GUIDELINES FOR GREENHOUSE GAS MANAGEMENT FOR LARGE EMITTERS IN NEW BRUNSWICK

October 2023
Department of Environment and Local Government

EXECUTIVE SUMMARY

Since the province of New Brunswick (NB) released its first Climate Change Action Plan (CCAP) in 2007, and through subsequent renewed plans, the province has successfully built a strong foundation for climate action. In 2018, the province legislated greenhouse gas (GHG) reduction targets of 10.7 Mt for 2030 and 5 Mt for 2050 in the Climate Change Act.

Recently, in September 2022, NB released its renewed CCAP 2022 2027, Our Pathway Towards Decarbonization and Climate Resilience. In it, the province reiterated its commitment to reaching its 2030 GHG reduction target and committed to reaching net-zero GHG emissions by 2050.

Large emitters are responsible for approximately half of NB's total GHG emissions. Significantly decarbonizing them is essential to meeting provincial GHG targets, addressing the impacts of climate change, helping them to remain competitive and increasing their sustainability.

This guide has been developed to assist large emitters in developing and adopting a GHG Management Plan, as may be specified in their Approval to Operate, pursuant to the Air Quality Regulation, the New Brunswick Clean Air Act, or otherwise.

The document provides a detailed explanation of the considerations which can be included in a typical GHG Management Plan, along with information regarding its submission.

TABLE OF CONTENTS

GLOSSARY OF TERMS

The following words and terms used in this guidance document shall have the indicated meaning:

"Act" means the New Brunswick *Clean Air Act*;

"air" means the atmosphere but does not include the atmosphere within a building or within the underground workings of a mine;

"Approval to Operate *or* **Approval"** means an approval issued under the NB *Clean Air Act* or the regulations that has not expired or been suspended or cancelled. Every source of emissions in the province must obtain an Air Quality Approval or Approval to Operate from the Department of Environment and Local Government. The Approval specifies the operating conditions and emission limits and can be in effect for up to five years. It's against the law to violate the terms of the Approval.

"carbon dioxide equivalent unit (CO_2e)" is a unit of measure used to allow the addition of or the comparison between gases that have different global warming potentials (GWPs). Since many greenhouse gases (GHGs) exist and their GWPs vary, the emissions are added in a common unit, CO_2e. To express GHG emissions in units of CO_2e, the quantity of a given GHG (expressed in units of mass) is multiplied by its GWP;

"carbon intensity" is the average emission rate of a given pollutant from a given source relative to the intensity of a specific activity; for example, grams of carbon dioxide released per megajoule (MJ) of energy produced, or the ratio of GHG emissions produced to gross domestic product (GDP).

"**carbon productivity"** is the amount of GDP produced per unit of carbon equivalent (CO_2e) emitted. It is the inverse of carbon intensity of GDP. Furthermore, when carbon is priced and emissions are restricted, GHG emissions can be viewed as an input into total factor productivity and thus consider its impact on growth along with other input factors such as labour and capital.

“contaminant” means

a) any solid, liquid, gas, micro-organism, odour, heat, cold, sound, vibration, radiation or combination of any of them, present in the environment,
    i) that is foreign to or in excess of the natural constituents of the environment,
    ii) that affects the natural, physical, chemical or biological quality or constitution of the environment, or
    iii) that endangers the health of human, plant or animal life or the safety or comfort of a human, that causes damage to property or plant or animal life or renders them unfit for use by persons or that interferes with visibility, the normal conduct of transport or business or the normal enjoyment of life or use or enjoyment of property,
b) any pesticide or waste, or
c) anything that is designated by the Minister as a contaminant under section 7 of the New Brunswick *Clean Air Act*.

“direct emissions” means the release of specified contaminants into the atmosphere from a source;

“energy intensity” means the amount of energy used in producing a given level of output or activity. It is measured by the quantity of energy required to perform a particular activity (service), expressed as energy per unit of output or activity measure of service.

“global warming potential (GWP)” is the relative measure of the warming effect that the emission of a specified gas has on the Earth’s atmosphere calculated as the ratio of the 100-year time-integrated radiative forcing that would result from the emission of one kilogram of a given specified gas relative to that from the emission of one kilogram of carbon dioxide;

“indirect emissions” means the release of specified contaminants into the atmosphere from the consequence of the activities of the reporting entity, but occur at sources owned or controlled by another entity (i.e. indirect scope 2 emissions from consumption of purchased electricity, heat or steam and/or scope 3 emissions such as those from transport-related activities in vehicles not owned or controlled by the reporting entity).

“facility” means the “source” as defined below.

“Minister” means the Minister of Environment and Climate Change and includes any person designated to act on the Minister's behalf;

“operator” when used with reference to a source, means the person who controls the operation of a source and includes the occupier of the real property upon or in which the source is located;

“OBPS” refers to the provincial Output-Based Pricing System where industrial facilities subject to the system will face a carbon price on the portion of their emissions that are above a limit, which is determined based on relevant output-based standards (emissions per unit of output).

“process emissions” means emissions from an industrial process involving chemical or physical reactions other than combustion and where the primary purpose of the industrial process is not energy production.

“release”, when used with reference to a contaminant or other matter regardless of form, includes the discharging, emitting, leaving, depositing or throwing of the contaminant or other matter and the doing of or the omission to do any other activity in respect of the contaminant or other matter, with the direct or indirect result that the contaminant or other matter enters the air, whether or not the contaminant or other matter previously existed in the air;

“source” means any stationary property, real or personal, taken as a whole, that releases or may release any air contaminant;

“SW” means Environment and Climate Change Canada’s Single Window system, which is a one-window secure online electronic data reporting system accessible at https://ec.ss.ec.gc.ca/;

Where this Guideline uses a term defined in the Act or the Regulation, the term has the meaning set out in the Act or Regulation;

Where this Guideline uses a term defined in the GHGRP that has a meaning that is different, the term is deemed to have the meaning set out in this Guideline.

INTRODUCTION

Since the province of New Brunswick (NB) released its first Climate Change Action Plan (CCAP) in 2007, and through subsequent renewed plans, the province has successfully built a strong foundation for climate action. In 2018, the province legislated greenhouse gas (GHG) reduction targets of 10.7 Mt for 2030 and 5 Mt for 2050 in the *Climate Change Act*[1].

