STANDARDS RESEARCH

Commercial Building Energy Data Reporting Best Practices and Requirements

Assessing the Potential for Standardization

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Disclaimer

Abbreviations

BOMA	Building Owners and Managers Association
CaGBC	Canada Green Building Council
CRM	Customer relationship management
CSA	Canadian Standards Association
EPA	Environmental Protection Agency
ESPM	ENERGY STAR® Portfolio Manager
EUI	Energy use index
EWRB	Energy and Water Reporting and Benchmarking (program)
FAQ	Frequently asked questions
GGBP	Greener, Greater Buildings Plan
GHG	Greenhouse gas
IMT	Institute for Market Transformation
IPCC	Intergovernmental Panel on Climate Change
LEED	Leadership in Energy and Environmental Design
MERN	Ministry of Energy and Natural Resources of Quebec
NECB	National Energy Code of Canada for Buildings
NRCan	Natural Resources Canada
NSDEM	Nova Scotia Department of Energy and Mines
PACE	Property Assessed Clean Energy (Chicago)
PCF	Pan-Canadian Framework
SEED	Standard Energy Efficiency Data
TÉQ	Transition énergétique Québec
U.S. DOE	United States Department of Energy

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Executive Summary

Commercial building energy data reporting initiatives have been growing in previous years across Canada with the goal of achieving energy and climate targets as well as encouraging the identification and implementation of energy efficiency and conservation measures. Several provinces and cities have developed voluntary programs. For the moment, Ontario is the only province with energy data reporting legislation. In 2017, the province introduced a mandatory regulation entitled Ontario's Energy and Water Reporting and Benchmarking (EWRB), requiring the collection of energy and water consumption data for offices and buildings that are used for multi-residential, commercial, and industrial purposes [1]. Given the wide range of requirements currently employed across Canada, there is a need to evaluate the different energy data reporting practices and requirements for commercial buildings and compare the differences and overlaps between the various building energy data reporting key steps and attributes.

The goal of this research was to examine the best practices and methodologies used to report data on commercial buildings through existing initiatives across Canada and the U.S. These data provided the basis for recommendations on energy data reporting for future standardization. This report presents the results of (1) an environmental scan and stakeholder interviews that served to identify the voluntary and mandatory ongoing initiatives across Canada and the U.S.; (2) an investigation to present key steps and attributes of energy data reporting; (3) an analysis that determined significant opportunities and challenges to be considered; and (4) recommendations for future standard development.

The environmental scan, completed through the above-mentioned interviews, has provided critical insights on current gaps in the availability of standards, guidelines, and best practices for supporting building energy data reporting. There are currently no standards to facilitate the harmonization of commercial building energy reporting data practices. Based on the research findings, several best practices (the four pillars) for future standard development were identified, which relate to:

- General program design principles
- Data-collection control
- Data disclosure and visualization
- Stakeholder engagement

The recommendations presented in this report regarding those best practices provide an important step towards facilitating the harmonization of energy data reporting for commercial buildings across Canada.

"Monitoring energy consumption is a first step in evaluating building energy performance."

1 Introduction

Under the Pan-Canadian Framework (PCF) on Clean Growth and Climate Change [2] that was published in 2017, federal, provincial, and territorial governments committed to reducing greenhouse gas (GHG) emissions by 40% by 2030 as compared to 2005 levels. Under this plan, the engagement to improve energy efficiency in buildings is one of the main activities to achieve the reduction targets.

Buildings are very important in the PCF, considering the building sector is responsible for 18% of total GHG emissions [3]. In the buildings sector, several opportunities to improve building performance already exist, such as high-efficiency heating systems and building monitoring and control systems, and stakeholders in the real estate sector are increasingly adopting building energy management practices. Assuming that we can only control what is measured, more and more building owners and managers are undertaking actions to monitor energy consumption in their buildings to improve their energy efficiency and implicitly reduce their energy costs as well as GHG emissions [4], [5], [6].

Monitoring energy consumption is a first step in evaluating building energy performance. Reporting energy data goes a step further by requiring building owners and managers to submit energy consumption data to the program authority, that is, local, provincial, territorial, and federal governments or non-governmental organizations. For mandatory programs, reporting is compulsory [7]. Furthermore, several jurisdictions are implementing benchmarking and disclosure requirements. However, no standards exist to facilitate the harmonization of reporting data across Canada.

The purpose of this project is to conduct a comprehensive environmental scan to better understand the state of energy building data reporting for commercial buildings. This analysis will serve to provide a set of informed recommended practices for the standardization of energy data reporting.

1.1 Context

1.1.1 Background

An increasing number of building owners and building managers are monitoring the energy consumption of their buildings to improve energy efficiency and implicitly reduce energy costs as well as GHG emissions [6]. For the last ten years, there has been a growing number of data reporting initiatives, both voluntary and mandatory, across Canada and the U.S. [7], [8], [9], [10], and [11]. In addition to this, guidance has been developed to support these initiatives, for example, the guidelines developed by Natural Resources Canada (NRCan) for commercial and institutional buildings [12]. Despite this, there is currently no predominant strategy being developed to provide national guidance on what key program design principles are needed to ensure best practices are followed and to support the development of effective and efficient regulations.

Energy efficiency standards are of prime importance to most national energy efficiency initiatives. When properly designed, they contribute to significantly improving uniformity and effectively fostering energy data reporting, thus contributing to accelerating energy efficiency efforts and climate change initiatives [12].

One of the challenges associated with building energy efficiency initiatives is the multiple options associated with building energy data reporting and disclosure [13]. The wide range of requirements across jurisdictions represents a substantial limitation in the implementation and ultimate understanding of the impacts of energy efficiency initiatives.

1.1.2 Objectives

The purpose of this project was to conduct a comprehensive literature and data review to identify the best practices and methodologies used to report data on commercial buildings in different existing initiatives across Canada and the U.S. These data served as the basis for providing recommendations on energy data reporting for future standardization.

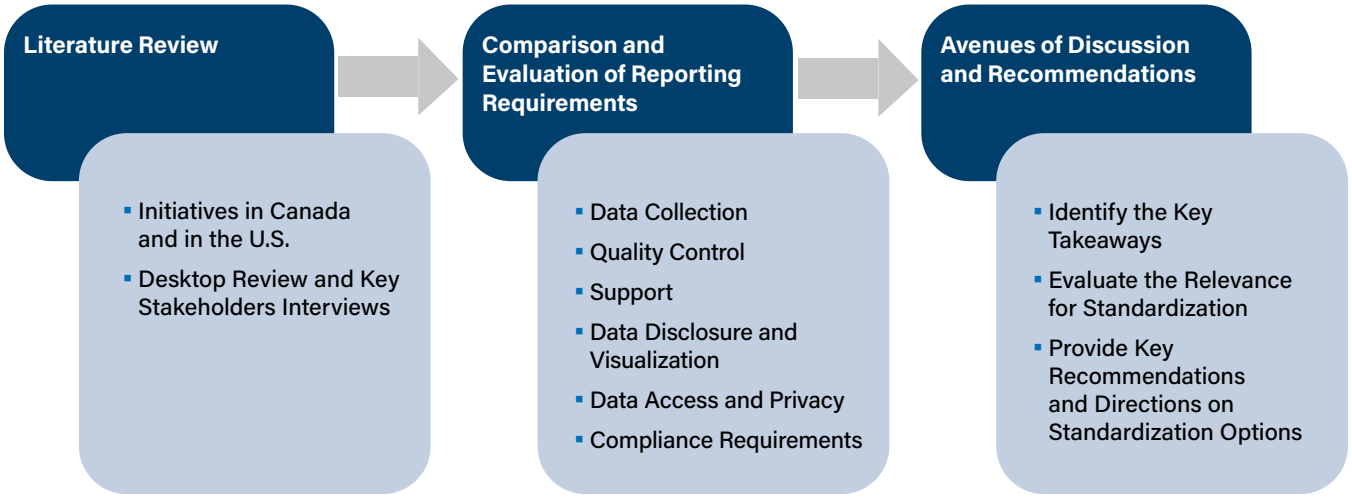
Specifically, the objectives of this research were to:

- Examine and summarize existing jurisdictions and voluntary programs requiring energy data reporting and disclosure for commercial buildings across Canada and the U.S.;
- Conduct a detailed evaluation on the different energy data reporting requirements and practices for commercial buildings for each of the selected initiatives;
- Compare the differences and overlaps between the various building energy data reporting key steps and attributes;
- Present the building energy data reporting landscape, covering in detail the findings and recommendations regarding energy data reporting standardization.

2 Methodology

The goal of this research was to summarize the state of energy data reporting and determine a set of informed recommendations on best practices for the standardization of energy data reporting requirements. Figure 1 summarizes the key methodological activities in this project.

Figure 1: Methodology adopted to conduct the research project



2.1 Overview

A comprehensive environmental scan was first conducted to understand the state of energy building data reporting, specifically for commercial buildings. Several existing initiatives were investigated, both voluntary and mandatory, as follows:

- **Alberta:** Building Energy Benchmarking Program
- **Manitoba:** Race to Reduce and Building Energy Disclosure Project
- **Ontario:** Energy and Water Reporting and Benchmarking (EWRB)
- **Quebec:** Energy Transition Master Plan and Building Energy Challenge
- **British Columbia:** Building Benchmark BC
- **Nova Scotia:** Energy Benchmarking Pilot
- **Yukon:** Good Energy Program
- **Canada:** Disclosure Challenge
- **New York City:** NYC's Local Law
- **Chicago:** Energy Use Benchmarking
- **Boston:** Building Energy Reporting and Disclosure Ordinance
- **San Francisco:** Energy Benchmarking Program
- **Philadelphia:** Building Energy Benchmarking Ordinance

In addition to this list of initiatives, which is not exhaustive and continues to grow in Canada, there are several jurisdictions across Canada that benchmark their own buildings and facilities. These programs have not been further analyzed and are not presented in this report as they only target government buildings, for example, the energy benchmarking program developed in Vancouver and the City of Richmond in British Columbia.

Once ongoing programs related to commercial building energy data reporting and disclosure were selected, a comparison of these initiatives was conducted to identify the differences and overlaps between the various building energy data reporting requirements. The different energy data reporting key steps and attributes were studied in detail for this purpose. Data on the following were examined:

- Data collection
- Quality control
- Support
- Disclosure and visualization
- Compliance requirements
- Data access and privacy

Ultimately, several avenues of discussion were further detailed based on the results of the analysis and on the recommendations that were developed for standardizing energy data reporting practices.

