaries chosen for reporting.

2. Building Your Action Plan

There are eight steps that you should follow in preparing your Action Plan:

1. Obtain senior management support
2. Develop an inventory
3. Establish business-as-usual projections
4. Set targets
5. Identify measures to achieve targets
6. Record results achieved
7. Describe your education, training and awareness programs
8. Submit your action plan

The [Canadian GHG Challenge Registry Standardized Reporting Template](#) (see Appendix 2: Canadian GHG Challenge Registry Standardized Reporting Template) can assist you in developing your Action Plan to address these steps. As well, several other organizations and programs have drafted sector- or program-specific templates. All Champion-level templates are posted on our web site. For more information, visit www.ghgregistries.ca.

2.1 Principles

As a general guide to the preparation of your Action Plan we would recommend the following principles found in the [World Business Council for Sustainable Development \(WBCSD\)](#) and the [World Resources Institute \(WRI\)](#) "Greenhouse Gas Protocol":

1. **Relevance:** Ensure the GHG inventory appropriately reflects the GHG emissions of the company and serves the decision-making needs of users – both internal and external to the company.
2. **Completeness:** Account for and report all greenhouse gas emission sources and activities within the chosen inventory boundary. Disclose and justify any specific exclusions.
3. **Consistency:** Use consistent methodologies to allow meaningful comparison of emissions over time. Transparently document any change to the data, inventory boundary, methods, or any other relevant factors in the time series.
4. **Transparency:** Address all relevant issues in a factual and coherent manner, based on a clear audit trail. Disclose any relevant assumptions and make appropriate references to the accounting and calculation methodologies and data sources used.
5. **Accuracy:** Ensure that the quantification of GHG emissions is systematically neither over nor under actual emissions, as far as can be judged, and that uncertainties are reduced as far as practicable. Achieve sufficient accuracy to enable users to make decisions with reasonable assurance as to the integrity of the reported information.

2.2 Reporting Baselines, Business-as-Usual Projections, Targets and Results

2.2.1 Boundaries

In order to properly define the data gathering required for completing your Action Plan, it is essential to clearly establish boundaries around the operations being tracked. In addition, you need a consistent method of accounting for the dynamic changes in these boundaries that you may experience due to acquisitions, divestitures, shutdowns, and other substantive changes that occur over time.

Geographic Boundaries

The primary focus of our Challenge Registry is to encourage actions which will reduce Canada's GHG Inventory. Hence, those GHGs emitted, reduced, sequestered or avoided that would impact *Canada's Greenhouse Gas Inventory* should be clearly identified in your Action Plan.

Coordination of reduction activities is being undertaken at both the Federal and Provincial levels in Canada. As a result, it is recommended that your data be gathered and reported by identifying the emissions from each facility within your corporate umbrella such that this information can then be 'rolled-up' into provincial, national and entity-based reporting formats.

Organizational Boundaries

Your organization may be structured with a variety of wholly owned, partially owned, joint-ventured, and other entities. You will need to decide what will and will not be included in your Action Plan with respect to each of these situations.

It is suggested that if you have majority control of the operation of a facility or another entity, you include 100% of the GHG emissions in your plan. If you have significant influence over another facility or entity, you should include a portion of these emissions based on your equity share. These methods are similar to current financial reporting structures. It is understood that this approach could result in more than one registered Action Plan reporting overlapping information. As long as the basis for your reporting is clearly outlined this "double counting" can be identified and rationalized, if required.



More detailed explanations and further examples can be found at the GHG Protocol website at www.ghgprotocol.org.

Operational Boundaries

GHG emissions can be broken down into two distinct groups – direct and indirect.

Direct emissions are those emissions that are directly released by your organization, usually from the burning of fossil fuels in heating buildings, running plants and processes and operating vehicles. It would also include such things as methane released from landfills owned by the organization and fugitive emissions from natural gas pipelines. Direct emissions should be reported by individual gas type (CO₂, CH₄, N₂O, etc.) as well as in aggregate (CO₂ equivalent). These emissions should be calculated and reported on a facility basis.

Indirect energy emissions are those emissions associated with an outside organization that supplies energy. Electricity generation is most common, but purchased steam, hot water and chilled water are considered indirect energy emission sources. You are encouraged to include the indirect emissions associated with these outside sources because the actions you take will affect the amount of GHGs they generate. Indirect energy emissions should be quantified in aggregate (CO₂ equivalent). These emissions can be reported on either an entity or facility basis.

Other indirect emissions are typically services for business travel or transportation of goods (airplanes, ships, rail, bus, taxi, etc.), commuting by employees, and offsite waste decomposition. Reporting emissions from other indirect emissions sources is optional, but tools for determining these emissions impacts are included in this guide. Other indirect emissions may be quantified in aggregate (CO₂ equivalent). These emissions are best calculated and reported on an entity basis.

We recommend that you report direct emissions, indirect energy emissions, and other indirect emissions that are significant for your organization. You can gain extra points in our Champion Level Reporting system for separately listing these emissions.

Temporal Boundaries

Boundaries can also be temporal (time-based) in nature. That is, emissions will change over time as you implement changes to reduce energy consumption and GHG emissions. We recommend that you report actual GHG emissions on an annual basis, starting with 1990 or the earliest date where accurate data is available. Annual emissions should be documented up to the most recent data available. Emissions projections, preferably business-as-usual projections, should be documented into the future to at least 2007.

2.2.2 Measurement Techniques

Unlike criteria air contaminants such as nitrous oxides (NO_x) and sulphur dioxide (SO₂), carbon dioxide (CO₂), the primary GHG, is seldom monitored directly. If direct measurements of CO₂ emissions are available, using these measurements is the most accurate way to determine your GHG emissions.