Recently, in September 2022, NB released its renewed CCAP 2022-2027, *Our Pathway Towards Decarbonization and Climate Resilience*[2]. In it, the province reiterated its commitment to reaching its 2030 GHG reduction target and committed to reaching net-zero GHG emissions by 2050.

Large emitters are responsible for approximately half of NB's total GHG emissions. Significantly decarbonizing them is essential to meeting provincial GHG targets, addressing the impacts of climate change, helping them to remain competitive and increasing their sustainability.

This guide has been developed to assist large emitters in developing and adopting a Greenhouse Gas (GHG) Management Plan, as may be specified in their Approval to Operate, pursuant to the Air Quality Regulation, the *New Brunswick Clean Air Act*[3]. This easy-to-use guide provides information on economically achievable actions and strategies that large emitters can integrate and implement in their respective GHG Management Plan and in their operations to better manage and reduce GHG emissions.

The approved document, *Guidelines for Greenhouse Gas Management for Large Emitters*, will be updated on a regular basis and will be posted on the Department of Environment and Local Government's website at http://www2.gnb.ca/content/gnb/en/departments/elg.html.

1 NEW BRUNSWICK, 2018. CLIMATE CHANGE ACT, SNB 2018, C 11. AVAILABLE AT: HTTPS://WWW.CANLII.ORG/EN/NB/LAWS/STAT/SNB-2018-C-11/LATEST/SNB-2018-C-11.HTML#DOCUMENT

2 NEW BRUNSWICK, 2022. OUR PATHWAY TOWARDS DECARBONIZATION AND CLIMATE RESILIENCE – NEW BRUNSWICK'S CLIMATE CHANGE ACTION PLAN 2022-2027. AVAILABLE AT: HTTPS://WWW2.GNB.CA/CONTENT/DAM/GNB/CORPORATE/PROMO/CLIMATE/CLIMATE-CHANGE-ACTION-PLAN.PDF

3 NEW BRUNSWICK, 1997. CLEAN AIR ACT, SNB 1997, C C-5.2. AVAILABLE AT: HTTPS://WWW.CANLII.ORG/EN/NB/LAWS/STAT/SNB-1997-C-C-5.2/LATEST/SNB-1997-C-C-5.2.HTML#DOCUMENT

Additional information regarding GHG Management Plans can be obtained directly from the Authorizations Branch of the NB Department of Environment and Local Government (NB DELG):

AUTHORIZATIONS BRANCH
ENVIRONMENT AND LOCAL GOVERNMENT
P. O. BOX 6000
2ND FLOOR, MARYSVILLE PLACE
FREDERICTON, NB E3B 5H1

Phone: (506) 453-7945
Email: elg/egl-info@gnb.ca

GHG MANAGEMENT PLAN OVERVIEW

A GHG Management Plan, is a necessary framework to properly address large emitter GHG emissions and reduction opportunities. To this end, a GHG Management Plan is intended to ensure senior management commitment to manage GHG emissions at the facility level. When implemented, it will help to plan capital stock turnover, manage costs, drive efficiencies, improve stakeholder satisfaction, maintain or increase production and create a greater competitive advantage.

As an operating condition of their Approval to Operate, pursuant to the Air Quality Regulation, the *New Brunswick Clean Air Act*, specified operators of facilities in the province of NB are required to develop and implement a GHG Management Plan as described in this Guideline document.

A GHG Management Plan could include the following elements:

i) Declaration of Commitment on GHG Emissions;
ii) Introduction and Previous Initiatives;
iii) Annual GHG Emissions;
iv) Contribution to Total Provincial GHG Emissions;
v) Benchmarking;
vi) GHG Targets;
vii) GHG Reduction Strategy;
viii) Baselining;
ix) Boundary Considerations;
x) Provincial Policy or Regulation Considerations;
xi) Continual Improvement; and,
xii) Monitoring and Reporting.

Furthermore, larger emitters are encouraged to include the following considerations in their respective GHG Management Plans:

xiii) Link with Parallel Pollution Reduction Opportunities
xiv) GHG Management Plan Verification; and,
xv) Communications and Employee Awareness.

Additional details on each of these elements are given in the next sections of this Guideline document.

Large emitters are encouraged to meet the *Guidelines for GHG Management for Large Emitters in New Brunswick* to the best of their ability recognizing that GHG emissions may not be a material business risk for all companies and organizations and therefore some are better able to incorporate the full scope of the Guidelines while others may not be able to. Further, it is recognized that newer facilities which have incorporated best available technology economically achievable (BATEA) energy and GHG management systems and technologies may have fewer emission reduction opportunities than existing facilities.

Operators who are responsible for more than one facility requiring a GHG Management Plan as per its Approval to Operate, pursuant to the Air Quality Regulation, the *New Brunswick Clean Air Act*, may choose to tie the individual GHG Management Plans into an over-arching Corporate GHG Management Plan. However, this does not preclude a facility from requiring a GHG Management Plan as per its Approval to Operate, pursuant to the Air Quality Regulation, the *New Brunswick Clean Air Act*.

It is to be noted that the GHG Management Plan along with any Annual Progress Report submitted to the NB DELG will be made available should the public request them, such as per the *Right to Information and Protection of Privacy Act* (RTIPPA).

Once completed, the operator shall submit an electronic copy of the GHG Management Plan to the Authorizations Branch of the NB DELG at: elg/egl-info@gnb.ca.

GHG MANAGEMENT PLAN ELEMENTS

In this section, additional details are provided for each of the considerations which typically forms a GHG Management Plan.

DECLARATION OF COMMITMENT ON GHG EMISSIONS

The GHG Management Plan should start by stating the company's or organisation's GHG emissions and energy policies if they currently exist. If these don't exist, large emitters should strive to develop them. They should include a declaration of the large emitter's commitment to reduce GHG emissions through all available means by a specified amount (%) in a given timeframe.

Large emitters should strive to generate management acceptance of the importance of GHG emissions and energy planning and create a corporate culture that embraces and adheres to the plan(s).

They should assign facility-level responsibility for GHG emissions to a department or individual, such as an Energy Manager.