2.2 Data Sources

Several data sources were used for this research project:

- Annual reports from program authorities, in which the results, analyses, and data-collection methodologies were presented;
- Program websites that provide an overview of the given initiative and its organization;
- Research and government reports on energy data reporting, such as the reports published by the Canada Green Building Council (CaGBC), the U.S. Department of Energy (DOE), and the Institute for Market Transformation (IMT), which cover topics such as lessons learned on policy structure, help desks, support, quality control, data access and privacy;
- Guidelines developed to support the development of building energy benchmarking, labelling, and disclosure, such as the model national framework developed by NRCan [12];
- Feedback from several program authorities that have implemented voluntary or mandatory energy data reporting and disclosure programs for at least three years:
  - Building Owners and Managers Association (BOMA) Québec
  - CaGBC
  - City of Edmonton
  - City of Winnipeg
  - Ministry of Energy, Northern Development and Mines of Ontario

3 Environmental Scan

3.1 Current Ongoing Initiatives across Canada and the U.S.

For the last ten years, energy data reporting and disclosure initiatives have expanded at different rates, depending on the political and regulatory context. In Canada, several existing initiatives involve energy data reporting. These initiatives are all on a voluntary basis, except in Ontario where an Energy and Water Reporting and Benchmarking (EWRB) program was implemented, and there is no specific current standard or guideline established.

Conversely, at least 30 cities, including several large cities such as New York, Philadelphia, and Chicago, and two states, that is, California and Washington, have regulations or policies in place making the publication of energy data mandatory for particular building categories.

The main characteristics of both mandatory and voluntary programs that were investigated are presented in this section[1]. The main findings are summarized in Table 2 and Table 3 of Appendix B.

3.1.1 Alberta – Building Energy Benchmarking Program

In 2017, the City of Edmonton launched a voluntary three-year pilot energy data reporting program called the Building Energy Benchmarking Program. This program is one of several actions taken for the city to achieve low-carbon development and energy efficiency as a part of Edmonton's Community Energy Transition Strategy.

To qualify for the program, the total gross floor area of the building has to be greater than 20,000 sq ft and be a commercial, multi-residential, or industrial building. Industrial buildings can participate in the program as long as they are classified under industrial business or light industrial zones. In 2020, the floor area threshold was lowered to accept buildings greater than 10,000 sq ft [14].

The ENERGY STAR® Portfolio Manager (ESPM) is the tool used for data collection. This tool is presented in detail in Appendix A. All participants are required to create an account and input several specific data. The initiative offers assistance for submitting data through workshops or passive support with an online technical toolkit. Participants have the choice of sharing their data only with the City of Edmonton or publicly. Data quality control is conducted by a third party. This step validates that inputted data are consistent and identifies data that are possibly inaccurate. When necessary, participants are contacted and asked to correct their information.

In addition to providing participants with the opportunity to benchmark the energy consumption of their buildings, the City of Edmonton offers approximately 15 scholarships per year, of up to $10,000 each, to enable participants to hire an expert to conduct an energy audit on an ESPM-registered building.

After each round of participation, the program publishes a public report presenting the program highlights. It is important to note that participants who have agreed to share their data publicly are identified in that report, that is, the name of the facility is included along with its energy performance, while those who opt to share their data only with the City of Edmonton are kept anonymous. In that case, their energy performance is only presented in aggregate analyses.

In addition to the program's summary report, each participant receives a customized report once a year that presents the annual energy performance of their buildings compared to the average of buildings in the same sector registered by other participants. This customized report also presents the energy efficiency programs to which the participant could apply.

The target of this initiative was to have 300 large buildings enrolled in the first year. At the end of the first year of the pilot program in 2018, 99 buildings were part of the program, followed by 184 in the second year, and 278 in the third year, which is equivalent to an increase of approximately 50% each year. These results confirm that the recruitment and promotion program was successful and the retention program to maintain

1 The list of initiatives is not exhaustive.

as many participants as possible worked as well, with a percentage of 86% of participants from the second year also participating in the third year. As well, it must be noted that while the Building Energy Benchmarking program was initially planned for three years, it has been extended for a fourth year, and it might be extended for a fifth year [15].

3.1.2 British Columbia – Building Benchmark BC

The Building Benchmark Program of British Columbia (BC) is a two-year pilot program initiated by the province with four cities actively engaged in the program: Burnaby, Richmond, Surrey, and Vancouver. The main goal of the project is to raise awareness among stakeholders about energy use and GHG emissions, whether they are in the private or the public sector, and to help increase their understanding of the power of benchmarking. Also, this program was developed to help move towards mandatory energy data reporting and disclosure.

In 2020, the program targeted several types of buildings:

- Private buildings with a floor area larger than 50,000 sq ft;
- Multi-unit residential buildings with a floor area larger than 20,000 sq ft;
- Municipal buildings of any size [16].

The data are disclosed through an interactive map as well as an annual report.

3.1.3 Manitoba – Race to Reduce and Building Energy Disclosure Project

Two voluntary initiatives were found in Manitoba and are described below.

3.1.3.1 Race to Reduce

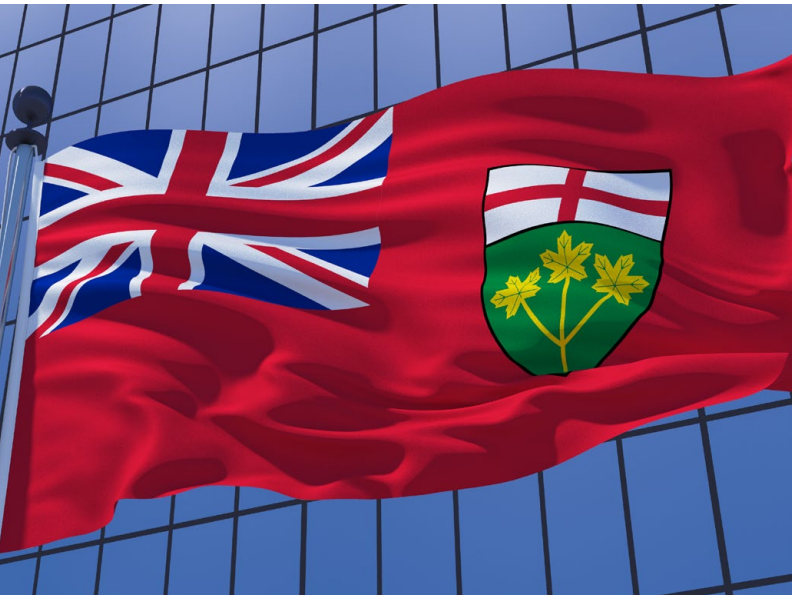
In January 2017, Manitoba Hydro implemented a voluntary four-year program called the Race to Reduce Challenge. This competition was aimed at encouraging landlords and tenants to register their building data on ESPM and reduce their energy consumption by 10% over four years. The Manitoba Race to Reduce Challenge was modelled on the Race to Reduce in Toronto that had been launched in 2011. The following eligibility criteria were defined by Manitoba Hydro for the Challenge, notably:

- Building with a surface area of at least 20,000 sq ft;
- Commercial and government buildings located in Manitoba;
- Buildings of which 80% of the surface is occupied by offices;
- Buildings with a minimum occupancy rate of 75%;
- Building owners and managers must allow Manitoba Hydro as well as the Province of Manitoba full access to ESPM data [17], [18].

Instead of entering energy consumption data into ESPM and sharing it with the Challenge, participants agreed to have Manitoba Hydro enter their energy consumption data by completing the registration form. Manitoba Hydro is one of the few utilities in Canada to offer automatic sharing of energy consumption data in ESPM and to allow the integration of this service into the participation process. Note that it was mandatory for the manager to share ESPM data with Manitoba Hydro to participate [19].

To encourage customers to participate, Manitoba Hydro specified that only certain data from the best performing buildings would be disclosed, for example, gross floor area, energy use index (EUI). Funding for this initiative was provided entirely by Manitoba Hydro, and the investment was recovered through the energy savings generated by the challenge. Several organizations collaborated in this initiative, such as the Chamber of Commerce and BOMA Edmonton, which strengthened communication around the initiative.

In addition, Pitblado Law was the first major law firm in Manitoba to adopt, in 2019, energy efficiency practices as part of Manitoba's Race to Reduce Challenge. A majority of multi-tenant buildings participated in the Manitoba Race to Reduce Challenge, in contrast to the Toronto Race to Reduce initiative. Multi-tenant-owned buildings faced more challenges than single-tenant owned buildings, because engaging everyone in the building is more difficult. Each tenant has to take part in the initiative so it can be successful. Therefore, it was necessary to communicate and engage with everyone



"Ontario is currently the only Canadian province with energy data reporting legislation."

in the building. Free-tenant engagement sessions were organized for the tenants, to get their consent and to get them involved. Since the beginning of this program, Pitblado Law has adopted several initiatives within its offices such as limiting printing, turning-off lights when not in use, and limiting the use of disposable dishes [20].

Manitoba Hydro communicated with participants through a quarterly newsletter. The newsletter contained information on the energy performance of buildings registered, advice on actions that could be taken, as well as energy efficiency programs to which participants could apply. In the last newsletter of summer 2020, the results indicated that, among the top five participants, some made a reduction of more than 30% in GHG emissions and more than 20% in terms of the EUI compared to the 2016 baseline [21].

3.1.3.2 Building Energy Disclosure Project

As part of its commitment to Winnipeg's Climate Action Plan, the City of Winnipeg launched the Building Energy Disclosure Project in June 2020. Commercial buildings of 20,000 sq ft and larger can participate, as well as institutional buildings. At the end of the first year, 160 buildings were registered. This initiative has been extended for at least another year. The aim of this project is to increase the participation rate while keeping the same building types admissible for the initiative with a future objective to continue benchmarking activities and eventually make it mandatory [22].

As a part of this program, participants must enter their data in ESPM. Building owners and managers must disclose their data with the City of Winnipeg for as long as they are involved in the initiative. For participants of the Race to Reduce Challenge, energy data was uploaded in ESPM by Manitoba Hydro. For multi-tenant buildings with two or more tenants and multiple utility meters registered under separate owners, a single building profile must be created with merged utility performance data information [23]. Participants must then work with project administrators to clean and complete their datasets.

Data are disclosed through individual scorecards to participants as well as a disclosure map. The individual scorecards are only disclosed to participants. They provide details on the building energy performance of participants as well as potential actions that can be developed to reduce their energy consumption and a list of available financial programs. At the time of this report, an annual report was also being drafted, which will expose some key results with aggregated data, present some case studies and the performance of top buildings, and provide some peer review.