However, since about 80% of emissions are from direct combustion of fossil fuels such as natural gas and fuel oil, using emission factors is the most common method of calculating emissions. Table 5 of Section 7 has the emission factors for a variety of fuels. Multiplying the quantity of fuel of a specific type purchased in a given year by the appropriate emission factor will allow you to estimate the GHG emissions associated with consuming that fuel. Mobile sources are also included and while CO₂ emission rates remain unchanged, CH₄ and N₂O emissions vary both with fuel consumption and motor technology.

In addition, some industry associations have developed guidelines to help companies calculate the GHG emissions from specific processes. You can find references to these guidelines by visiting our website at www.ghgregistries.ca.

2.2.3 Reporting Data

We recommend that you report your direct emissions, indirect energy emissions and other indirect emissions for your chosen base year (see Section 5. Champion Reporting Checklist) and subsequent years, by GHG gas type (direct emissions only), in units of tonnes of CO₂ e (direct, indirect energy and other indirect emissions). You can also report business-as-usual projections and emission targets in the same manner. Extra points are available in our Champion Level Reporting system for reporting direct emissions separately (CO₂, CH₄, N₂O, SF₆, PCFs, HFCs).

Most indirect emission factors (see Section 7. Emission Factors) only list emissions data in CO₂ equivalent.

You may find it of value to also calculate, estimate and target using a performance-based indicator or intensity value. Examples include GHG emission per unit of output or energy consumption per unit of output. Many institutional participants use building floor area and number of employees as units of output. For manufacturing companies, kg of product, number of units assembled or sales revenue have been used. You may also want to report on the percentage change in these values since the base year or from one year to the next. Some industry associations have developed specific intensity factors in their guidelines. You can find references to these guidelines by visiting our website at www.ghgregistries.ca.

2.2.4 Recalculating Historic Emissions

You may need to recalculate your historic emissions. Reasons for this type of change may include:

- Change in facility ownership
- Change in reduction project or offset ownership
- Change boundaries for calculating GHG emissions (see 2.2.1)
- Change in assumptions or GHG quantification methodology

If you have had to recalculate some or all of your previously reported emissions, you should document and justify the changes.

2.2.5 Quality Control

Ensuring that your GHG emission calculations are accurate and complete will save you time in reporting your information in the future. If you have achieved an ISO 9001 or ISO 14001 designation, then you are already familiar with implementing quality control procedures. Including GHG emission measurement and reporting is a logical step in such a process. You may want to consider the following as you develop your procedures:

- Use a standard system for reporting GHG across different facilities/departments
- Use the same units of measurement across different facilities/departments
- Use an appropriate calculation method
- Design a robust data collection system
- Perform regular accuracy checks
- Organize regular training of personnel
- Perform uncertainty analysis



One of the Champion Level Checklist items (see item 3.8: Results that have been externally verified) involves obtaining a third party verification of your Action Plan data and/or calculations. You may want to consider this to help ensure the accuracy of your information and methodology.

3. Transmittal Form

Your submission cannot be processed without a completed transmittal form and registration fee. We request that you fill out and submit the [Transmittal Form](#) which can be downloaded from our website. A sample is also provided in Appendix 1. This form streamlines the Champion Level Reporter evaluations and ensures that our records accurately reflect your correct contact information. Your transmittal form will not be posted. It is against our policy to distribute the contact information of our registrants.

The first section of the Transmittal Form is intended to assist us in ensuring that our database has recorded the most up-to-date contacts for your organization. Your *executive contact* should represent the most senior level of management responsible for the report – usually your President, Chief Executive Officer or an equivalent. You should also designate a *primary technical contact* for your company or organization – usually the person responsible for preparing your Action Plan. Other technical contacts should also be identified as *secondary technical contacts* (these may include other executives and managers responsible for Challenge Registry reporting, as well as technical staff involved in the reporting process). You may also wish to include information about any outside contractors that may have helped you prepare your Action Plan.

Submissions must be received in electronic format. Current technology enables us to post all MS Word and Adobe Acrobat (PDF) files. If you wish to submit your Action Plan in another electronic format, please contact our office to verify your compatibility with our system.

If your Action Plan was produced in more than one language, we also ask you to submit all available versions (each will be posted on our Web site).

Since we work with hundreds of companies operating in virtually every sector of the Canadian economy, we also ask you to specify the sector that you believe best classifies your operations. As well, please indicate if you are submitting an Action Plan to us for the first time, and if your organization should be classified as a small- or medium-sized enterprise. We plan to use this information to ensure that all Challenge Registry leaders are recognized, taking into account significant differences in the scale of operations.

Lastly, we ask you to check off the Champion Reporting categories that are documented within your Action Plan. We use this checklist as a cross-reference when we are in the process of determining whether your organization has achieved Bronze, Silver or Gold status.

4. Submitting Your Action Plan

All documents submitted for inclusion in the [Canadian GHG Challenge Registry](#)[®] will be treated as public documents unless they are clearly identified as confidential. Confidential documents may be registered upon request. If necessary, an entire report can be classified confidential¹. However, if only one or two portions of an Action Plan (such as tables or appendices) are confidential, we prefer to make available the balance of the Action Plan with the classified information removed. Confidential reporting will not affect Champion Level Reporter (Bronze, Silver or Gold) evaluations.

As indicated on the Canadian GHG Challenge Transmittal Form, you may submit your Action Plan in a variety of electronic forms.

E-mail reports and transmittal form to: reports@ghgregistries.ca

Mail or deliver CD-ROMs or floppy disks to:

CSA Climate Change, GHG Registries
170 Laurier Avenue West, Suite 600
Ottawa, Ontario K1P 5V5

You may manage your accounts through our on-line registry (go to www.ghgregistries.ca and click login). An on-line transmittal form and Action Plan posting system will be incorporated in the near future.

¹ To ensure document security, we maintain confidential documents in hard copy only – all confidential electronic documents are destroyed immediately after hard copies are produced.