Finally, large emitters are encouraged to have a procurement and supply chain management policy that favours renewable/low-carbon energy sources, incorporates energy efficient and GHG reduction criteria, incorporates GHG emissions-based lifecycle analysis in procurement decision making and encourages suppliers to have similar policies.

OPERATIONS AND PREVIOUS INITIATIVES

A GHG Management Plan should briefly describe the large emitter's operations and factors that affect its GHG emissions. It should also include a brief discussion of previous GHG related initiatives that were recently incorporated (i.e. past 5-7 years) and how these initiatives have reduced its GHG emissions in relation to its historical levels, or in the case of a newer facility, since its first year of operation.

ANNUAL GHG EMISSIONS

A GHG Management Plan should summarize the large emitter's most recent GHG emissions as per its most recent GHG Emissions Report from Environment and

Climate Change Canada (ECCC)'s GHG Reporting Program (GHGRP)[4]. Direct GHG emissions as presented in the GHG Management Plan and Annual Progress Reports should be determined by following the scope, methodology and quantification requirements established by ECCC for the GHGRP.

Scope 2 indirect emissions from the generation of purchased or acquired electricity, steam, heat or cooling by a large emitter, while not always required to be reported in the GHGRP, can be reported as part of a large emitter's GHG Management Plan, albeit separately from its direct emissions. This provides a greater context of the large emitter's GHG emissions reductions measures.

In regard to scope 3 indirect emissions, while large emitters are not required to report them in the GHGRP, they may choose to do so as part of their GHG Management Plans in order to provide a complete picture of their commitments to GHG reductions.

Additional guidance on quantifying scope 2 and/or scope 3 emissions can be found as published by the Greenhouse Gas Protocol[5].

CONTRIBUTION TO TOTAL PROVINCIAL GHG EMISSIONS

The GHG Management Plan should consider estimating the large emitter's contribution to the annual total provincial GHG emissions as this serves to assess the portion of the provincial GHG emissions that are attributed to the large emitter. NB's annual total provincial GHG emissions can be found in Canada's *National Inventory Report*[6].

BENCHMARKING

The operator should look to evaluate the large emitter's GHG emission intensity and the energy intensity (i.e. per unit of output production) as per industry best practices.

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4 Environment and Climate Change Canada (ECCC), 2023. Greenhouse Gas Reporting Program (GHGRP). Available at: https://www.canada.ca/en/environment-climate-change/services/climate-change/greenhouse-gas-emissions/facility-reporting.html

5 Greenhouse Gas Protocol. Guidance (Scope 2 Guidance & Scope 3 Calculation Guidance). Available at: https://ghgprotocol.org/guidance-0

6 Environment and Climate Change Canada. National Inventory Report 1990-20XX: Greenhouse Gas Sources and Sinks in Canada. Canada's Submission to the United Nations Framework Convention on Climate Change. Available at: https://publications.gc.ca/site/eng/9.506002/publication.html

Further, large emitters can consider discussing how their GHG emission intensity and energy intensity compares to other similar large emitters within their industrial sector. Comparing operations with those of others, to industry averages, or to best practices can help in determining opportunities to reduce GHG emissions.

Information on best practices and benchmarking can be found on the Canadian Industry Partnership for Energy Conservation (CIPEC) website[7] and on the ENERGY STAR® website[8].

GHG REDUCTION TARGETS

A GHG Management Plan shall clearly state the large emitter's:

i) GHG reduction targets; and,
ii) The implementation period.

GHG reduction targets should be established as a defined range whereas the low target consists of an economically achievable target while the high target consists of an aspirational target. The target range should be established in keeping with a long-term vision.

Typically, GHG reduction targets and supporting strategies are established with a 10-20 year view, while project implementations are typically on a shorter time period (i.e. 1-5 years).

GHG Management Plan targets should align with existing corporate Environmental, Social and Governance (ESG) goals and objectives.

Large emitters are encouraged to consider establishing net-zero targets[9] and/or GHG reduction targets which are consistent with those from the NB CCAP, or other current and imminently pending policy or regulatory instruments.

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7 Natural Resources Canada – NRCan. Canadian Industry Partnership for Energy Conservation (CIPEC). Available at: https://www.nrcan.gc.ca/energy-efficiency/energy-efficiency-for-industry/canadian-industry-program-energy-conservation-cipec/20341

8 ENERGY STAR®. Industrial Energy Management. Available at: https://www.energystar.gov/industrial_plants

9 Large emitters that are establishing net-zero targets are encouraged to join Canada's The Net-Zero Challenge, a made-in-Canada program, which seeks to normalize net-zero planning so that it becomes a default business practice in Canada. The program uses a credible and rigorous technical framework that will allow businesses to develop and implement credible and effective plans to transition their facilities and operations to net-zero emissions by 2050 and will provide

Finally, in addition to setting GHG reduction targets, large emitters are encouraged establish energy utilization targets. This can include energy consumption reduction targets and/or targets for non-emitting (i.e., clean or renewable) energy consumption and/or production.

GHG REDUCTION STRATEGY

In order to achieve the GHG reduction targets specified in the GHG Management Plan by their respective target dates, a strategy or set of activities needs to be developed and implemented.

The GHG Management Plan's GHG reduction strategy can incorporate detailed measures or options to reduce facility GHG emissions. These can be divided into the following categories, not limiting to:

i) Management Policies, Practices and Procedures;
ii) Energy Programs and Energy Management Information Systems (EnMS);
iii) Energy Efficiency;
iv) Fuel Switching;
v) Heat and Power Recovery;
vi) Renewable Energy;
vii) Materials Efficiency, Recycling and Feedstock Change;
viii) Capital Stock Turnover; and,
ix) Research, Development and Innovation.

Further insights for each category are given later in this section.
The implementation timelines for these measures vary from short to long-term. Some examples of short-term measures are: implementing energy efficiency measures and establishing, integrating and implementing energy management into the organizational structure. Likewise, fuel switching, implementing heat and power recovery, and integrating renewable energy generation can be categorized as medium-term measures. Finally, materials efficiency, significant capital stock turnover and incorporating research and innovation are typically long-term action items.