3.1.4 Ontario – Energy and Water Reporting and Benchmarking (EWRB)

Ontario is currently the only Canadian province with energy data reporting legislation. In 2017, the province introduced a mandatory regulation entitled Ontario's Energy and Water Reporting and Benchmarking (EWRB) requiring the collection of energy and water

consumption [1] for offices and buildings that are used for multi-residential, commercial, and industrial purposes [24]. This regulation was phased in gradually, targeting commercial and industrial buildings over 250,000 sq ft by July 1, 2018, followed by buildings over 100,000 sq ft by July 1, 2019. As of 2020, the floor area threshold was lowered to 50,000 sq ft and buildings must report GHG emission data as well.

One of Ontario's climate targets is to improve energy efficiency in buildings to achieve carbon neutrality by 2050. This program is designed to help building owners and managers improve their building's energy and water efficiency to increase the chances of reaching this goal. Owners must report building information, such as address, building vocation, gross floor area, as well as energy and water consumption levels. Energy data must then be reported annually by July 1st. If the building is larger than 100,000 sq ft, the reported information must be verified by a certified professional during the first year [1].

Commercial building owners or managers share their data with the Ontario government through ESPM.

The Government of Ontario publishes information on its online data catalogue [25].

3.1.5 Nova Scotia – Energy Benchmarking Pilot

The Province of Nova Scotia, represented by the Nova Scotia Department of Energy and Mines (NSDEM), along with Efficiency Nova Scotia and the CaGBC, officially launched the Energy Benchmarking Pilot in June 2020. The program encourages owners of multi-unit residential, commercial, and institutional buildings to register with the program to track and manage their energy, water, and waste consumption to increase their building's performance. The objective of the program was to enroll 25 participants the first year, 150 the second year, and 200 the third year. The participation rate exceeded expectations and there were already 57 participants as of September 2020 [8].

Although Nova Scotia lags many other Canadian provinces in disclosure programs, it is well advanced regarding energy efficiency in buildings. According to the Efficiency Canada Scorecard from 2020, in terms of policy for the buildings sector, Nova Scotia ranks fourth place. In 2020, Nova Scotia adopted the National Energy Code of Canada for Buildings (NECB) 2017. The NECB is a national code that contains minimum energy efficiency requirement levels for all new buildings. The adoption and enforcement of this federal code is not mandatory and is the responsibility of provincial authorities [26], [27].

3.1.6 Quebec

Two voluntary initiatives were found in Quebec and are described below.

3.1.6.1 Energy Transition Master Plan

A master plan has been developed by Transition énergétique Québec (TÉQ) for the 2018–2023 period.

One of the objectives of the master plan is to improve energy management practices in buildings in the commercial and institutional sectors. To this end, the Ministry of Energy and Natural Resources of Quebec (MERN) wishes to put in place, by 2022, a voluntary energy performance rating and disclosure program called the Energy Transition Master Plan to help commercial and institutional buildings reduce their GHG emissions and improve energy efficiency. This initiative is aimed at reducing overall energy consumption by 1.2% per year for five years. It is currently in development, so there is no information available on its attributes at the time of writing [28].

3.1.6.2 BOMA Quebec: Building Energy Challenge

In 2018, NRCan mandated the BOMA of Quebec to develop a voluntary data disclosure pilot project called the Building Energy Challenge. This project consists of developing data reporting practices for the energy consumption of buildings in the commercial and institutional sectors in the Province of Quebec and mobilizing local stakeholders.

The project is being rolled out over four years, from 2018 to 2021, with a 10% reduction target for GHG emissions [11].

For the BOMA Building Energy Challenge, participants are required to enter their energy data through ESPM, and the program offers a participant guide that provides instructions on how to enter the data.

After each year of participation, an annual report is publicly disclosed on the program website. The data presented therein are aggregated and anonymized. In addition, each participant receives a scorecard with the energy performance of their building and an annual report to compare the building to similar ones. Awards are delivered annually to the participant whose building reduces the EUI the most. A resilience prize has been added to the program to recognize good initiatives that have been put in place during the global COVID-19 pandemic to further decrease energy consumption. Ultimately, the challenge is aimed at demonstrating the importance of data reporting and promoting it as well.

3.1.7 Yukon – Good Energy Program

In 2019, the Government of Yukon initiated energy benchmarking with financial support provided by NRCan. Three objectives were set under this initiative. The first consisted of including building energy performance benchmarking in an existing energy efficiency and GHG emission reduction incentive program delivered by the Yukon government, known as the Good Energy Program. More than 30 privately owned buildings participating in this program had the opportunity to benchmark the results of their building with peers. The second objective was for the Yukon government to centralize existing datasets of their buildings and those of the City of Whitehorse through ESPM to facilitate analyses. About 280 buildings were registered through ESPM, as well as about ten buildings for the City of Whitehorse. The third objective consisted of facilitating energy data collection from fuel sources by installing meters and automatically collecting energy consumption data from these meters.

To benefit from energy data reporting, private building owners who participate in the Good Energy Program must enter their data in ESPM. They can receive support for the initial set-up of their account if they do not feel comfortable enough to do it themselves [29]. Other types of assistance are also provided to participants, such as training on how to use ESPM and analyze consumption, tutorials, videos, and pamphlets.

The data are not disclosed due to reservations among decision-makers in the private sector. In this context, no specific data quality control has been developed for private building data [29].

As for public buildings, both support and data verification are conducted by the people responsible for energy in the Yukon government. They are also in charge of extracting the data collected in ESPM to proceed with analyses.

3.1.8 Canada – Disclosure Challenge

The Disclosure Challenge is a voluntary initiative of the Canada Green Building Council (CaGBC).

In 2019, the Disclosure Challenge began with the voluntary support of five real-estate owners who registered more than 700 building assets in the program the first year. All types of buildings can be registered – office, industrial, and residential buildings, as well as retail, multi-usage, and institutional buildings. The data are gathered and reported using mainly ESPM and disclosed through a visualization tool based on the Standard Energy Efficiency Data (SEED) platform [5].

In this challenge, there is a lot of transparency regarding data disclosure since all data are publicly available. An interactive map connected to the data performance of participants is used for data visualization.

3.1.9 New York City's Local Law

In 2009, New York City became the first city to implement a regulation and require building owners and managers to submit annual data on their energy and water consumption through Local Law 84 as part of the Greener, Greater Buildings Plan (GGBP) [9]. The following buildings are targeted through the program:

- City-owned buildings with at least 10,000 sq ft;
- Private buildings with at least 50,000 sq ft;
- Buildings on the same tax lot with more than 100,000 sq ft combined;
- Two or more buildings held in condominium ownership and governed by the same board of building managers and that exceed 100,000 sq ft combined.

Building owners and managers are required to use ESPM and must submit data annually. Once the data are collected in ESPM, they are analyzed and published in the New York City Energy and Water Performance Map.

In addition to benchmarking, New York City decided to take a step forward by passing Local Law 87 in 2009 [30]. It requires the buildings mentioned above to proceed with audits and retro-commissioning studies every ten years. Also, Local Law 133, launched in 2016, was expanded to buildings larger than 25,000 sq ft; it requires building energy and water consumption reporting [31].

3.1.10 City of Chicago – Energy Use Benchmarking

The City of Chicago introduced a mandatory regulation called Chicago's Energy Use Benchmarking. This new regulation is applicable to commercial, institutional, and residential buildings with a gross floor area greater than 50,000 sq ft. All data are collected in ESPM [32].

This initiative has gathered information on more than 1,750 buildings representing a total area of 210 million sq ft.

Onsite data verification is conducted under this program for registered buildings. However, this has been difficult due to the COVID-19 pandemic. Therefore, the data verification requirement for this regulation was suspended until June 1, 2021 [33].

3.1.11 City of Boston – Building Energy Reporting and Disclosure Ordinance

The City of Boston introduced a mandatory regulation through the Building Energy Reporting and Disclosure Ordinance. This initiative is in line with Boston's Climate Action Plan and is expected to reduce building energy consumption and GHG emissions by 15% within five years [34]. This regulation is aimed at increasing the awareness of building owners and managers, tenants, and other stakeholders regarding their energy usage and greenhouse gas emissions to achieve Boston's emission reduction goals.

The following buildings are targeted by the program:

- All city-owned buildings;
- Commercial buildings with at least 35,000 sq ft;
- Residential buildings with at least 35,000 sq ft or more than 35 units;
- Parcels with multiple buildings that exceed 100,000 sq ft or more than 100 units combined [10].

This initiative has gathered information on more than 1,600 buildings representing a total area of 250 million sq ft.

Also, buildings covered by this regulation must demonstrate concerted efforts to reduce their emissions every five years through energy actions or audits.

3.1.12 City of San Francisco – Energy Benchmarking Program

In 2011, the City of San Francisco passed a benchmarking law included in the San Francisco Environment Code Chapter 20 [35]. This regulation first requires non-residential buildings of more than 10,000 sq ft to annually benchmark their energy data. Since 2020, this program also included residential buildings of 50,000 sq ft. All data are collected in ESPM.

Data are publicly disclosed through an annual report and can also be visualized through an interactive map publicly available online. One of the particularities of the San Francisco report is that non-energy related indicators, such as unemployment rates and economic growth, are also presented in the results and analyzed in comparison to energy indicators. For example, from 2009 to 2013, the gross domestic product of San Francisco increased by 19%, the total number of people employed increased by 11%, while energy use in commercial buildings decreased by 2%. In 2014, 1,847 private sector buildings and 465 public sector buildings were part of the program [36].

3.1.13 City of Philadelphia – Building Energy Benchmarking Ordinance

The Energy Benchmarking Program of Philadelphia is a city initiative as part of Greenworks. Greenworks is a vision for a sustainable City of Philadelphia in which the mayor set a goal of reducing 80% of carbon emissions by 2050. In 2010, the city launched an energy benchmarking and disclosure law known as Philadelphia Code Section 9-3402. It requires commercial and multi-family buildings with a floor area of 50,000 sq ft and larger to report their data through ESPM. Since 2013,

this initiative has included more than 2,700 buildings occupying more than 320 million sq ft and representing 20% of the total citywide square footage [37].

Data are publicly disclosed through an annual report and can also be visualized through an interactive map publicly available online. Results from 2013 were presented in the 2019 annual report indicating that there was a 12% reduction in GHG emissions and 5% reduction in energy use. Also, over half of participants reported achieved energy savings every year. According to the same report, the three main contributing sectors to GHG emission reductions were colleges/universities, offices, and multi-family buildings [38].