5. Champion Reporting Checklist

In order to provide us with an objective way to award Bronze, Silver or Gold Champion Level Reporter status based on your Action Plan, we have developed the Champion Reporting Checklist. Within this Checklist, we use a point system to quantify the depth of your Action Plan. Points are awarded for each element on an 'all or nothing basis' — meaning that if you have included a given element in your Action Plan, you will be assigned all of the points indicated for that element. The points for the three levels are:

50 points to reach the Bronze level →



70 points to reach the Silver level →









90 points to reach the Gold level →






The elements marked with a '✓' in the Checklist are minimum requirements for that level of reporting and must be included in your Action Plan in order to attain the indicated reporting level. Each checklist element is explained in detail in section 5.1: Checklist Element Detail Descriptions of this guide.

Table 1 — Champion Reporting Checklist

Components	Required Elements Identified with a ✓			
	Points Earned	 Bronze	 Silver	 Gold
1 Senior Management Support				
1.1 Statement of endorsement	N/A	✓	✓	✓
1.2 Commitment to regular reporting	N/A	✓	✓	✓
1.3 Internal practices on climate change	2			
1.4 Management system description	3			
2 Base Year Quantification				
2.1 Any quantification that can be used in target setting	N/A	✓	✓	✓
2.2 Provide methodology for the calculation of the base year quantification	2		✓	✓
2.3 Include GHG emissions inventory by gas type	4			
2.4 Provide methodology for the calculation of the base year quantification by gas type	4			
2.5 Include indirect energy emissions	2			✓
3 Results Achieved				
3.1 Results reported within one year of commitment	N/A	✓	✓	✓
3.2 Results in all years since base year quantification	2			
3.3 Tonnage inventory of emissions	2		✓	✓
3.4 Tonnage inventory of emissions since base year quantification	2			
3.5 Results in comparison with previous targets	4		✓	✓
3.6 Results that are below base year quantification levels of CO ₂ e or energy intensity per unit of output	6			✓
3.7 Results that are verifiable	2			✓
3.8 Results that have been externally verified	3			
3.9 Document emission reduction offsets	2			

Components	Required Elements Identified with a ✓			
	Points Earned	 Bronze	 Silver	 Gold
4 Business-as-Usual Projection				
4.1 Describe basis for Business-As-Usual projection (without emissions reduction actions)	2		✓	✓
4.2 Business-As-Usual projection (without emissions reduction actions) expressed in tonnes of CO2 equivalent emissions to at least 2007.	2			✓
4.3 Identify major sources of GHG emissions	1			
4.4 Include indirect energy emissions	1			
4.5 Specified by GHG type	1			
5 Target Setting				
5.1 Commit to target setting	N/A	✓	✓	✓
5.2 Identify your target or explain the process by which you are selecting your target	5			✓
5.3 Target projected to 2007 or beyond	2			
5.4 Process for target review and update	2			
6. Past Actions				
6.1 Estimate sum of impacts of identified key activities	2			
6.2 Estimate individual impacts of key activities/projects	2			
6.3 Estimate sum of impacts of key activities/projects in tonnes CO ₂ equivalent	2			
6.4 Estimate individual impacts of key activities/projects in CO ₂ equivalent	2			
7. Potential Future Actions to Achieve Targets				
7.1 List potential reduction activities and/or projects	N/A	✓	✓	✓
7.2 Quantify the sum of all impacts of potential activities using any reporting format	4			
7.3 Quantify the impact of individual potential activities using any reporting format	3			
7.4 Quantify the sum of all impacts of potential activities in tonnes CO ₂ equivalent.	4			
7.5 Quantify the impact of potential individual activities in tonnes CO ₂ equivalent	4			
7.6 Categorize the activities	4			

Components	Required Elements Identified with a ✓			
	Points Earned	 Bronze	 Silver	 Gold
8 Education, Training and Awareness				
8.1 Climate change issue explained to employees	3		✓	✓
8.2 Communicate response to climate change	3			✓
8.3 Identify opportunities for individual action	3			✓
8.4 Create incentives for emission reductions by employees outside of work	2			
8.5 Create incentives for emissions reductions through supply-side management	2			
8.6 Create incentives for emissions reductions through demand-side management	2			
8.7 Participate in life-cycle analysis or other activities to influence external contacts	1			
8.8 Undertake public education	1			
Maximum Total	100			

The base year quantification may be adjusted to take into account changes in operations, and any quantification related to GHG emissions is acceptable.

Points Awarded: N/A Mandatory Element for: Bronze, Silver, Gold

Checklist Item 2.2 — Provide methodology for the calculation of the base year quantification

To earn this checklist element, you should describe how you determined your base year quantification. All guidelines and third-party reference materials should be cited. As well, if a unique calculation methodology is used, sample calculations should be included in the body of the report or in an appendix.

Points Awarded: 2 Mandatory Element for: Silver, Gold

Checklist Item 2.3 — Include GHG emissions inventory by gas type

To earn this checklist element, your base year quantification must account for direct emissions by gas type. For the vast majority of organizations, these emissions are CO₂, CH₄ and N₂O – primarily the products of combustion of fossil fuels. Other relevant gas types that may be documented include SF₆ as well as gases from the HFC and PFC families. (These gases are typically emitted from specialized manufacturing processes and are not relevant to the vast majority of registrants.) In some rare instances, an estimation methodology used for calculating direct emissions does not break out emissions by gas type, or produces only CO₂ estimates. An organization that finds they cannot estimate their CH₄ or N₂O emissions can earn this checklist element by explaining the limitations of their calculation methodology and declaring that the non-CO₂ direct emissions from their operations are negligible (not material).

Points Awarded: 4

Checklist Item 2.4 — Provide methodology for the calculation of the base year quantification by gas type

To earn this checklist element, you should describe how you estimated your direct emissions. All guidelines and third-party reference materials should be cited. As well, if a unique calculation methodology is used, sample calculations should be included in the body of the report or in an appendix.