PUBLIC RECOGNITION AND VISIBILITY, ACCESS TO A COMMUNITY OF PRACTICE, AND SUSTAINABILITY INCENTIVE FOR FEDERAL FUNDING AND PROCUREMENT TO PARTICIPANTS. ADDITIONAL INFORMATION CAN BE FOUND AT ECCC'S THE NET-ZERO CHALLENGE WEBSITE AT HTTPS://WWW.CANADA.CA/EN/SERVICES/ENVIRONMENT/WEATHER/CLIMATECHANGE/CLIMATE-PLAN/NET-ZERO-EMISSIONS-2050/CHALLENGE.HTML.

While options to reduce GHG emissions are presented as a high-level approach in this document, relevant information for the oil and gas, pulp and paper, electricity generation and waste management sectors are mentioned, albeit briefly.

In regard to the oil and gas industry, studies have shown that most petroleum refineries can economically improve energy efficiency by 10-20%. Key energy saving options are: the use of cogeneration, improved heat integration, combustion optimization, control of compressed air and steam leaks, reducing fugitive emissions and the use of efficient electrical devices. Other options available include reducing the amount of material flared[10,11].

For its part, options in regard to the pulp and paper industry include the use of biomass fuels such as spent pulping liquor and manufacturing residuals, combined heat and power to generate electricity, black liquor gasification, heat and steam recovery and recycling of waste paper[12]. Despite the recent energy improvements and use of renewable energy in the pulp and paper industry, options to reduce GHG emissions still exist.

In the electricity generation sector, there are a variety of options available in order to increase the overall efficiency in existing electric power plants which in turn, reduces their GHG emissions. To this end, processes can be optimized by using Energy Management Systems (EnMS) and other advanced computational tools and software. Other options include: (i) real-time performance monitoring of efficiency, (ii) reducing air, water, steam, and flue gas leakage, (iii) optimizing fuel performance and balancing fuel and air flows to the plant's burners, (iv) steam turbine upgrades, and (v) the use of variable speed motors.

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10 WORRELL, E. AND C. GALITSKY, 2005. ENERGY EFFICIENCY IMPROVEMENT OPPORTUNITIES FOR PETROLEUM REFINERIES - AN ENERGY STAR® GUIDE FOR ENERGY AND PLANT MANAGERS. BERKELEY, CA: LAWRENCE BERKELEY NATIONAL LABORATORY (LBNL 56183).

11 BERNSTEIN, L., J. ROY, K. C. DELHOTAL, J. HARNISCH, R. MATSUHASHI, L. PRICE, K. TANAKA, E. WORRELL, F. YAMBA, Z. FENGQI, 2007. INDUSTRY. IN CLIMATE CHANGE 2007: MITIGATION. CONTRIBUTION OF WORKING GROUP III TO THE FOURTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE [B. METZ, O.R. DAVIDSON, P.R. BOSCH, R. DAVE, L.A. MEYER (EDS)], CAMBRIDGE UNIVERSITY PRESS, CAMBRIDGE, UNITED KINGDOM AND NEW YORK, NEW YORK, UNITED STATES.

12 MARTIN, N., E. WORRELL, M. RUTH, M., L. PRICE, R.N. ELLIOTT, A. SHIPLEY AND J. THORNE, 2000. EMERGING ENERGY-EFFICIENT INDUSTRIAL TECHNOLOGIES. WASHINGTON D.C., AMERICAN COUNCIL FOR AN ENERGY-EFFICIENT ECONOMY AND BERKELEY, CA, LAWRENCE BERKELEY NATIONAL LABORATORY (LBNL-46990).

Finally, in the waste management sector, incorporating highly efficient landfill gas capture systems allow landfills to capture landfill gas. Captured landfill gas can then be used to generate clean electricity on-site, or be processed into renewable natural gas (RNG) that can be mixed with natural gas within pipeline infrastructure, and even be used as a transportation fuel for RNG-based vehicles. Facilities having closed landfill spaces can also look to integrate other renewable energy such as solar PV on these lands to generate additional renewable electricity[13,14]. Lastly, landfills can look to develop anaerobic bioreactors at their facilities which have several potential advantages compared to traditional waste management operations. Including an increase in RNG generation and a reduction in fugitive GHG emissions[15,16].

Management Policies, Practices and Procedures

All organizations can reduce GHG emissions and improve energy utilization by applying the same sound management principles and techniques they use elsewhere in their businesses for key resources such as raw materials and labour. These management practices must include full managerial accountability. When managed well, profitability and competitiveness will increase.

GHG and energy management must be a matter of concern to everybody in the organization before it can succeed. Without strong, sustained and visible support of the organization's top management, a GHG Management Plan is likely to fail. Employees will apply their best efforts only when they see that their supervisors are fully committed. Hence, it is crucial that top management provide full support and demonstrate their commitment. To this end, top management should define, establish, implement and maintain an overarching GHG and Energy Management Policy. The policy should include, but not be limited to, a commitment to continual improvement in both GHG emission reductions and energy utilization along with a framework for setting objectives and targets related to them. It should be documented and communicated at all levels within the organization.

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13 U.S. Environmental Protection Agency (U.S. EPA). RE-Powering America's Land. Available at: https://www.epa.gov/re-powering

14 Solar Power World, July 15, 2019. How does solar on capped landfills work? Available at: https://www.solarpowerworldonline.com/2019/07/how-does-solar-on-capped-landfills-work/

15 U.S. Environmental Protection Agency (U.S. EPA). Bioreactor Landfills. Available at: https://www.epa.gov/landfills/bioreactor-landfills#anaerobic

16 Waste Management. The Bioreactor Landfill – Next Generation Landfill Technology. Available at: https://www.wm.com/sustainability/pdfs/bioreactorbrochure.pdf

Once a GHG and Energy Management Policy has been established, top management should look to assign oversight and management duties to an Energy Manager and create a cross-functional Energy Team. Steps and procedures are then put into place to assess performance, through regular reviews of energy and GHG emissions data, technical assessments, and benchmarking. From this assessment, a baseline of performance is developed and goals for improvement are set[10].