3.2 Summary

Overall, the environmental scan highlighted that there are currently a multitude of initiatives underway, with varying requirements. Programs differ primarily in their voluntary or mandatory nature, and mandatory programs are linked to legislation such as Ontario's Energy and Water Reporting and Benchmarking (EWRB) program or New York City's Local Law. Depending on the program, participants may operate in the commercial, residential, or institutional sector. Another criterion that often determines participation is total floor area. Most programs start with large buildings in terms of total floor area, then the floor area criteria are reduced over the years to include a larger number of buildings. Despite these differences, all these programs have the same objectives of reducing building energy consumption, improving building performance, and encouraging responsible behaviour. Therefore, it is important to evaluate all the initiatives, establish an overview of the situation, and determine the relevance of developing an energy data reporting standard.

4 Key Steps and Attributes to Energy Data Reporting

Energy data reporting is composed of different key steps and attributes. This section provides a landscape of the following key features:

- Data collection
- Quality control
- Support
- Disclosure and visualization
- Compliance requirements
- Data access and privacy

For each of these key steps and attributes, several challenges as well as best practices have been identified. These are presented in this section and are summarized in Appendix C.

4.1 Data Collection

The first step in data collection consists of defining the data input requirements since the required data will have a critical impact on the results, energy data reporting, and decisions made by building owners and managers to improve the energy performance of their buildings.

Considering existing data-collection initiatives and tools available in the market, the required data are divided into two main groups:

- Building characteristics such as construction year, floor area, facility type, occupancy rates, equipment types, and operating hours;
- Energy consumption data (e.g., electricity, gas, steam, waste fuels) and GHG emissions.

Appendix B presents in detail the data collected by each of the reviewed initiatives.

Several data metrics are used by the analyzed initiatives. For instance, floor area can be expressed either in sq m or in sq ft, depending on the geographic location of the initiative. A similar observation was made for the EUI. Although it is generally expressed in GJ per sq m, which is the standard format used in ESPM, this indicator is sometimes expressed in kWh per sq m, particularly in the industrial sector. This highlights the current lack of harmonization regarding reporting data metrics.

In addition, it is important to note that collected data may serve different needs. While the focus of this research is on building energy data reporting and disclosure, data collection and benchmarking are also required for other purposes. For example, both BOMA

BEST and Leadership in Energy and Environmental Design (LEED) programs use ESPM as a benchmarking tool, and it is part of their rating systems.

As for the frequency of which data should be reported, all initiatives promote annual submissions of energy data. In this manner, building owners and managers can gather their monthly energy data consumption for the last 12 months.

Apart from the input requirements, the tool used to collect the information is also a key component in the success of the process. ESPM is used in each of the reviewed data-collection initiatives. Some additional applications such as Excel are used as well.

Energy data can be registered in ESPM either by building owners and managers or by utilities, as long as the program enables them to do so. In most programs, building managers are responsible for providing the data. However, the environmental scan revealed that approximately 30% of self-reported data contain errors [39]. Technical support can be offered to address this obstacle, which can take several forms as detailed in Section 4.3. In some initiatives, energy suppliers are directly involved in energy data collection. Instead of requiring building owners and managers to collect energy data, utility providers deliver their customers' consumption data. This can be very helpful, particularly when building owners and managers need to collect data from their tenants, as in this case, each tenant must fill out a consent form. If the service is available, utility providers can upload aggregated energy consumption data directly from tenants in the data-collection tool, without necessarily requiring consent forms from each tenant.

4.2 Quality Control

One of the big challenges associated with the collection of such a large amount of data is the quality of the data collected. There are two main aspects that affect data quality: missing data and misreporting. These two difficulties can be explained by:

- Problems accessing the required data;
- Lack of utility meters;
- Managers misinterpreting the data received from utilities;
- Lack of time to submit the data; and
- Lack of understanding about the requested data, as not everyone has a technical background. Therefore, it is also important to clarify and define different terms used in the requirements.

These obstacles may have a significant impact on the results of a program. As an example, the Building Benchmark BC program started in January 2020 with a target of 550 properties by the end of the year. By April, 765 individual buildings were registered across the province. However, only 70% of them had some data and property owners shared less than half of the required data [16].

Data verification thus contributes to ensuring the information provided is complete and reliable [40]. Several solutions are available. For example, alerts can be set up on the information indicated on several building characteristics, such as floor area and energy consumption. Energy consumption can be automatically transferred into the tool without users having to enter the data manually. These features help reduce typographical errors and thus enhance the reliability and completeness of the information entered into data-collection tools.

All programs have developed data quality controls through the use of the Data Quality Checker provided by ESPM. This option allows users to set alerts to identify missing information, incorrect meter readings, incorrect units of measure, possible typos, and other data entry problems [41].

In addition to ensuring the quality of the information entered into the collection tool upstream, several programs have developed initiatives to track quality control practices once the building information has been inputted. Control can be achieved through sampling methods and graph plotting. The energy consumption data entered in the tool can also be compared to energy bills submitted by energy utilities. The procedures used by the reviewed initiatives are summarized in Appendix B.

"Developing an adequate communication strategy at an early stage is thus promoted to encourage building owners and managers to participate in energy data reporting programs."

Verification can be carried out internally within an organization as long as the person in charge has sufficient knowledge about the verification procedures to be followed. Verification can also be performed by a third party. For instance, in Ontario's EWRB, a specific condition has been set for buildings larger than 100,000 sq ft, which requires involving a certified professional for the first data verification and then at spaced intervals.

4.3 Support

Establishing a dialogue with building owners and managers is another essential element included in the framework of developing energy data reporting initiatives. Given the concerns raised by stakeholders in the real estate sector and the various questions that can arise when disclosing data, providing support is a key step to help building owners and managers to understand program requirements, analyze their energy consumption, and correctly submit their data. At a more global level, support is also necessary to raise building owners' and managers' awareness regarding the benefits associated with energy data reporting and disclosure. Developing an adequate communication strategy at an early stage is thus promoted to encourage building owners and managers to participate in energy data reporting programs.

For all programs, building owners and managers can obtain support on program websites or through emails and by phone, except for the Race to Reduce Challenge in Manitoba and the Building Benchmark BC initiative for which support is exclusively provided online and by emails.

Multiple formats such as help centres, training, and webinars are used by program authorities to understand ESPM. Training workshops on energy management and the interpretation of the information provided, in-person sessions,[2] as well as online webinars/videos can be offered. For several initiatives, in-person assistance or training is also proposed to participants. The formats used by each initiative are presented in more detail in Appendix B.

To help building stakeholders who are less familiar with entering information into the data-collection tool, step-by-step guides and procedures detailing the data entry process can be made available to users to provide solutions to the most frequently encountered situations. In addition, more personalized support can also be offered through either an email address to which users can forward questions or a dedicated phone line. This support is intended to not only increase participant satisfaction and participation levels but also reduce verification efforts, since data entered with the help of technical assistance are more likely not to contain data errors.

2 In-person sessions were being offered before the COVID-19 pandemic.

4.4 Disclosure and Visualization

At a global level, energy data reporting and disclosure must respect several criteria:

- Disclose the information in an aggregated form;
- Put governing entities in charge of data disclosure instead of individual owners or organizations; and
- Share the information in a manner that creates a fair business environment for individual building owners and managers.

This last point also highlights the necessity to ensure the quality and validity of the data disclosed so each building is evaluated correctly.

Considering that some of the stakeholders who have access to these data do not necessarily have a technical background, energy data must be reported in a manner that can be understood. Ongoing initiatives use multiple formats for data visualization, for example, public annual reports, individual scorecards, and energy mapping. These are presented in more detail in Appendix B.

In most cases, the results are presented to participants in the form of a one- or two-page dashboard that highlights key indicators. Some messages are also sent to help building owners or managers interpret results as much as possible. These summary documents, also called performance profiles, have several sections:

- The first section briefly presents the identity card of the building being analyzed. General information is mentioned (e.g., location of the building, floor area, construction year, energy sources used). This is the case, for example, with the dashboard delivered by the City of Edmonton.
- In the second section, which is the main section, the performance profile of the building is summarized. Several indicators are presented to the building owner or manager. Most often, the ENERGY STAR score and energy intensity are presented. Financial indicators such as energy costs spent per unit area are sometimes also presented because they are generally more meaningful to the reader.
- The third section includes information related to the next actions to be taken to improve the energy performance of the building. Energy efficiency programs and demand-side management programs applicable to the building being analyzed can be presented, along with key resources that can be called upon for support.

In addition to dashboards, users sometimes have access to a visualization tool in the form of a map through a web application. It is then possible for users to have an overview of the registered buildings and to focus on certain buildings by filtering them according to specific criteria.

Another example of visualization was launched by the City of Chicago in 2019. This is a star rating designed to replace the ENERGY STAR rating with an indicator that is easier to interpret for building owners and managers. This rating system groups buildings located in an equivalent performance range within the same category rather than comparing them on the basis of an exact score. In addition, participants who have improved their ENERGY STAR score by ten points or more within two years are awarded an additional star. This scoring system is aimed at rewarding participants who have made significant efforts and offering them the opportunity to publicly display this progress.

The way in which the data are presented depends on several criteria, mainly the target, collected data metrics, and data disclosure requirements. Most initiatives use several formats at the same time, for example, synthesized public reports and a detailed scorecard per building addressed to each of the participants for their own buildings. These public reports simultaneously raise awareness among real estate stakeholders and encourages them to take part in these initiatives, as well as communicating to building owners and managers the detailed energy performance of their buildings, which they can then compare to their peers' performance through the individual energy scorecards [42].

Depending on the context in which the data disclosure program was launched, the data disclosed are more or less extensively distributed. In the U.S. where

efforts to benchmark energy consumption data have multiplied in recent years following the introduction of ordinances, the data disclosures are most often made public through various distribution channels (e.g., government sites, downloadable dashboards, or online mapping tools). However, some municipalities or jurisdictions only require building owners or managers to disclose energy performance data in the case of real estate transactions or upon request of tenants, lenders, or buyers. In some cases, buildings are exempt from disclosing data if they have special characteristics.

Regarding voluntary building energy data reporting initiatives, existing data disclosure practices are more diverse. In some cases, participants must share all their data with the program authority. However, only aggregated data are then disclosed to participants to favour anonymity. In other cases, the choice to disclose data in whole or in part is left to participants, for example, the Building Energy Benchmarking Program in Alberta. In the case of a partial disclosure, only the names of participants and floor areas are shared. When a full disclosure is selected by a participant, the EUI as well as the intensity of GHG emissions are also disclosed. If participants initially opt for partial disclosure, they can still opt for full disclosure.

The information most often presented in the analyzed initiatives includes building characteristics, building energy consumption data, EUI, GHG emissions, ESPM score, and ranking in relation to similar buildings. Both disclosed information and disclosure formats used by the initiatives are further detailed in Appendix B.