Points Awarded: 4

Checklist Item 2.5 — Include indirect energy emissions

To earn this checklist element, you must estimate the GHG emissions impact your organization has beyond its own operations. While you are not directly responsible for these emissions, the actions of your organization may affect the emissions of others. Indirect emissions may result from a variety of sources including purchased electricity, steam and chilled water.

To earn this checklist element, you must estimate the emissions impact of indirect energy emissions sources or document that these emissions are not material. The most commonly reported source is purchased electricity.

Points Awarded: 2

Mandatory Element for:

Gold



Reporting other indirect emissions such as business travel, waste disposal, and employee commuting is optional.

Section 3. Results Achieved

Checklist Item 3.1 — Results reported within one year of commitment

To earn this checklist element, you must report the quantified results of at least one performance measure for the most recent reporting year. The results can be any performance measure that has an impact on GHG emissions, including emissions intensity or energy intensity. We prefer results expressed in absolute GHG emissions (tonnes CO₂ equivalent). However, any quantification related to GHG emissions is acceptable. An estimate of energy consumption or utility costs for the most recent reporting year is generally considered the absolute minimum to earn this element. First time participants can earn this element if results are reported in their next Action Plan, which is submitted within one year.

Points Awarded: N/A

Mandatory Element for:

Bronze, Silver, Gold

Checklist Item 3.2 — Results in all years since base year quantification

To earn this checklist element, organizations must report the trend in results between the base year and the most recent reporting year. We encourage registrants to address each year. Special consideration will be given to those who claim that research costs or uncertain data prevent attributing results for all interim years. However, to earn this checklist element, registrants must estimate results for at least one year between the base year and the current reporting year, as well as justify any gaps in the results data.

Points Awarded: 2

Checklist Item 3.3 — Tonnage inventory of emissions

To earn this checklist element, the results of the most recent reporting year must be reported in terms of mass emissions (tonnes CO₂ equivalent) or emissions intensity (tonnes CO₂ equivalent per unit production or per facility area).

Points Awarded: 2

Mandatory Element for:

Silver, Gold



Direct emissions should be reported in individual gas types (t CO₂, t CH₄, t N₂O, etc.) as well as t CO₂ equivalent.

Indirect energy emissions and other indirect emissions (optional) should be reported in t CO₂ equivalent.

Checklist Item 3.4 — Tonnage inventory of emissions since base year quantification

To earn this checklist element, the results of each year between the base year and the most recent reporting year must be reported in terms of mass emissions (tonnes CO₂ equivalent) or emissions intensity (tonnes CO₂ equivalent per unit production or per facility area). Special consideration will be given to those registrants who claim that

Checklist Item 5.3 — Target projected to 2007 or beyond

To earn this checklist element, the timeframe for at least one target must be to 2007 or beyond. Targets with ambiguous time-frames such as “Our goal continues to be to reduce our energy intensity by one per cent per year,” or “We will maintain emissions rates below base year levels,” must specify the year 2007 or later to earn this checklist element.

Points Awarded: 2



2007 is the final year of reporting before the first Kyoto Protocol accounting period of 2008-2012.

Checklist Item 5.4 — Process for target review and update

To earn this checklist element, your report must indicate how past targets were reviewed and updated, as well as when new targets will be reviewed and updated.

Points Awarded: 2



For example, “Low demand for our product caused a production reduction, which resulted in missing our emissions intensity target set in 2001. We have adjusted our goal for year 2005 based on our current rate of production. Senior management will review this new target on an annual basis.”

Section 6. Past Actions

Checklist Item 6.1 — Estimate sum of impacts of identified key activities

To earn this checklist element, you must report a list of implemented emissions reduction activities and estimate the total impact of these activities.

Points Awarded: 2

Checklist Item 6.2 — Estimate individual impacts of key activities/projects

To earn this checklist element, you must report a list of implemented emissions reduction activities and quantify the impact of each of these activities. If some activities are not quantifiable, the report should indicate why. At least two key activities or projects must be quantified.

Points Awarded: 2

Checklist Item 6.3 — Estimate sum of impacts of key activities/projects in tonnes CO₂ equivalent

To earn this checklist element, you must report a list of implemented emissions reduction activities and estimate the total impact of these activities in tonnes CO₂ equivalent.

Points Awarded: 2

Checklist Item 8.5 — Create incentives for emissions reductions through supply-side management

To earn this checklist element, an organization must report how they share ideas with their suppliers and encourage GHG emissions reductions upstream of their operations.

Points Awarded: 2

Checklist Item 8.6 — Create incentives for emissions reductions through demand-side management

To earn this checklist element, an organization must report how they share ideas with their customers and encourage GHG emissions reductions downstream of their operations.

Points Awarded: 2

Checklist Item 8.7 — Participate in life-cycle analysis or other activities to influence external contacts

To earn this checklist element, an organization must report how they initiated or were engaged in a life-cycle analysis of a product or output, and how this life-cycle analysis included climate change impacts. This checklist element could also be earned by documenting how the organization worked with external contacts, such as trade associations, on climate change issues.

Points Awarded: 1

Checklist Item 8.8 — Undertake public education

To earn this checklist element, the report must include an explanation of how the organization attempted to encourage the public-at-large to reduce their impact on GHG emissions.

Points Awarded: 1

6. Global Warming Potentials

In order to measure the impact of the various gases involved in global warming using a single unit of measurement, the scientific community has adopted a standard based on the impact of one tonne CO₂ over a 100-year time frame. The impacts of other gas types are compared to CO₂ over the same time frame to produce standard Global Warming Potentials (GWPs), expressed in tonnes CO₂ equivalent (CO₂ e). For example, an emission of one tonne of Methane (CH₄) is equivalent to an emission of 21 tonnes CO₂ when the impact is averaged over 100 years. The impact of that tonne of CH₄ is then expressed as 21 t CO₂ e.