In developing GHG and energy policies within an organization, top management and the operational manager responsible should consider conducting an energy/GHG audit of the organization as organisational barriers can still provide obstacles for improvement opportunities even when energy and GHG emissions are a significant cost for an organisation. To this end, energy/GHG audits and management systems (further discussed in the following section) create a foundation for improvement and provide guidance for managing energy and GHGs throughout an organisation. Research has shown that energy/GHG audits can often provide missing information needed in order to overcome barriers towards implementing energy management and efficiency measures within an organization[17] and that the integration of energy management systems into broader industrial management systems has been shown to be beneficial in reducing GHG emissions[18].

Energy Management Programs and Energy Management Systems (EnMS)

In terms of management programs, there are several standards for establishing energy management programs including, but not limited to, those from the International Organization for Standardization (ISO) and ENERGY STAR®.

The ISO 50001 Energy Management System Standard provides organizations with a structured framework to manage energy such that it can increase efficiency, reduce costs and improve energy performance. The standard is fully compatible with all of ISO's management systems standards including ISO 9001 (quality management), ISO 14001 (environmental management) and ISO 14064 (GHG reduction and emissions trading).

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17 Schleich, J., 2004. Do Energy Audits Help Reduce Barriers to Energy Efficiency? An Empirical Analysis for Germany. International Journal of Energy Technology and Policy, 2, pp. 226-239.

18 McKane, A., W. Perry, A. Li, T. Li, and R. Williams, 2005. Creating A Standard Framework For Sustainable Industrial Energy Efficiency. Presented at Energy Efficiency in Motor Driven Systems (EEMODS 2005) Conference, Heidelberg, Germany, 5-8 September 2005.

ISO 50001 integrates energy efficiency into management practices by making better use of existing energy-consuming processes. The ISO 50001 standard has been adopted as a Canadian national standard and is the recommended standard with respect to this Guideline. Research by Natural Resources Canada (NRCan) found that Canadian companies certified under ISO 50001 achieved cumulative energy performance improvements of nearly 10% in the first two years[19].

Recently, NRCan has released a new 50001 Ready program[20] which recognizes Canadian industrial facilities and buildings that attest to the implementation of an ISO 50001-based energy management system. The 50001 Ready program is a self-paced, no-cost way for industrial facilities to improve facility-level performance, reduce GHG emissions, achieve energy cost savings without requiring any external audits or certification. Once participating facilities have completed the program's 25 tasks, they may be eligible for 50001 Ready Canada recognition, and may be designated as "Ready-recognized", whereby NRCan recognizes them for their energy management leadership.

Additional details on the ISO 50001 Energy Management System Standard can be found on the CIPEC's website[7] or on the ISO 50001 website[21].
For its part, ENERGY STAR® has developed a series of tools and guidelines related to establishing and conducting an effective energy management program based on the successful practices of their partners. NRCan through CIPEC uses these tools and subsequent Energy Performance Indicators (EPI) in a voluntary program which benchmarks facilities against their peers and recognizes the most energy efficient Canadian facilities with ENERGY STAR® for Industry certification.

Further, in order to help organizations and businesses compared their energy management program and practices to those outlined in their ENERGY STAR® *Guidelines for Energy Management*, ENERGY STAR® has developed an assessment matrix which helps to quickly identify an energy program's strengths and weaknesses and provide ideas for improvements. Additional information on

19 NATURAL RESOURCES CANADA (NRCAN), 2017. ISO 50001 ENERGY MANAGEMENT SYSTEMS STANDARD. AVAILABLE AT: HTTPS://WWW.NRCAN.GC.CA/ENERGY-EFFICIENCY/ENERGY-EFFICIENCY-FOR-INDUSTRY/ENERGY-MANAGEMENT-INDUSTRY/ISO-50001-ENERGY-MANAGEMENT-SYSTEMS-STANDARD/20405

20 NATURAL RESOURCES CANADA (NRCAN), GET 50001 READY CANADA RECOGNITION WITH THE READY NAVIGATOR TOOL. HTTPS://NATURAL-RESOURCES.CANADA.CA/50001-READY-CANADA

21 INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO). ISO 50001 - ENERGY MANAGEMENT. AVAILABLE AT: HTTP://WWW.ISO.ORG/ISO/HOME/STANDARDS/MANAGEMENT-STANDARDS/ISO50001.HTM

ENERGY STAR®'s Energy Management tools and guidelines can be found on the ENERGY STAR® website[8] and on the CIPEC website[7].

In any case, large emitters could establish a comprehensive energy and GHG emissions management program that requires:

i) Facility or business unit to identify and annually review the energy and emissions sources that are deemed to be material according to its established criteria;
ii) Clear accountability for energy utilization and GHG emissions management assigned to operational managers;
iii) Energy data is reviewed regularly and integrated into operator actions for energy intensive processes;
iv) Actions and process controls related to energy utilization and GHG emissions are included in management systems for material sources; and,
v) General energy and GHG awareness training is provided to personnel with additional training for key personnel.

Other management tools include GHG inventory and reporting systems. These tools allow industry to develop strategies to adapt to changing government and consumer requirements by understanding the sources and magnitudes of its GHG emissions. Protocols for inventory development and reporting have been developed which define an accounting and reporting standard that companies can use to ensure that their measurements are accurate and standard. Since protocols are generally sector specific, operators need to verify which protocols are applicable to their needs, such as those from the Greenhouse Gas Protocol[22], ISO 14064[23] and IPCC[24].

Finally, an Energy Management System (EnMS) provides relevant information that makes energy performance visible to various levels of an organization, enabling individuals and departments to plan, make decisions and take effective action to manage energy. It can lead to productivity improvements through the continuous monitoring of energy performance, and savings opportunities that, once implemented, are sustained over the long term. The performance information

22 World Resources Institute and World Business Council for Sustainable Development. Greenhouse Gas Protocol. Available at https://ghgprotocol.org/
23 International Organization for Standardization (ISO). ISO 14064 – Greenhouse Gases – Part I, II, III. Available at: https://www.iso.org/standard/66453.html
24 The Intergovernmental Panel on Climate Change (IPCC). Available at: https://www.ipcc.ch/

generated by an EnMS enables companies and organizations to take actions that create financial value through the management and control of energy. It has been shown that implementing an EnMS can lead to total energy savings of 10-20% in the first five years and up to 30% afterwards[25].