In addition to energy-related results, some initiatives also present data that have been directly or indirectly impacted by a reduction or increase in building energy performance, such as employment rate or household spending. This good practice includes the economic and social benefits gained from energy data reporting and disclosure processes and further enhances the benefits brought by these initiatives [12].

4.5 Compliance Requirements

It is important to mention that there is no consensus on the definition of compliance among program authorities. For some voluntary initiatives, buildings comply with the energy data reporting and disclosure initiative by sharing information through ESPM with the program organization only. For others, building compliance is achieved once all building information required for benchmarking has been provided in the data-collection tool. And still other voluntary initiatives, as well as most mandatory initiatives, consider buildings to be compliant once required data are submitted and they have completed the data quality control process. Hence, a clear definition of compliance is required during the program design due to the multiple models currently in use.

Often, compliance only targets buildings respecting specific conditions, for example, they are not new constructions or the building owner is not experiencing financial distress. As detailed in Appendix B, compliance thresholds and data requirements have been set in several programs, and these vary across the initiatives.

Building owners and managers who meet the compliance targets for a building can be eligible for exemptions under certain circumstances, such as low occupancy, new construction, and financial distress. The amount and types of exemptions vary greatly among the initiatives. Usually, building owners or managers need to complete an exemption form that will be evaluated for qualifying criteria. Overall, as soon as exemptions are developed for a program, it is necessary to ensure proper communication to make exemption forms available to building owners or managers and to establish an evaluation process to ensure that each case is reviewed correctly.

Financial penalties in the case of non-compliance have also been introduced in many mandatory initiatives, and typically include daily or annual fines. In some cases, program authorities have also decided to publicly disclose when a property is required to benchmark but is not compliant. However, through the ongoing initiatives that have set up penalties, building owner assistance and clarification of energy data requirements is encouraged rather than the issuing of penalties. The experience of existing initiatives demonstrates that providing support in multiple formats and step-by-step guidance to meet requirements can improve data compliance.

Apart from compliance requirements and the tools that have been developed for that purpose, data compliance raises several challenges and barriers for both program authorities and building owners or managers. Supporting compliance can be a challenge for program authorities. In some cases, it may be complex to obtain the right contact information for the current owner or to identify the appropriate person to whom the compliance notice should be addressed. Another encountered challenge lies in the validation of information that has been collected to ensure compliance. For building owners or managers, several main challenges have also been identified among the initiatives, including (1) lack of capacity, knowledge, or basic understanding regarding data metrics and energy performance; (2) malfunctioning meters in smaller or older buildings, which can make benchmarking more challenging; (3) difficulty in obtaining whole-building energy consumption data from utilities or tenants; and (4) uncertainty that the building meters are all entered in ESPM.

Smaller building owners and managers are more likely to encounter these challenges because they typically have less time, resources, or skills to be compliant. Based on these observations, non-compliance often appears to be due to data collection and registration challenges rather than reluctance. As such, several organizations focus their efforts on support and education rather than issuing fines. However, depending on the compliance issues, especially if they are related to energy data collection and registration, these may require more personalized guidance.

Considering mandatory energy data reporting and disclosure, several program authorities couple their regulations with complementary laws to enforce building energy audits and retro-commissioning requirements. A few program authorities – Boston, New York, and San Francisco for example – require building owners and managers to submit audit data or confirm that an audit has been conducted to be compliant. In addition, some jurisdictions like New York require building owners and managers to conduct retro-commissioning and retrofit measures. Additional data gathered through the audits can help program authorities to more easily identify high-opportunity buildings and energy efficiency opportunities.

4.6 Data Access and Privacy

The data collected for energy benchmarking and reporting include personal and confidential information. Since energy data reporting and disclosure implies sharing information with a large set of stakeholders, this may raise confidentiality concerns due to privacy laws and data access limitations. Finding the best arrangement for data privacy and security is difficult. Data-gathering technology is rapidly evolving and legislation on data protection is not always adapted to facilitate the release of utility data.

Moreover, data access is highly dependent not only on building managers but also on other key stakeholders in the building sector, for example, utilities and tenants. Many utilities provide consumption data in formats that require the customer to enter the data manually into ESPM. This situation creates the possibility of manual errors and makes the customer less likely to benchmark. In the case of buildings occupied by several tenants with individual meters, building owners often need to seek authorization or meter data from each tenant to satisfy privacy laws or utility confidentiality policies. Manually collecting these authorizations or data on a monthly or annual basis is time consuming and may be fruitless. In this case, tenant concerns regarding data privacy may prevent building managers from accessing all the data needed to correctly evaluate the entire building. In addition, utilities generally will not deliver energy data from tenants' individual accounts without customer consent. Obtaining the consent of each occupant might become challenging in this situation.

It is important to establish limitations on data usage to ensure that the information can be consulted only by authorized people to prevent any unapproved individuals from accessing restricted data, and that the information may not be modified or deleted without approval. Specific access and authentication controls can be developed to this end.

As already mentioned, all reviewed initiatives use ESPM. The software provides secure communications as well as secure and password protected access. This means no information is released publicly or sold to third parties [43]. Data collected from the initiatives are only used to benchmark and identify energy efficiency trends.

More generally, the organizations that have developed existing programs have overcome the challenges of data access and privacy on their own and with different results and solutions. Several good practices emerged from the research analysis as listed below; they are further detailed in Appendix B.

- Limit utility releases to monthly, whole-building aggregated data. In most cases, this should provide sufficient information for benchmarking purposes while maintaining the privacy of individually metered customers. Aggregation thresholds need to be established. As for buildings with a limited number of meters, data aggregation may not be sufficient to ensure the results do not reveal the energy usage patterns of any customers;
- Encourage authorization for the release of energy usage data by the required authorities through leasing documents;
- Be transparent about the shared data, explain the process, and do not disclose confidential data;
- Allow tenants and owners to opt out of public data releases if publishing the data would reveal trade secrets or create security risks;
- Establish methods for filling in missing data; and
- Determine methods for collecting data on delivered fuels (e.g., oil, propane).

5 Challenges and Opportunities for Standard Development

The environmental scan of existing initiatives has revealed several good practices and overlaps, as well as a few challenges. In this section, several main analysis outputs are put forward to provide an overview of the challenges and opportunities that could arise from a standardization approach to managing energy data reporting requirements for building energy systems.

5.1 A Complex and Long-Term Process

Both voluntary and mandatory programs were analyzed through the environmental scan. All mandatory initiatives that were reviewed are still ongoing and most have been expanded since their launch. As for voluntary programs, it is interesting to note that they were systematically developed over several years. A few of these initiatives, such as the Building Energy Benchmarking Program in Alberta, the Building Benchmark BC, and the Energy Benchmarking Pilot Program in Nova Scotia, have been extended at least for an additional year. Several voluntary programs such as those in British Columbia and Quebec have been developed to prepare building owners and managers for upcoming provincial and federal regulations on energy use in buildings. These pilots will help move initiatives towards mandatory energy labelling by setting energy reporting requirement foundations that are expected to be established at the provincial level. This is in response to the PCF, which plans for mandatory building reporting and transparency requirements. This context demonstrates that energy data reporting is not a short-term initiative but rather an initiative designed in the long term to lead towards market transformation.

In addition, the environmental scan revealed that a phased implementation process was favoured by most of the analyzed initiatives. More specifically, several jurisdictions require government buildings or larger buildings, or both to comply with energy data reporting prior to extending requirements to privately owned buildings. New phases are then rolled out annually by adding other building types or reducing the floor area threshold progressively. This is a way to create tested implementation strategies and gather support for the development of programs.

Another observation that arose from the environmental scan relates to the benefits offered by these programs. They are numerous and can vary depending on the stakeholder in question, that is, building owners and managers, tenants, program authorities, and utility providers. The following benefits are commonly promoted by program authorities:

- Increased knowledge of building owners and managers about the energy performance of their buildings;
- Ability to monitor the evolution of their energy efficiency levels and the impacts of the energy efficiency measures implemented;

- Ability to compare their performance with that of similar buildings;
- Increased property value, attractiveness, and tenant retention;
- Increased information to better understand commercial building energy use;
- Ability to develop improved programs, tools, and processes that assist building owners and managers in making their properties more energy efficient;
- Ability to provide data to the market, stimulating the market valuation of energy efficiency, and leading to market transformation in the long term;
- Alignment with existing commitments regarding climate regulations and policies and contributing to the achievement of government objectives;
- Recognition as a leader in energy savings and driving investments in buildings; and
- Creation of local jobs that consist of conducting energy retrofits.

The variety of these benefits reveals not only the multifaceted intentions of program authorities regarding energy data reporting initiatives but also the involvement of many stakeholders. All these observations highlight the complexity of the process and the impactful consequences it can have on the market. The lack of uniformity thus adds to the challenges that program authorities face when designing their programs.

5.2 A Decision-Making Tool Rather than a Solution

Energy data reporting programs are aimed at providing both insights to building stakeholders – for example, building owners and managers and occupants – on their building energy performance and tools for understanding and evaluating the resulting evolution over the years. However, it is important to understand the information delivered on a building does not directly result in more energy efficient properties. It rather removes a key energy efficiency implementation barrier, which is the lack of information about energy usage in buildings, by providing the information that enables building owner decision-making. Hence, this is a first step in establishing performance thresholds by identifying a baseline reference and providing information that can be compared to peer buildings.

Collecting large sets of fine-scale building energy data can also help energy efficiency programs to target rebates and incentives for buildings in which the energy savings potential is the most significant. This is very helpful considering building energy data reporting is even more powerful when combined with descriptions of applicable energy efficiency programs and recommendations on potential cost-effective energy savings measures that could be implemented to reduce energy consumption in buildings.

Finally, compiling data from a large number of buildings over time allows property owners, policymakers, incentive designers, and capital providers to concentrate their resources on the best interventions in the most appropriate buildings and achieve the highest energy performance.

5.3 A Need for Harmonization

The environmental scan demonstrated that there is a multitude of initiatives in Canada and across the U.S. at the municipal and provincial levels. Although they all use ESPM, these initiatives individually developed various procedures and best practices regarding energy data reporting. This indicates there is currently no common approach on how to best address energy data reporting. Consequently, efforts in designing these programs are duplicated. A more harmonized building energy data reporting methodology could increase compatibility between buildings as well as confidence, synergies, and market uptake. The advantage of having several ongoing initiatives is that these initiatives will help avoid some of the mistakes that have been already made, but most importantly, they will improve building energy data reporting across Canada more quickly.