The following figures represent the standards used by [Environment Canada](#) for determining GHG emissions in the preparation of Canada's National GHG Inventory. These were originally published by the IPCC in 1996. While these factors were updated by the IPCC in 2001², the new emission factors have yet to be adopted by Environment Canada. The factors published in 1996 will likely remain the official standard until the end of the first Kyoto budget period (2012). By reporting individual greenhouse gases separately, you can always adjust using the most current GWP factors.

Table 2 — Global Warming Potentials

Greenhouse Gas	Chemical Formula	Global Warming Potential (based on a 100-year period) ³
Carbon Dioxide	CO ₂	1
Methane	CH ₄	21
Nitrous Oxide	N ₂ O	310
Sulphur Hexafluoride	SF ₆	23,900
Hydrofluorocarbons (HFCs):		
HFC-23	CHF ₃	11,700
HFC-32	CH ₂ F ₂	650
HFC-41	CH ₃ F	150
HFC-43-10mee	C ₅ H ₂ F ₁₀	1,300
HFC-125	C ₂ HF ₅	2,800
HFC-134	C ₂ H ₂ F ₄ (CHF ₂ CHF ₂)	1,000
HFC-134a	C ₂ H ₂ F ₄ (CH ₂ FCF ₃)	1,300
HFC-143	C ₂ H ₃ F ₃ (CHF ₂ CH ₂ F)	300
HFC-143a	C ₂ H ₃ F ₃ (CF ₃ CH ₃)	3,800
HFC-152a	C ₂ H ₄ F ₂ (CH ₃ CHF ₂)	140
HFC-227ea	C ₃ HF ₇	2,900
HFC-236fa	C ₃ H ₂ F ₆	6,300
HFC-245ca	C ₃ H ₃ F ₅	560

² Intergovernmental Panel on Climate Change, *IPCC Third Assessment Report – Climate Change 2001*, <http://www.ipcc.ch/index.html>, "Volume One: Climate Change 2001: The Scientific Basis", Technical Summary, p. 47.

³ IPCC (1996a), 1995 Summary for Policy Makers – A Report of Working Group I of the Intergovernmental Panel on Climate Change.

Greenhouse Gas	Chemical Formula	Global Warming Potential (based on a 100-year period) ³
Perfluorocarbons (PFCs):		
Perfluoromethane	CF ₄	6,500
Perfluoroethane	C ₂ F ₆	9,200
Perfluoropropane	C ₃ F ₈	7,000
Perfluorobutane	C ₄ F ₁₀	7,000
Perfluorocyclobutane	c-C ₄ F ₈	8,700
Perfluoropentane	C ₅ F ₁₂	7,500
Perfluorohexane	C ₆ F ₁₄	7,400

7. Emission Factors

All energy-related emissions factors have been drawn from the Environment Canada publication, *Canada's Greenhouse Gas Inventory 1990-2002*⁴, unless otherwise noted.

Table 3 — Emissions Factors for Common Combustion Energy Sources for Commercial and Industrial Boilers (Not Steel Production)

Fuel	Carbon Dioxide CO ₂	Methane CH ₄	Nitrous Oxide N ₂ O
Natural Gas (m ³)	1.891 kg/m ³ (all sectors except natural gas producers) 2.389 kg/m ³ (producer consumption only) ⁵	0.000037 kg/m ³ (industrial, commercial, agricultural and residential) 0.00049 kg/m ³ (electric utilities) 0.0019 kg/m ³ (pipelines) 0.0065 kg/m ³ (producer consumption)	0.000033 kg/m ³ (industrial, commercial, agricultural, residential, producer consumption) 0.000049 kg/m ³ (electric utilities) 0.00005 kg/m ³ (pipelines)
Natural Gas (GJ)	For virtually all applications, multiply factors above by 26.25 to get kg/GJ. (This factor does not apply to natural gas producers.)		
Still Gas	2.000 kg/m ³	0.000037 kg/m ³	0.000002 kg/m ³
Light (‘Distillate’) Oil (Oil #2)	2.830 kg/l	0.000006 kg/l (industrial) 0.000026 kg/l (commercial, residential) 0.00018 kg/l (electric utilities)	0.000031 kg/l (electric utilities, industrial, commercial) 0.000006 kg/l (residential)
Heavy (‘Residual’) Oil (Oil #6)	3.090 kg/l	0.00012 kg/l (industrial) 0.000057 kg/l (commercial, residential) 0.000034 kg/l (electric utilities)	0.000064 kg/l
Kerosene	2.550 kg/l	0.000006 kg/l (electric utilities, industrial) 0.000026 kg/l (commercial, residential)	0.000031 kg/l (electric utilities, industrial, commercial) 0.000006 kg/l (residential)
Diesel	2.730 kg/l	0.00013 kg/l	0.0004 kg/l
Propane	1.500 kg/l	0.000024 kg/l	0.000108 kg/l
Butane	1.730 kg/l	0.000024 kg/l	0.000108 kg/l
Ethane	0.976 kg/l	-	-

⁴ *Canada's Greenhouse Gas Inventory 1990-2002*, Greenhouse Gas Division, Environment Canada, August 2004.

⁵ Raw natural gas is often used as fuel by the upstream oil and gas industry. This fuel contains ethane, propane, butane and other non-methane hydrocarbons, which are stripped out of natural gas at gas plants.