In order to help companies and organizations understand and implement EnMS, NRCan has develop and published a comprehensive *Energy Management Information Systems*[26] handbook which covers all aspects of an EnMS – including metering, data collection, data analysis, reporting and cost/benefit analyses. Large emitters without EnMS and those looking to implement one are strongly encouraged to review this handbook.

Energy Efficiency

There exists a wide range of opportunities in industry to improve energy efficiency which lead to improving energy utilization and reducing GHG emissions[27]. In Canada, it has been estimated that energy efficiency improvements could improve industrial energy intensity by approximately 16% by 2030[28]. In existing facilities, many industrial processes have very low energy efficiency and average energy use is much higher than the best available technology economically achievable (BATEA) would permit.

There are several factors that affect the energy efficiency of facilities, these include choice and optimization of technology, operating procedures and maintenance, and capacity utilization. Research has shown that large amounts of energy can be saved by strict adherence to designed operating and maintenance procedures[29].

In regard to wasteful energy use, there are many problems that can cause this effect, such as steam and compressed air leaks, poorly maintained insulation, and

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25 Institute for Industrial Productivity and International Energy Agency (IEA), 2012. Energy Management Programmes for Industry: Gaining through Saving, International Energy Agency, Paris, France,

26 Natural Resources Canada (NRCan), 2010. Energy Management Information System – A handbook for Managers, Engineers and Operational Staff

27 International Energy Agency (IEA), 2006. Energy Technology Perspectives 2006: Scenarios and Strategies to 2050. International Energy Agency, Paris, France.

28 International Energy Agency (IEA) and Natural Resources Canada (NRCan), 2018. Energy Efficiency Potential in Canada to 2050, Insight Series 2018. International Energy Agency, Paris, France.

29 US DOE, 2004. 20 Ways to Save Energy Now. US Department of Energy, Washington, D.C., United States.

air leaks in boilers and furnaces. Finally, frequent shutdowns and poor thermal integration are notable causes of low capacity utilization.

Further, there is a large potential for energy efficiency improvements in relation to the use of electric motors systems in industry. It has been shown that electric motor-driven systems account for over 60% of industrial electricity use[30]. In order to achieve maximum efficiency in these systems, it is important to properly size all components, to improve the efficiency of end-use devices (pumps, fans, etc.), to reduce electrical and mechanical transmission losses, and to use proper operation and maintenance procedures.

Another potential for energy efficiency savings relies in identifying and eliminating compressed air leakages, whereas typical estimates indicate that approximately 20% of compressed air is lost due to these leaks.

For their parts, there are still energy efficiency measures that may be applicable for steam boilers, distribution systems, furnaces, and process heaters. These include general maintenance programs, improved insulation, combustion controls and leak repairs in the boilers, improved steam traps, condensate recovery, preheating combustion air, optimizing combustion controls, and using oxygen enrichment or oxy-fuel burners. Finally, it is to be noted that boiler systems can also be upgraded to cogeneration systems which are more energy efficient[31,32].

Fuel Switching

Generally, large emitters use fuel for steam generation and/or process heat, with the choice of fuel being determined by cost, availability and environmental considerations. It is estimated that industrial fuel switching within fossil fuels

30 XENERGY, INC., 1998. EVALUATION OF THE US DEPARTMENT OF ENERGY MOTOR CHALLENGE PROGRAM. BURLINGTON, MASSACHUSETTS, UNITED STATES.

31 EINSTEIN, D., E. WORRELL, AND M. KHRUSHCH, 2001. STEAM SYSTEMS IN INDUSTRY: ENERGY USE AND ENERGY EFFICIENCY IMPROVEMENT POTENTIALS. PROCEEDINGS OF THE 2001 ACEEE SUMMER STUDY ON ENERGY EFFICIENCY IN INDUSTRY - VOLUME 1, TARRYTOWN, NY, JULY 24-27TH, 2001, PP. 535-548.

32 US DOE, 2002. STEAM SYSTEM OPPORTUNITY ASSESSMENT FOR THE PULP AND PAPER, CHEMICAL MANUFACTURING, AND PETROLEUM REFINING INDUSTRIES - MAIN REPORT. US DEPARTMENT OF ENERGY, WASHINGTON, D.C., UNITED STATES.

(replacing coal or oil with natural gas or biomass) can reduce GHG emissions by 10-20%[33].

Further, in some instances, waste materials can also be used as input fuel for steam generation. Used oil and solvents, and sewerage sludge are currently being used by a number of industries. Waste materials can reduce GHG emissions compared to an alternative where they are disposed of without energy recovery[34]. However, the use of waste materials is limited not only by their availability but also by environmental regulations, e.g. airborne toxic materials[35].

Heat and Power Recovery

In virtually all industries, energy recovery can provide significant opportunities to reduce GHG emissions and improve energy utilization. This can be in the form of heat, power or fuel recovery.

Opportunities for heat recovery at lower temperatures are possible with the use of chemical heat sinks in heat pumps, organic Rankine cycles and chemical recuperative gas turbines. Other opportunities are related to the use of new, more efficient heat exchangers, more robust (e.g. low-corrosion) heat exchangers, and the use of heat pumps to recover low-temperature heat.

Heat recovery systems need to be energy-efficient and cost-effective (i.e. process integration). Generally, it is estimated that cost-effective energy savings of 5-40% are generally found in process integration analyses[3].

For its part, power can be recovered from processes operated at high pressures using pressure recovery turbines. Opportunities for the use of pressure recovery turbines exist in blast furnaces, fluid catalytic crackers and natural gas grids. In addition, pressure recovery turbines can be used instead of pressure relief valves in steam networks and organic Rankine cycles from low-temperature waste streams.

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33 INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC), 2001. CLIMATE CHANGE 2001: MITIGATION. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC) [B. METZ, ET AL. (EDS)]. CAMBRIDGE UNIVERSITY PRESS, CAMBRIDGE, UNITED KINGDOM.

34 HUMPHREYS, K. AND M. MAHASENAN, 2002. TOWARDS A SUSTAINABLE CEMENT INDUSTRY - SUBSTUDY 8: CLIMATE CHANGE. WORLD BUSINESS COUNCIL FOR SUSTAINABLE DEVELOPMENT (WBCSD), GENEVA, SWITZERLAND.