The harmonization of these initiatives would also be a great help and time saver for building owners and managers, especially for those who have buildings in different regions. Smaller cities often do not have the human or financial resources to implement these types of programs. Therefore, the adoption of regulations at the provincial or federal level or the implementation of a common methodology on a larger regional scale can facilitate the expansion of building energy data reporting.

"Standardization could help better inform building owners and managers and reinforce market transformation as well as energy performance in buildings."

Harmonization may not necessarily involve legislation, but a similar methodology should be put in place for all initiatives. It would therefore be important to think about developing a standard to harmonize commercial building energy data reporting. Establishing a standard process for data collection, analysis, compliance, and reporting would permit data gathering on a larger scale and help develop an even more robust system.

Section 6 below provides specific recommendations regarding the possible standardization approaches to develop for energy data reporting.

6 Recommendations

To reach the full potential of building energy data reporting and ultimately improve energy performance in buildings, several aspects related to energy data reporting would need to be standardized.

Indeed, standardization could help better inform building owners and managers and reinforce market transformation as well as energy performance in buildings. This section provides recommendations and opportunities regarding the possible standardization approaches to be developed for energy data reporting. They are focused on four pillars:

- General program design principles
- Data collection and control
- Data disclosure and visualization
- Stakeholder engagement

6.1 General Program Design Principles

6.1.1 Key Objective

Develop national building energy data reporting and disclosure requirements and guidelines for commercial buildings based on existing initiatives and best practices.

6.1.2 Key Actions

6.1.2.1 Define the Program Intent

For the last ten years, energy data reporting and disclosure initiatives have been launched at different scales depending on political and regulatory contexts. They have been developed to answer various purposes such as:

- Aligning with the existing commitments regarding climate regulations and policies;
- Accelerating market transformation towards energy efficiency for buildings;
- Gathering information to better understand commercial building energy use, thus enabling the development of improved programs, tools, and processes that will assist building owners and managers in making their properties more energy efficient; and
- Helping to move towards mandatory energy data reporting and disclosure.

However, based on the analysis of the initiatives, it appears that GHG emission reduction targets are the main driver behind most of the building energy data reporting programs focusing on existing buildings, especially mandatory ones, which account for most of the long-term GHG emissions associated with the building sector.

Depending on the intended purposes of energy data reporting, the type and quantity of data to be collected, reporting indicators, and the ways of disclosing the data will differ. Therefore, it is essential as a first step to define clearly and precisely the intent of the program. It may be, for instance, an opportunity to inform incentive programs or assess the impacts of energy and GHG emission reduction policies. Once the objectives of the program are defined, it will be important for the program authority to explain what benefits are offered to building owners and managers to further drive energy efficiency.

6.1.2.2 Adopt Phased Implementation

Phased implementation is a common practice among the analyzed initiatives. Progressively developing an energy data reporting initiative should be favoured. This would gradually include a number of buildings in the benchmark instead of requiring them to be compliant all at once. Waiting to include a large number of buildings allows the program authority to:

- Ramp up capabilities over time;
- Test and gradually improve the implementation process year by year; and
- Adapt procedures, e.g., data quality control or support, in accordance with existing property profiles, e.g., property types, sizes.

To determine which building categories and sizes should be involved in the different phases of the program, building type distribution should be evaluated. This will serve to evaluate which buildings are predominant in the existing building stock and determine which buildings should be compliant with the program at the first and later stages. Other criteria might also be considered to determine which buildings should be selected first, for example, the buildings that may have greater potential for energy efficiency measures, properties that may need less assistance to collect and enter their data in ESPM, or buildings that may be targeted by specific financial programs.

Once building categories and sizes to be included in the program are determined, the different steps and their respective duration will have to be communicated wisely so building owners and managers impacted by the program are made aware that their buildings have to be compliant. They will also need all the information required to proceed.

6.2 Data Collection and Control

6.2.1 Key Objectives

Data collection is central when developing an energy data reporting program. Establishing a good methodology requires a lot of thought. It is the first link in the chain and therefore has a huge impact on everything else. The data collected should enable stakeholders to understand trends in the energy performance of buildings and be able to identify underperforming buildings [44]. Hence, the development of an energy data reporting program should be aimed at standardizing the data to be collected and the reporting metrics to be used.

6.2.2 Key Actions

6.2.2.1 Define Which Data Inputs Are to Be Collected and Which Reporting Metrics Are to Be Disclosed

A large amount of data can be collected and disclosed. However, if not selected cautiously, building owners and managers may not be able to collect all the data required or be willing to do so. Hence, one of the first steps in the standardization process consists of evaluating what data should be collected and clearly specifying to participants which data are mandatory and must be collected, and which data can be collected on a voluntary basis.

Defining the intent of the program helps define which data inputs are required to support energy performance analysis and identify the output metrics needed for energy data reporting. Requirements

specified in energy policies, energy objectives, targets, and action plans should be considered to this end. Using data inputs that help the program authority to further understand commercial building energy use and thus enable improved programs, tools, and processes is also another avenue to consider.

The main challenge associated with selecting the right data to be collected lies in striking a balance between achieving the desired outcomes in the market and the concerns that building owners and managers may have. Therefore, consultations with key stakeholders, such as building owners and managers, utilities, and governments, will be essential to ensure the success of the program.

The amount of data to be collected has to be optimized to balance the quality and comprehensiveness of the data gathered with the acceptance of and participation in the program.

With regard to these recommendations, a preliminary list of mandatory data input requirements, as well as data outputs to be disclosed, are recommended. These are presented in Table 1. It is noted that several optional data have also been included and could be collected on a voluntary basis. They should be further considered depending on the intent of the program to be developed.

6.2.2.2 Select an Adapted Tool for Data Collection and Quality Control

Another important aspect to focus on is the choice of tools for data collection and data quality control. Among the elements described in Section 4, several main findings were identified under this assignment and should be considered while selecting the tool:

- For several data, there is a discrepancy when examining the data units more particularly for building floor area and energy use;
- A large variety of data can be collected, especially due to the multiple property types and fuel sources that can be encountered;
- Energy data collection may require the involvement of several building stakeholders, thus multiplying transcription errors and increasing the time required for data collection; and
- Building owners and managers are not always comfortable with energy data reporting requirements and data collection.

Currently, ESPM is used by all initiatives reviewed under this project. ESPM enables dealing with a large number of metrics, is easy to install, and is free. It also includes specific attributes that can be beneficial for quality control and automatic energy data upload, namely the Data Quality Checker and the web services, respectively. More details regarding ESPM and web services are provided in Appendix A.

Despite its advantages and popularity, ESPM does have certain challenges. For instance, visualizing the energy performance of a building in comparison to its peers cannot be done directly in the tool. Data exportation is required in order to further analyze the data and conduct energy benchmarking.

More generally with respect to the main observations presented above, it is recommended that the tool selected respect the following criteria:

- Be already available on the market without requiring development;
- Be applicable to buildings of different types;
- Be compatible with the tools and practices already in place on the market;
- Enable converting different collected metric systems in a standard form;
- Ensure data reliability and accuracy through:
  - The collection of a limited number of data sets;
  - The promotion of an automated process for data uploading;
  - The elaboration of an internal procedure to validate the data.
- Provide reliable results and indicators easily interpretable by participants;
- Provide assistance to building owners and manager in collecting data;
- Be available in both English and French; and
- Be affordable.

Table 1: Suggested data input requirements and data reporting metrics

Description	Data Inputs	Reporting Metrics
Mandatory		
Property name and address	x	x
Primary property use type	x	x
Year of construction	x	x
Total gross floor area (ft^2 or m^2)	x	x
Energy use by fuel type (kWh, m^3, L, GJ)	x	
Annual weather normalized site EUI (GJ/m^2)		x
Total energy use (GJ)		x
Total GHG emissions (tCO_{2e})		x
ENERGY STAR score (when applicable)		x
Ranking compared to peer buildings		x
Optional		
GHG intensity (tCO_{2e}/m^2)		x
Building certifications achieved (LEED, BOMA BEST®, ENERGY STAR, etc.)	x	
Total water use (m^3)	x	
Water use intensity (m^3/m^2)		x
Total utility costs ($)	x	

6.3 Data Disclosure and Visualization

6.3.1 Key Objective

A clear and appropriate presentation of energy performance to users is essential. Indeed, the results must be both easy to understand to allow energy owners and managers to make informed decisions about the energy efficiency actions to be implemented and sufficiently motivating to encourage them to take actions to improve the energy performance of their buildings.

6.3.2 Key Actions

6.3.2.1 Establish an Adequate Data Access and Privacy Procedure

It is recommended that the program authority develop a robust data-collection and database system and make the data available as widely as possible to both participants as well as researchers, policymakers, and the general public, for example by enabling data to be downloaded and providing online visualization tools. However, data access may raise strong privacy concerns and only allowing data access to officials directly involved and occasionally for research purposes might be optimal. For this reason, energy data disclosed at the building level will have to be favoured rather than at the tenant or meter level. More generally, the modalities associated with data consent will have to be clearly defined by the program, for example, the format used for data consent, the entity responsible for gathering data consent, and the entity responsible for collecting data.

It should be clear that data disclosure differs from data visualization. While the disclosed data provided to the public are relatively consistent across reviewed jurisdictions, the way the data are presented visually varies significantly.

6.3.2.2 Define Suitable Visualization Formats

An adequate presentation of the results is essential to interpret the information, enable efficient data analysis, and ultimately recognize the energy performance of building energy consumption. The data visualization formats should be selected properly based on the aim of the program authority, for example, create emulation among building owners and managers regarding building energy efficiency and display trends, and allow users to explore several aspects of energy use, as well as provide an overview of building energy performance situations and targets.

For example, data analysis platforms have become very popular in the past years. They often offer user-friendly interfaces through interactive maps and dashboards that present the key performance indicators to provide a quick overview on the state of the building stock. Several program authorities of both voluntary and mandatory initiatives have developed interactive maps that allow users to filter results and interact with building energy data. Such a tool can be relevant for the program authority to make sense of large data sets without having to conduct deep manual analyses. Beyond visualization, it is essential that the data be made easily available through downloadable spreadsheets to allow building stakeholders to conduct their own analyses if they are interested in doing so.

More generally, for building energy performance to be correctly interpreted by building owners and managers, it will be necessary to provide them with reading keys to help them judge the performance of their building and the actions to be taken. Studies have demonstrated that norms and social pressure can serve to foster action [42]. Therefore, social comparison is proving to be an effective tool to encourage building owners and managers to reduce the energy consumption of their buildings.

6.4 Stakeholder Engagement

6.4.1 Key Objective

Stakeholder engagement is crucial to maximizing the success of any energy data reporting program. The objective is to design a suitable outreach program while facilitating data collection to achieve a high compliance rate.