Table 4 — Indirect Energy Emissions Resulting from Electric Energy Consumption in kg CO₂ e/kWh⁶

Province	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Alberta ⁷	1.046	1.056	1.061	1.059	1.063	1.058	1.049	1.054	1.032	1.022	1.001	0.985	0.985
British Columbia ⁸	0.019	0.012	0.020	0.045	0.044	0.061	0.012	0.021	0.035	0.025	0.046	0.066	0.032
Manitoba ⁹	0.027	0.019	0.016	0.013	0.011	0.008	0.011	0.011	0.033	0.020	0.034	0.015	0.018
New Brunswick ¹⁰	0.400	0.385	0.427	0.380	0.445	0.590	0.432	0.552	0.552	0.495	0.501	0.571	0.571
Newfoundland and Labrador ¹¹	0.282	0.214	0.243	0.218	0.124	0.212	0.196	0.198	0.187	0.144	0.138	0.272	0.286
Northwest Territories/Nunavut ¹²	0.377	0.355	0.340	0.339	0.447	0.427	0.302	0.264	0.264	0.169	0.167	0.163	0.200
Nova Scotia ¹³	0.791	0.800	0.800	0.800	0.790	0.771	0.800	0.819	0.816	0.815	0.947	0.933	0.916
Ontario ¹⁴	0.223	0.208	0.203	0.150	0.127	0.143	0.150	0.202	0.264	0.261	0.295	0.302	0.304
Prince Edward Island ¹⁵	0.77	0.73	0.55	0.65	0.71	0.67	0.71	0.75	0.71	0.71	0.73	0.71	0.72
Québec ¹⁶	0.0340	0.0146	0.0442	0.0197	0.0209	0.0163	0.0148	0.0071	0.0310	0.0178	0.0106	0.0151	0.0093
Saskatchewan ¹⁷	0.767	0.767	0.856	0.806	0.858	0.813	0.809	0.833	0.845	0.847	0.877	0.924	0.888
Yukon – diesel ^{18, 19, 20}	0.795	0.817	0.777	0.782	0.755	0.757	0.767	0.752	0.781	0.796	0.803	0.798	0.765
– system	0.076	0.066	0.078	0.071	0.040	0.111	0.191	0.207	0.060	0.080	0.048	0.044	0.044
Canadian Average ²¹	0.202	0.195	0.203	0.180	0.176	0.184	0.177	0.198	0.225	0.214	0.223	0.233	0.219

The regional emission factors represent our best estimate of actual emissions from electricity production (both foreign and domestic) supplied to regional power grids. However, the Canadian Average includes only domestic sources and also includes emissions from off-grid and industrial generation facilities. We recommend using the most accurate regional factors wherever possible.

⁶ 2002 is the last year of data compiled for all provinces. This table is only updated once a complete year of data has been tabulated. Values are based on utility average emissions (i.e. total annual CO₂ e emissions/total annual kWh generated), not marginal emissions (i.e. based on the type of electricity generation used for the peak electricity); values do not include any purchased greenhouse gas offsets (if any); values include the impact of electricity imported into each province (if data was available); values exclude electricity used to run power plants (i.e. net electricity generated is used); emissions from vehicles and heating buildings excluded.

⁷ Alberta Electrical Generation System's Average Greenhouse Gas Emission Intensity, KEFI-Exchange report for Albert Environment

⁸ 1990 to 2002 data from BC Hydro Greenhouse Gas Report June 2001, Page 19 and BC Hydro Greenhouse Gas Report December 2003, Page 14, without offsets.

⁹ Manitoba Power, Voluntary Challenge and Registry Update 2003, Table 9

¹⁰ New Brunswick Power, VCR Inc. 2000 Annual Report and calculations from Environment Canada and StatsCanada

¹¹ Newfoundland and Labrador Hydro Voluntary Challenge and Registry Report 2001-2002 draft, Appendix 1

¹² Northwest Territories Power Corporation Greenhouse Gas Report 2003/04, October 2004, Table 6

¹³ Nova Scotia Power Environmental Report to Employees, adjusted for total electricity sold (not generated)

¹⁴ Before 2002: Ontario Power Generation VCR Inc. 2000 Annual Report. After 2002 VCR internal analysis based on IMO reports and OnAIR emissions database.

¹⁵ Correspondence with Maritime Electric, Feb 2002 and May 2004

¹⁶ Hydro Quebec, personal communications

¹⁷ SaskPower, VCR Inc. Climate Change Action Plan [Progress Report – June 2001] and personal communications

¹⁸ Yukon Development Corporation 2004 Progress Report, Page 8

¹⁹ NOTE: Data is based on fiscal years, which start in April.

²⁰ NOTE: GHG emissions rates depend on local generation equipment. These are system-side averages. Contact your utility company for more accurate values.

²¹ A. Matin et al., *Canada's Greenhouse Gas Inventory 1990-2002*, Environment Canada, August 2004, p. 242.

Table 5 — Emissions Factors for Common Transportation Fuels²²

Vehicle (Fuel)	Carbon Dioxide CO ₂	Methane CH ₄	Nitrous Oxide N ₂ O
Car (Gasoline)	2.360 kg/l	0.00012 kg/l	0.00026 kg/l
Car (E10 Ethanol blend gasoline)	2.124 kg/l	0.00012 kg/l	0.00026 kg/l
Car (Diesel)	2.730 kg/l	0.00005 kg/l	0.0002 kg/l
Light Truck (Gasoline)	2.360 kg/l	0.00022 kg/l	0.00041 kg/l
Light Truck (E10 Ethanol blend gasoline)	2.124 kg/l	0.00022 kg/l	0.00041 kg/l
Light Truck (Diesel)	2.730 kg/l	0.00007 kg/l	0.0002 kg/l
Heavy-Duty Vehicle (Gasoline)	2.360 kg/l	0.00017 kg/l	0.001 kg/l
Heavy-Duty (E10 Ethanol blend gasoline)	2.124 kg/l	0.00017 kg/l	0.001 kg/l
Heavy-Duty Truck (Diesel)	2.730 kg/l	0.00012 kg/l	0.00008 kg/l
Motorcycle (Gasoline)	2.360 kg/l	0.0014 kg/l	0.000046 kg/l
Motorcycle (E10 Ethanol blend gasoline)	2.124 kg/l	0.0014 kg/l	0.000046 kg/l
Propane Vehicles	1.500 kg/l	0.00052 kg/l	0.000028 kg/l
Natural Gas Vehicles ²³	2.758 kg/kg	0.03210 kg/kg	0.00009 kg/kg
Off-Road Vehicles (Gasoline)	2.360 kg/l	0.0027 kg/l	0.00005 kg/l
Off-Road (E10 Ethanol blend gasoline)	2.124 kg/l	0.0027 kg/l	0.00005 kg/l
Off-Road Vehicles (Diesel)	2.730 kg/l	0.00014 kg/l	0.0011 kg/l
Railroad Locomotives (Diesel)	2.730 kg/l	0.00015 kg/l	0.0011 kg/l
Boats (Gasoline)	2.360 kg/l	0.0013 kg/l	0.00006 kg/l
Ships (Diesel)	2.730 kg/l	0.00015 kg/l	0.00100 kg/l
Ships (Light 'Distillate' Oil)	2.830 kg/l	0.0003 kg/l	0.00007 kg/l
Ships (Heavy 'Residual' Oil)	3.090 kg/l	0.0003 kg/l	0.00008 kg/l
Conventional Aircraft (Aviation Gasoline)	2.330 kg/l	0.00219 kg/l	0.00023 kg/l
Jet Aircraft (Aviation Turbo Fuel)	2.550 kg/l	0.00008 kg/l	0.00025 kg/l