35 INTERNATIONAL ENERGY AGENCY (IEA), 2006. ENERGY TECHNOLOGY PERSPECTIVES 2006: SCENARIOS AND STRATEGIES TO 2050. INTERNATIONAL ENERGY AGENCY, PARIS, FRANCE.

Finally, in regard to cogeneration or combined heat and power (CHP), which involves using energy losses in power production to generate heat for industrial processes and/or district heating, it is estimated that large mitigation potentials still exist in industry[36,37]. It is to be noted that generally, the main challenges of integrating CHP technologies to existing industrial processes are related to the economics of the residual heat usage.

Renewable Energy

Energy generated from renewable sources can be used in industrial processes to lower GHG emissions while demonstrating corporate social responsibility. In some industries, the use of renewable energy is well established. Biomass is widely used in the pulp in paper industry for the generation of heat. Some industries use wind or solar energy to generate electricity, which is typically used internally for industrial processes while any surplus is sold to the local electricity distributer or system operator.

In NB, the Large Industrial Renewable Energy Purchase Program (LIREPP), allows qualifying large industrial customers to sell electricity generated from renewable electricity generating facilities located in NB, such as biomass and river hydro to NB Power. The revenue from renewable energy sales assist these qualifying customers to reduce their net electricity costs and thereby increase their competitiveness in the global market. Interested proponents should contact NB Power or the NB Department of Natural Resources and Energy Development for more details on this program.

Materials Efficiency, Recycling and Feedstock Change

Materials efficiency is defined as the reduction of energy use by the appropriate choice of materials and recycling. In industrial sectors, recycling is the more common option and can occur both internally within facilities and externally, as in the waste management sector.

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36 Laurin, A., J. Nyboer, C. Strickland, N. Rivers. M. Bennett, M. Jaccard, R. Murphy, and B. Sandownik, 2004. Strategic options for combined heat and power in Canada. Office of Energy Efficiency, Natural Resources Canada, Ottawa, ON, Canada.

37 Lemar, P.L., 2001. The potential impact of policies to promote combined heat and power in US industry. Energy Policy, 29, pp. 1243-1254.

Feedstock change or materials substitution is also applicable in industry. Some examples of materials substitution are the addition of wastes (blast furnace slag and fly ash) and geo-polymers to clinker to reduce GHG emissions from cement manufacturing. In some material substitution options, there can be an increase of emissions from the industrial sector that will be more than offset by the reduction of emissions in other sectors, such as the production and use of lightweight materials for vehicle manufacturing. Additionally, the use of bio-materials is another case of material substitution that has been used in certain applications.

Finally, large emitters can look at minimizing raw material inputs and product redesigns to reduce their GHG emissions and improve energy utilization.

Capital Stock Turnover

In general, capital stock turnover tends to slow the introduction of new clean and efficient technologies in the market place. Industries can look at accelerating capital stock turnover as a method of reducing their GHG emissions and improve energy utilization while using tools, such as life-cycle cost analysis, to evaluate available options.

Research, Development and Innovation

While innovation needs to be at the core of any progressive organization in order to remain competitive and propel revenue growth, it can also play a significant part in reducing GHG emissions and improving energy utilization. Research, development and innovation can make an important contribution to the achievement of commitments over the long term through step changes in energy utilization and GHG emissions performance.

To this end, industries are encouraged to invest in research and development, feasibility studies and/or demonstration of technologies and/or new processes that target energy utilization and reducing GHG emissions. These measures could be included in their GHG Management Plans.

Since many businesses in NB do not have the resources to perform research, development and innovation, they may choose to collaborate with universities and colleges, research institutes, or other companies. The NB Innovation Foundation (NBIF) provides funding and support for various research, development and

innovation activities, such as basic research/proof of concept, technology development and demonstration[38].

Finally, it is to be noted that innovation measures for reducing GHG emissions and improving energy utilization may involve more than one industry or large emitter. For example, by integrating energy and material flows and by using heat-cascading systems, co-sitting of industries, often named eco-industrial parks, has shown to reduce GHG emissions and improve energy utilization[39].

GHG MANAGEMENT PLAN REQUIREMENTS

In the GHG Management Plan, the operator shall clearly identify and summarize the strategy or set of activities that will be taken in order to achieve the established GHG reduction target.

Large emitters should consider subdividing their strategy and action items into short, medium and long-term categories based on their implementation timelines and should provide a rationale for each of them.

Finally, the operator shall state how often the GHG Management Plan be updated and revised. While the submitted GHG Management Plans will last the time period of the large emitter's valid Air Quality Approval to Operate, it can be updated at any time if needed by the large emitter, i.e. if major facility refurbishments are undertaken. A GHG Management Plan should be renewed with the renewal of the large emitter's valid Air Quality Approval to Operate.

BASELINING

In the GHG Management Plan, the large emitter's GHG reduction target shall be quantified relative to a reference level of GHG emissions, referred to as baseline emissions.

In order to determine their baselines emissions, large emitters should select baseline years that (i) best reflect representative operating conditions at the facilities and (ii) be selected as being 3 of the last 5 years.

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38 New Brunswick Innovation Foundation (NBIF). Available at: https://nbif.ca/

39 Heeres, R.R., et al., 2004. Eco-industrial Park Initiatives in the USA and the Netherlands: First Lessons. Journal of Cleaner Production, 12(8-10), pp. 985-995.

Large emitters regulated under the NB Output-Based Pricing System (NB OBPS) are encouraged to select the same baseline years as those selected under the NB OBPS[40].

Once baseline years have been selected, large emitters can determine their baseline emissions as being the average of GHG emissions of the selected years, respectively.

BOUNDARY CONSIDERATIONS

The large emitter's boundary considerations for the GHG Management Plan shall be consistent with the definition of the source used in the operator's Approval to Operate and ECCC's definition of a facility. It is important to note that the boundary considerations are applicable only to the large emitter's direct emissions; to this end, large emitters may specify greater boundary considerations when scope 2 and/or 3 indirect emissions are included in their GHG Management Plans.