6.4.2 Key Actions

6.4.2.1 Promote Early Involvement

Prior to launching an energy benchmarking program, it is essential for program administrators to engage with local stakeholders as a means of gaining the support of key actors and leveraging the expertise and support of potential advocates to help ensure compliance with the program. If a standard is to be developed, it will be necessary to include different actors in the elaboration of the program, such as decision-makers and researchers, but especially building owners and managers and even tenants in order to include different points of view. Several jurisdictions identified this approach as critical to successfully designing an energy data reporting program. In particular, engaging utility service providers early is essential because they play a crucial role in providing consumption data to building owners and managers. Utility support will also be beneficial to understand customer data privacy concerns and examine the possible options for releasing energy usage data, especially if they offer the possibility of automatically uploading the data to their customers' ESPM accounts. This is a good option to consider while developing a standardized approach since it increases compliance rates and data quality.

Stakeholder groups – including, for example, building owners and managers, real estate companies, energy service providers, and organizations that represent a greater part of the buildings that will be covered by the program, – could be created early in the development stage to ensure that concerns and ideas are identified.

Once stakeholders are involved in the early phase of the program design, stakeholder engagement must then continue throughout the entire process, especially with building managers and owners who must be provided with the necessary assistance.

6.4.2.2 Educating About Requirements and Providing Some Guidance

The development of a standardized approach for building energy data reporting also requires wisely developing an outreach program. Several program authorities of existing initiatives developed a variety of education and outreach efforts such as sending

letters to building owners and managers; distributing mass emails to large building associations for dissemination to their members; offering training, online documents and videos; running an advertising campaign that highlights benchmarking requirements; as well as providing a call centre so building owners and managers can receive technical assistance on program requirements. It is important that program authorities communicate widely and wisely on the plan in order to provide a sense of stability and support and thus demonstrate their continued commitment to the program. It is essential that they be involved in many ways to expound and communicate their commitment to energy data reporting and disclosure. This endorsement will confirm the importance of energy data reporting for building owners and managers and help to foster their participation.

Building compliance must be set and encouraged through different means: establish deadlines for data submissions while considering a delay for all data required to be available (especially energy consumption data); as well as allow for flexibility and exemptions. Modifications to compliance obligations may be required, or the program authority may need to adjust its engagement strategy accordingly to improve compliance rates.

With regard to assistance, several requirements must be considered based on identified existing support best practices. First, the use of different support formats must be promoted, such as online documentation and webinars, call centres, and in-person training. The information and channel of communication must be adapted in accordance with identified targets. Also, the number and the types of resources put in place to provide assistance must be carefully evaluated to ensure they answer the building owners' and managers' concerns adequately. A customer relationship management tool can be developed to support building owners and managers track data quality and report inaccurate data.

6.4.2.3 Promote Best Practices and Opportunities for Cost Savings

Several other means can be developed to promote building owners' and managers' compliance and their acceptance of a standardized building energy data reporting program. Providing recognition is one of the solutions that has been developed in several jurisdictions to create emulation and motivate building owners and managers to commit to actions regarding their building energy performance. Awards are given for high-performing buildings, such as those buildings that have the highest ENERGY STAR score and those that have reduced their energy consumption or GHG emissions the most.

Also, to show building owners and managers what the benefits of reporting their building data are, assistance must not be limited to the interpretation of results. Building owners and managers should be provided with some insights on the measures that could be implemented to improve the energy performance of their buildings as well as on the financial programs available to help them implement the measures.

Training should thus not only focus on data collection but also on the importance and benefits of benchmarking programs for owners and managers. They need to know how their buildings perform, how they can improve performance, and what the available tools are. It would therefore be important to establish a plan to recruit qualified personnel to assist participants. It could also be possible to call upon external companies to manage this part of the process.

7 Conclusion

Across Canada, standards for commercial building energy data reporting do not currently exist. Standards may play a critical role in addressing barriers to energy data reporting by setting minimum and unified requirements. The dynamic nature of the Canadian building energy data landscape presents both a unique challenge and an opportunity for future standard development given the variability among existing initiatives, and it underscores the importance of standardization that has the potential to harmonize commercial building energy data reporting across Canada. The goal of this report was to (1) capture the current landscape through existing energy data reporting and disclosure initiatives developed across Canada and the U.S., (2) identify gaps and overlaps, and (3) provide recommendations for future standard development.

Results from the environmental scan provide a current resource of the national, provincial/territorial, and municipal level best practices, guidelines, and regulations that are currently deployed in Canada and in the U.S. regarding commercial building energy data reporting. The key opportunities (the four pillars) identified for future standard development relate to:

- General program design principles
- Data collection and control
- Data disclosure and visualization
- Stakeholder engagement

Given the growing number of individual initiatives found across Canada, detailed analyses of the similarities and differences between the various initiatives should be undertaken if a standard is developed for commercial building energy data reporting. This is particularly important for informing the development of a standard to address current barriers. This will help ensure that the standard meets the needs of all stakeholders involved in commercial building energy data reporting, thus encouraging building owners and managers to participate in energy data reporting programs.

In addition, the development and implementation of energy data reporting standards can further mitigate several issues encountered through the ongoing initiatives.

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Appendix A

ENERGY STAR® Portfolio Manager

ENERGY STAR® Portfolio Manager (ESPM) is a web-based energy management tool that was created by the U.S. Environmental Protection Agency (EPA) in 2000 and introduced in Canada in 2013 [45]. This tool is used to track energy and water consumption for various types of buildings such as commercial buildings, residential buildings, public-sector buildings, and industrial buildings. In recent years, ESPM has been a key tool in promoting energy benchmarking in the building sector. Many cities, provinces, and states in Canada and in the U.S. have adopted it as a data disclosure tool for both mandatory and voluntary initiatives. ESPM also provides users with the opportunity to benchmark their buildings against similar buildings across Canada through the ENERGY STAR rating. A study conducted by the U.S. EPA demonstrated that benchmarked buildings achieve average annual savings of 2.4% [46].

Energy consumption data can be integrated in three ways in ESPM:

- The user enters data manually (creating or updating one meter at a time);
- The user uploads data using an Excel spreadsheet (creating or updating multiple meters at once); and
- The energy service provider uploads energy data directly in ESPM via ENERGY STAR web services.

ENERGY STAR web services is a functionality provided by ESPM to allow utility providers to directly upload their clients' property characteristics and energy or water consumption levels. From the customers' point of view, this provides significant time savings since users do not have to worry about collecting data and inputting them into ESPM. Energy providers also benefit because data sharing is bidirectional. Utilities or energy service companies can automatically upload energy consumption data directly to their customers' ESPM accounts. They can obtain key energy performance data from ESPM, and they can then integrate these into their energy information software and services [47].

This option also increases the quality of the data since the automatic integration of the data through web services has the advantage of reducing manual data entry errors, especially for large property owners with several buildings in their portfolio.

NRCan and the Environmental Protection Agency (EPA) have developed a free application programming interface for utilities and service providers to build their own custom web services. Currently, four utility service providers offer web services to exchange data with ESPM:

- BC Hydro
- Manitoba Hydro
- FortisBC
- NB Power

As for the U.S., more and more utilities are stepping up to have their data sent automatically in ESPM for their customers via web services. A complete list of utilities that provide energy data access solutions as well as interactive maps are available on the ENERGY STAR website [48].

This tool has been successful for several reasons. The interface is user-friendly, and several tutorials and guidelines are available for users on the ENERGY STAR website. For data collection, ESPM enables automatically uploading energy data directly from the utility providers. The web-based tool also allows users to track their energy consumption for specific years. Moreover, ESPM is free.

In addition to these advantages, ESPM also provides users with the ability to address several challenges with the geographic diversity of registered buildings. First, considering the bilingual context of Canada, this tool is available in both French and English and both measurement systems, imperial and metric, can be used. Several improvements are also ongoing, such as the introduction of new regional indicators for GHG emissions.

Appendix B

Energy Data Reporting Key Steps and Attributes

Table 2: Summary of existing initiatives – voluntary programs[3]

Name of the Initiative	Province/ Municipality/ State	Program Authority	Target	Commercial Buildings Floor Area Threshold	Duration
Building Energy Benchmarking Program	Alberta	City of Edmonton	No specific target	Greater than 20,000 sq ft	3 years (2017–2019), extended for 2 years
Race to Reduce	Manitoba	Manitoba Hydro	Reduce participants' energy consumption by 10% over 4 years	Greater than 20,000 sq ft, 75% occupied, 80% office space	4 years (2017–2020)
Building Energy Disclosure Project	Manitoba	City of Winnipeg	No specific target	Greater than 20,000 sq ft	1 year (2020), extended for at least 1 year
Energy Transition Master Plan	Quebec	Ministry of Energy and Natural Resources of Quebec (MERN)	Reduce global energy consumption by 1.2% per year (2018 to 2023)	N/A	5 years (2018–2023)
Building Energy Challenge	Quebec	Building Owners and Managers Association (BOMA)	Reduce GHG emissions by 10% or more since enrollment in the program	N/A	4 years (2018–2021)
Building Benchmark BC	British Columbia	OPEN Green Building Society	No specific target	Greater than 50,000 sq ft	2 years
Disclosure Challenge	Canada	Canada Green Building Council (CaGBC)	No specific target	N/A	1 year (2019)
Energy Benchmarking Pilot	Nova Scotia	Efficiency Nova Scotia	No specific target	N/A	3 years (2020–2022)
Good Energy Program[4]	Yukon	Government of Yukon	No specific target	All participants to the Good Energy Program	2 years (2019–2020), extended for at least 1 year

3 This list was populated based on the information available at the time this report was prepared.

4 The benchmarking initiative has been included in an existing energy rebate program, known as the Good Energy Program.

Table 3: Summary of existing initiatives – mandatory programs

Name of the Initiative	Province/ Municipality/ State	Program Authority	Target	Commercial Buildings Floor Area Threshold
Ontario's EWRB	Ontario	Ministry of Energy	Achieve Toronto's greenhouse gas emission target of zero emissions by 2050	Greater than 50,000 sq ft since 2020 (greater than 100,000 sq ft before then)
New York City – Local Law 133 (2016)	New York	City of New York	No specific target	Greater than 50,000 sq ft
Chicago – Energy Use Benchmarking	Chicago	City of Chicago Department of Business Affairs and Consumer Protection	No specific target	Greater than 50,000 sq ft
Boston – Building Energy Reporting and Disclosure Ordinance (2013)	Boston	City of Boston	Reduce building's energy consumption or GHG emissions by 15% in a 5-year term	Greater than 35,000 sq ft
Philadelphia – Building Energy Benchmarking Ordinance (2012)	Philadelphia	City of Philadelphia	Achieve Philadelphia's Climate Goal: cut carbon footprint from government buildings and streetlights by 50%	Greater than 50,000 sq ft
California – Assembly Bill 802 (2015)	San Francisco	City of San Francisco	Buildings must reduce energy use by 20% by 2030	Greater than 50,000 sq ft