Table 6 — Indirect Emissions Factors for Transportation

Rail Transportation ²⁴ (Freight)	0.0162 kg CO ₂ e/tonne-km
Rail Transportation (Passengers)	0.1033 kg CO ₂ e/passenger-km
Bus Travel ²⁵ (Urban)	0.1460 kg CO ₂ e/passenger-km
Bus Travel (Inter-city)	0.0565 kg CO ₂ e/passenger-km
Air Travel ²⁶	0.1359 kg CO ₂ e/passenger-km

²² Only emission factors for vehicles with latest emissions control technology are referred to in this list. To better estimate CH₄ and N₂O from older or less technically sophisticated vehicles, please refer to the Environment Canada document [Canada's Greenhouse Gas Emission Inventory 1990-2002](#), Table A7-5 Energy Mobile Combustion Sources, p. 173.

²³ Adapted from Environment Canada figures, converted to kg of natural gas, the common units for vehicle natural gas.

²⁴ Railway Association of Canada.

²⁵ Energy Use Data Handbook 1990 and 1996 to 2002, Natural Resources Canada.

²⁶ Air Transport Association of Canada unpublished emission intensity for Canadian airlines.

Table 7 – Emissions Factors Biomass Combustion

Source	Carbon Dioxide ²⁷ CO ₂	Methane CH ₄	Nitrous Oxide N ₂ O
Wood Fuel/Wood Waste ²⁸	0.950 kg/kg fuel	0.00005 kg/kg fuel	0.00002 kg/kg fuel
Accidental Forest Fires	1.630 kg/kg fuel	0.003 kg/kg fuel	0.00175 kg/kg fuel
Prescribed Burns	1.620 kg/kg fuel	0.0062 kg/kg fuel	0.0013 kg/kg fuel
Spent Pulping Liquor or Black Liquor	1.428 kg/kg fuel	0.00005 kg/kg fuel	0.00002 kg/kg fuel
Stoves and Fireplaces			
Conventional Stoves	1.500 kg/kg fuel	0.015 kg/kg fuel	0.00016 kg/kg fuel
Conventional Fireplaces and Inserts	1.500 kg/kg fuel	0.015 kg/kg fuel	0.00016 kg/kg fuel
Stoves/Fireplaces with catalytic or other controls	1.500 kg/kg fuel	0.0069 kg/kg fuel	0.00016 kg/kg fuel
Other Wood Burning Equipment	1.500 kg/kg fuel	0.015 kg/kg fuel	0.00016 kg/kg fuel

²⁷ Typically, CO₂ from biomass is tracked but not included in official inventories. It is assumed that since the source fuel was a sustainable forest, the net CO₂ impact is virtually zero. However, CH₄ and N₂O emissions from biomass combustion are included in most inventories.

²⁸ These factors may be reviewed by Environment Canada and are for wood with high moisture content.

Table 8 — Biological Sequestration²⁹

Urban Trees	9.18	kg CO ₂ /tree/yr
Rural Trees	10.19	kg CO ₂ /tree/yr

Table 9 — Fugitive Emissions from Coal Mining

Province	Method	Coal Type	t CH ₄ /kt coal
Nova Scotia	Underground	Bituminous	13.79
	Surface	Bituminous	0.13
New Brunswick	Surface	Bituminous	0.13
Saskatchewan	Surface	Lignite	0.06
Alberta	Surface	Bituminous	0.45
	Underground	Bituminous	1.76
	Surface	Sub-Bituminous	0.19
British Columbia	Surface	Bituminous	0.58
	Underground	Bituminous	4.1

²⁹ Planting trees for carbon credits, Tree Canada Foundation.

Table 10 — Agriculture Emissions from Livestock

	Enteric CH ₄ (kg CH ₄ per head per year)	Manure Management CH ₄ (kg CH ₄ per head per year)	N ₂ O from Various Manure Management Systems ³⁰ (kg N ₂ O per head per year)			
			Liquid System	Solid Storage & Drylot	Other Systems	Pasture Range and Paddock
Non-Dairy Cattle	75 (Bulls) 72 (Beef Cows) 56 (Beef Heifers) 47 (Heifers for slaughter, steers and calves)	1	0.0885	1.7710	0.4427	1.7710
Dairy Cattle	118 (Dairy Cows) 56 (Dairy Heifers)	36	0.1107	2.2137	0.5534	2.2137
Poultry	Not Estimated	0.078	0.0007	0.0141	0.0035	0.0141
Sheep and Lambs	8	0.19	0.0064	0.2135	0.0534	0.2135
Swine	1.5	10	0.0236	0.4710	0.1178	0.4710
Horses	13	1.4	0.0581	1.1618	0.2905	1.1618
Goats	8	0.12	0.0581	1.1618	0.2905	1.1618

³⁰ Internal calculation based on Environment Canada source data from [Canada's Greenhouse Gas Inventory 1990-2002](#), pp. 176-177.