PROVINCIAL POLICY OR REGULATORY CONSIDERATIONS

Large emitters should indicate to which manner their GHG Management Plans are consistent with New Brunswick's 2030 GHG target and 2050 net-zero commitment, the NB CCAP[2], and other applicable federal and provincial policies and regulations (i.e. NB OBPS).

LINK WITH PARALLEL POLLUTION REDUCTION OPPORTUNITIES

Large emitters are encouraged to link their GHG Management Plans to other air and/or water pollution reduction opportunities and capital investment strategies, as these may reinforce each other, and can happen concurrently.

If GHG Management Plans are linked to other air and/or water pollution reduction opportunities, large emitters should provide information on this consideration.

40 New Brunswick (2021). Reduction of Greenhouse Gas Emissions - Climate Change Act, NB Reg 2021-43. Available at: https://www.canlii.org/en/nb/laws/regu/nb-reg-2021-43/latest/nb-reg-2021-43.html

GHG MANAGEMENT PLAN VERIFICATION

Large emitters are encouraged to conduct internal verification, completed by company personnel, of the robustness of a facility's processes, systems and performance.

To achieve higher levels of performance within the energy utilization and GHG emissions management system, large emitters could also consider conducting an independent assessment of its management system, reporting system and performance targets. To this end, verification requirements of GHG emissions and energy consumption data should be in accordance with the requirements of the NB OBPS.

While large emitters do not need to seek third party verification for their GHG Management Plans nor the GHG emissions data presented in it in order to fulfill their GHG Management Plan commitments, the information reported by them should nevertheless be verifiable, which means in a manner that would allow GHG emissions data to be verified by the government or a certified third party.

CONTINUAL IMPROVEMENT

The GHG Management Plan, typically should be part of a broader Environmental Management Program containing an Energy Management Program and EnMS; a structured framework for managing an operation's significant environmental impacts. This provides a process through which organizations can engage with employees, customers, clients and other stakeholders.

Whatever scheme is adopted, the elements will largely be the same, following the PDCA method (Deming cycle) of:

i) Plan what you're going to do;
ii) Do what you planned to do;
iii) Check (study) to ensure that you did what you planned; and
iv) Act to make improvements.

Through this cycle, all GHG Management Plans set a framework through which large emitters can build on-going *continuous improvement* to improve carbon productivity.

This system allows operations to adjust and learn from a multi-faceted network of influences not just environmental but also, economic and social.

To this end, the operator shall implement a Continual Improvement Strategy or a Follow-up Program, in which:

i) The operator shall verify and evaluate the effectiveness of GHG emission reduction measures specified in the GHG Management Plan;
ii) The operator shall identify and implement remedial actions items as needed in order to meet the GHG reduction targets and strategy specified in the GHG Management Plan.
iii) The operator shall identify and incorporate "lessons learned" into normal procedures; and,
iv) The operator shall address evolving climate change knowledge, technology, policy and legislation.

A Continual Improvement Strategy or GHG Management Plan Follow-up Program should be incorporated into the large emitter's normal operations.

COMMUNICATIONS AND EMPLOYEE AWARENESS

Organisations should strive to make personnel at all levels aware of energy and GHG goals. Research has shown that employee training and engagement and an organization's adoption of energy management in their day-to-day practices are beneficial[41]. In general, good results have been obtained from programmes that provide regular feedback on the organization's energy performance.

Organisations can extend their influence by working with external parties to promote improved GHG emissions management. This can be done through engagement with one or more communities of interest including: community groups, non-government organizations, government energy efficiency programs, industry associations, and local schools. They can take steps such as supporting educational programs and GHG emissions reduction projects in communities where facilities are operating, and advocating for government policies that support efforts by industry to reduce GHG emissions. Engagement with communities of interest around this issue provides an opportunity to receive valuable support and feedback, and to develop proactive responses to help improve energy utilization

41 CAFFAL, C., 1995. ENERGY MANAGEMENT IN INDUSTRY. CENTRE FOR THE ANALYSIS AND DISSEMINATION OF DEMONSTRATED ENERGY TECHNOLOGIES (CADDET). ANALYSIS SERIES 17. SITTARD, NETHERLANDS.

and GHG emissions. It also helps to demonstrate that responsibility for reducing GHG emissions is shared among all New Brunswickers.

MONITORING AND REPORTING

For all large emitters emitting 10,000 tonnes of GHG emissions or more per year, as a requirement of their Approval to Operate, pursuant to the Air Quality Regulation, the *New Brunswick Clean Air Act* and as a requirement of ECCC's GHGRP, the operator will continue to monitor and report the industrial facility's annual GHG emissions, for the previous calendar year, through ECCC's SW system by the annual June 1st reporting deadline[42].

During the reporting process, the operator shall at the same time report to the province of NB by selecting the ECCC and & NB reporting options which creates a combined report that is submitted once and goes both to the NB DELG and to ECCC.

In addition, **by July 1st of each year**, the operator shall submit, for the previous calendar year, an **Annual Progress Report** that should include as a minimum, the following summary information:

i) Total annual direct GHG emissions in carbon dioxide equivalent units (CO_2e) as reported to NB and ECCC through ECCC's SW system;
ii) Description of why direct emissions have changed year over year (i.e. since previous Annual Progress Report);
iii) Progress made on GHG reductions targets and strategy as specified in the GHG Management Plan;
iv) Effectiveness of GHG reduction measures or action items that have been implemented; and,
v) Lessons learned which may lead to further improvements that can be shared with government and other operators.

Once completed, the operator shall submit an electronic copy of Annual Progress Report to the Authorizations Branch of NB DELG at: elg/egl-info@gnb.ca.

42 IT IS TO BE NOTED THAT THE SW SYSTEM IS NORMALLY READY TO COLLECT DATA SUBMISSIONS BY THE SPRING OF EACH YEAR; THEREFORE, OPERATORS ARE ABLE TO SUBMIT THEIR INFORMATION WELL IN ADVANCE OF THE JUNE 1ST REPORTING DEADLINE.

DURATION OF GHG MANAGEMENT PLAN

Once submitted, a GHG Management Plan will be valid for a time period of 5 years.

Large emitters can update their GHG Management Plans at any time in order to align with other Environmental, Social and Governance (ESG) goals and objectives.