Table 11 — Agriculture Emissions from Soils

Process	Emission
Fertilizer application	0.0125 kg N ₂ O per kg N content
Animal wastes applied as fertilizer	0.0125 kg N ₂ O per kg N content
Plant biological nitrogen fixation and crop residue decomposition ³¹	0.00032 kg N ₂ O per kg crop residue (dry peas, soya beans, lentils, field beans) 0.00016 kg N ₂ O per kg crop residue (wheat, barley, corn, oats, rye, mixed grains, flax, canola, buckwheat, mustard, sunflowers, canary seed, tame hay) 0.000056 kg N ₂ O per kg crop residue (fodder corn) 0.000047 kg N ₂ O per kg crop residue (potatoes) 0.000038 kg N ₂ O per kg crop residue (sugar beets)
Cultivation of Histosols (peatlands)	5 kg N ₂ O per ha per year

³¹ Internal calculation based on Environment Canada source data from [Canada's Greenhouse Gas Inventory 1990-2002](#), p. 177.

Table 12 — Coal Fired Boilers³²

Carbon Dioxide CO ₂			Methane CH ₄	Nitrous Oxide N ₂ O
Region / Coal Type	1990-1994	1995-1999		
Nova Scotia				
Canadian Bituminous	2.300 kg/kg	2.249 kg/kg		
U.S. Bituminous	2.330 kg/kg	2.288 kg/kg	0.000022 kg / kg (utility)	0.000032 kg / kg (utility)
New Brunswick				
Canadian Bituminous	2.230 kg/kg	1.996 kg/kg	0.00003 kg / kg (industry)	0.00002 kg / kg (industry)
U.S. Bituminous	2.500 kg/kg	2.311 kg/kg		
Quebec			0.0004 kg / kg (residential)	0.00002 kg / kg (residential)
U.S. Bituminous	2.500 kg/kg	2.343 kg/kg		
Anthracite	2.390 kg/kg	2.390 kg/kg	0.00003 kg / kg (metallurgical coke)	0.00002 kg / kg (metallurgical coke)
Ontario				
Canadian Bituminous	2.520 kg/kg	2.254 kg/kg		
U.S. Bituminous	2.500 kg/kg	2.432 kg/kg		
Sub-Bituminous	2.520 kg/kg	1.733 kg/kg		
Lignite	1.490 kg/kg	1.476 kg/kg		
Anthracite	2.390 kg/kg	2.390 kg/kg		

³² Environment Canada, Canada's Greenhouse Gas Inventory, 1990-2002, August 2004, p. 171.

Table 12 — Coal Fired Boilers (cont'd)

Carbon Dioxide CO ₂			Methane CH ₄	Nitrous Oxide N ₂ O		
Region / Coal Type	1990-1994	1995-1999				
Manitoba			0.000022 kg / kg (utility)	0.000032 kg / kg (utility)		
Canadian Bituminous	2.520 kg/kg	2.252 kg/kg				
Sub-Bituminous	2.520 kg/kg	1.733 kg/kg				
Lignite	1.520 kg/kg	1.424 kg/kg				
Saskatchewan						
Lignite	1.340 kg/kg	1.427 kg/kg			0.00003 kg / kg (industry)	0.00002 kg / kg (industry)
Alberta						
Canadian Bituminous	1.700 kg/kg	1.852 kg/kg			0.0004 kg / kg (residential)	0.00002 kg / kg (residential)
Sub-Bituminous	1.740 kg/kg	1.765 kg/kg				
Anthracite	2.390 kg/kg	2.390 kg/kg				
British Columbia			0.00003 kg / kg (metallurgical coke)	0.00002 kg / kg		
Canadian Bituminous	1.700 kg/kg	2.072 kg/kg				
All Provinces						
Metallurgical Coke	2.480 kg/kg	2.480 kg/kg				

8. Unit Conversion Tables³³

Table 13 – Metric Prefixes

Abbreviation	Prefix	Multiple
k	kilo-	10 ³
M	mega-	10 ⁶
G	giga-	10 ⁹
T	tera-	10 ¹²
P	peta-	10 ¹⁵

Table 14 – Mass

1 tonne	1,000 kg
	10 ⁻³ kt (kilotonnes)
	10 ⁻⁶ Mt (megatonnes)
	1.1023 tons
	2,204.6 lbs. (pounds)

Table 15 – Volume

1 m ³ (cubic metre)	1,000 litres
	264.2 US gallons
	6.29 barrels
	35.315 ft ³ (cubic feet)
	1.308 yd ³ (cubic yards)

³³ *Canada's Energy Outlook 1996-2020*, Natural Resources Canada, Appendix D, April 1997.

Table 16 — Energy

1 GJ (gigajoule) = 947,817 Btu	277.8 kWh (kilowatt hour)
1 m ³ natural gas	0.03809 GJ
1 m ³ motor gasoline	34.66 GJ
1 m ³ aviation gasoline	33.62 GJ
1 m ³ diesel	38.68 GJ
1 m ³ light fuel oil	38.68 GJ
1 m ³ heavy fuel oil	41.73 GJ
1 m ³ light crude oil	38.51 GJ
1 m ³ heavy crude oil	40.90 GJ
1 kWh electricity = 3.6 MJ	0.0036 GJ
1 m ³ propane ³⁴	25.49 GJ
1 t wood (not wood pellets) ³⁵	18.0 GJ
1 cord hardwood (air dried) ³⁶	30.6 GJ
1 cord softwood (air dried) ³⁷	18.7 GJ
1 cord mixed wood (air dried) ³⁸	25.0 GJ
1 t wood pellets ³⁹	19.8 GJ
1 kg wood pellets	0.0198 GJ

³⁴ Estimate, 2003³⁵ Estimate, 2003³⁶ Natural Resources Canada, *A Guide to Residential Woodburning*, 2002, p. 54.³⁷ Ibid.³⁸ Ibid.³⁹ Ibid.