Table 4: Data collected

Data Collected	Building Energy Benchmarking Program – Edmonton	Race to Reduce – Manitoba	Building Energy Challenge – Quebec	Building Benchmark BC	Disclosure Challenge	Ontario's EWRB	New York City – Local Law 133	Chicago – Energy Use Benchmarking	Boston – Building Energy Reporting and Disclosure Ordinance	Philadelphia – Building Energy Benchmarking Ordinance	California – Assembly Bill 802
Building Characteristics											
Building Name	x			x	x	x	x	x	x	x	x
Primary Property Use Type	x	x	x	x	x	x	x	x	x	x	x
Address	x	x	x	x	x	x	x	x	x	x	x
Year of Construction	x	x	x	x	x	x	x	x	x	x	x
Total Gross Floor Area	x	x	x	x	x	x	x	x	x	x	x
Occupancy Rate			x				x	x			x
Weekly Operating Hours			x					x		x	
Number of Computers								x		x	
Number of Workers on Main Shift			x					x		x	
Proportion of the Building Heated			x					x		x	
Proportion of the Building Cooled			x					x		x	
Specific Identification Number Used Under the Program							x				x
Parcel Number/Specific ID						x			x		x
Third-Party Certifications						x					
Energy Consumption Data											
Energy Use Data for all Energy Sources	x	x*	x	x*	x*	x	x*	x*	x	x*	x*
Water Use						x	x		x		
Utility Costs			x								x

x* Those initiatives use the web services of ESPM. The utility provider can directly upload their clients' data into their ESPM account.

Table 5: Disclosure format used by existing initiatives

Initiative	Type of Control
Building Energy Benchmarking Program – Edmonton	▪ ESPM Data Quality Checker ▪ In-depth spot checks, participants with missing or incorrect data are contacted
Race to Reduce – Manitoba	▪ ESPM Data Quality Checker
Building Energy Challenge – Quebec	▪ ESPM Data Quality Checker
Building Benchmark BC	▪ ESPM Data Quality Checker
Disclosure Challenge	▪ ESPM Data Quality Checker
Ontario's EWRB	▪ ESPM Data Quality Checker Verification of data submitted by certified professionals for buildings larger than 100,000 sq ft
New York City – Local Law 133	▪ ESPM Data Quality Checker ▪ LL84 Seven-point Review System: Department of Buildings notifies owners of any deficiencies in their data
Chicago – Energy Use Benchmarking	▪ ESPM Data Quality Checker ▪ Data verification the first year and every three years by an in-house or third-party professional (engineer, architect, trained individuals) ▪ Pro-bono verification services for owners with limited financial resources
Boston – Building Energy Reporting and Disclosure Ordinance	▪ ESPM Data Quality Checker
Philadelphia – Building Energy Benchmarking Ordinance	▪ ESPM Data Quality Checker
California – Assembly Bill 802	▪ ESPM Data Quality Checker

Table 6: Support practices

Initiative	Type of Control	Involved Resources	Related Program or Incentives
Building Energy Benchmarking Program – Edmonton	▪ Online documents (technical toolkit) ▪ Newsletters ▪ Information sessions ▪ Workshops ▪ Support services help desk for one-on-one support	Information not available	▪ Edmonton's Commercial Energy Audit Rebate program, completed by a qualified professional ▪ Building Energy Retrofit Accelerator ▪ Recreation Energy Conservation program ▪ Solar for Schools program ▪ Alberta Municipal Solar program
Race to Reduce – Manitoba Hydro	▪ Online participant guide ▪ Library of case studies	Information not available	▪ Manitoba Hydro incentives ▪ LEED certification for Existing Buildings: Operation and Maintenance ▪ Government of Manitoba incentives
Ontario's EWRB – Ministry of Energy of Ontario	▪ Online guidelines ▪ Link to ESPM webinars ▪ Support help desk	Information not available	None specifically identified
Building Energy Challenge – BOMA Quebec	▪ Participant guide ▪ FAQ page ▪ Training ▪ Links to ESPM training	Partnership with NRCan	▪ Transition énergétique Québec (TÉQ): EcoPerformance Program ▪ Énergir: Feasibility studies ▪ Hydro-Québec: Efficient Solutions Program
Building Benchmark BC – City of Vancouver	▪ Information not available	Information not available	None specifically identified
Disclosure Challenge – CaGBC	▪ Case studies ▪ Workshops ▪ Conferences, webinars	Information not available	None specifically identified
New York City – Local Law 133	▪ Benchmarking starter kit ▪ Training ▪ Help centre	▪ In-house staff ▪ Partnership with the Mayor's Sustainability Office, the U.S. Green Building Council and the Association of Energy Engineers for training	▪ LL87: Energy Audits and Retro-commissioning ▪ LL88: Lighting Upgrades and Submetering
Chicago – Energy Use Benchmarking	▪ Benchmarking guide ▪ Available link to ENERGY STAR training website ▪ Compliance checklist ▪ FAQ ▪ Help centre ▪ In-person training	▪ US EPA's ENERGY STAR webinar ▪ Online videos for training ▪ Non-profit partner for call centre: Elevate Energy	Chicago PACE (Property Assessed Clean Energy): low-cost, long-term financing for energy efficiency
Boston – Building Energy Reporting and Disclosure Ordinance	▪ Step-by-step guide ▪ Available link to ENERGY STAR training website ▪ Online documents ▪ Tutorial videos ▪ Training ▪ Call centre	▪ In-house staff ▪ ESPM training videos	Building Energy Retrofit Resource Hub
Philadelphia – Building Energy Benchmarking Ordinance	▪ Online guides ▪ FAQ page ▪ Call centre	▪ In-house staff ▪ Partnership Green Building United for training	▪ PECO Smart Ideas ▪ PGW EnergySense ▪ Green Building United
California – Assembly Bill 802	▪ Online guides ▪ FAQ page ▪ Call centre ▪ Courses ▪ In-person workshops ▪ Training and technical assistance	▪ In-house staff ▪ Partnership with Pacific Gas and Electric Company (PG&E) for training	Energy efficiency audit requested for buildings larger than 10,000 sq ft, conducted by a qualified energy auditor at least once every 5 years

Table 7: Disclosure format used by existing initiatives

Initiative	Disclosure Format	Disclosure Level
Building Energy Benchmarking Program – Edmonton	▪ Annual Report (public) ▪ Individual participant reports (participants only)	▪ Aggregated and anonymized data for public disclosure ▪ Building level disclosure is possible but voluntary (with consent)
Race to Reduce – Manitoba	▪ Online report (public) ▪ List of top 5 leaderboard (public)	▪ Not aggregated data, with consent
Building Energy Challenge – Quebec	▪ Annual Report (public) ▪ Individual participant reports (participants only) ▪ Individual participant scorecard (participants only)	▪ Aggregated and anonymized data for public disclosure ▪ Not aggregated data, with consent for individual results
Building Benchmark BC	▪ Disclosure Dashboard/Interactive Map (public) ▪ Annual Report (public)	▪ Not aggregated data, with consent
Disclosure Challenge	▪ Disclosure Dashboard/Interactive Map (public) ▪ Annual Report (public) ▪ Individual building results (participants only)	▪ Not aggregated data, with consent
Ontario's EWRB	▪ Online information available on Ontario's Open Data Catalog	▪ Not aggregated data with consent for individual results
New York City – Local Law 133	▪ Excel worksheet (public) ▪ Annual or Biannual Report (public) ▪ Disclosure Dashboard/Interactive Map (public) ▪ Metered New York website	▪ Not aggregated data, full disclosure
Chicago – Energy Use Benchmarking	▪ Annual Report (public) ▪ One summary page with graphs (public) ▪ Disclosure Dashboard/Interactive Map (public) ▪ Individual data report (participants only)	▪ Aggregated data (public) ▪ Not aggregated data for individual results
Boston – Building Energy Reporting and Disclosure Ordinance	▪ Disclosure Dashboard/Interactive Map (public) ▪ Excel Worksheet data (public)	▪ Not aggregated data, public disclosure
Philadelphia – Building Energy Benchmarking Ordinance	▪ Disclosure Dashboard/Interactive Map (public) ▪ Annual Report (public)	▪ Not aggregated data, public disclosure
California – Assembly Bill 802	▪ Disclosure Dashboard/Interactive Map (public) ▪ Annual Report (public)	▪ Not aggregated data, public disclosure

Table 8: Disclosed information by existing initiatives

Disclosed Data	Building Energy Benchmarking Program – Edmonton	Race to Reduce – Manitoba	Building Energy Challenge Quebec	Building Benchmark BC	Disclosure Challenge	New York City – Local Law 133	Chicago – Energy Use Benchmarking	Boston – Building Energy Reporting and Disclosure Ordinance	Philadelphia – Building Energy Benchmarking Ordinance	California – Assembly Bill 802 (2015)
Building Name	x	x				x	x	x	x	x
Building Location		x		x	x	x	x	x	x	x
Property Type	x		x	x	x	x	x	x	x	x
Gross Floor Area	x		x	x	x	x	x	x	x	x
Year of Construction	x		x	x	x	x	x	x	x	x
Energy Star Score	x			x	x	x	x	x	x	x
Source EUI	x	x		x	x	x				
Site EUI	x		x	x	x		x	x	x	
Weather Normalized Source EUI						x				
Weather Normalized Site EUI										x
Total Energy Use							x		x	
% of Energy from Each Energy Source	x		x			x				
Energy Savings		x								
% of Energy Use Change Compared to the Previous Year			x							x
Total GHG Emissions	x		x	x	x	x	x	x	x	x
GHG Intensity	x		x	x	x			x		
GHG Emissions Reduction		x	x							
Ranking Compared to Peer Buildings			x	x	x	x				
Water Use									x	
Water Use Intensity				x	x	x		x		
Utility Costs			x							x

Table 9: Compliance procedures

Initiative	Compliance Definition	Exemption Criteria	Penalties
Ontario's EWRB	▪ Report all required data in ESPM and run ESPM Data Quality Checker. ▪ Further verification for buildings 100,000 sq ft or larger, verification is conducted by a certified professional before submitting the data.	**Ongoing exemption:** ▪ At least 50% of the gross floor area of the building is occupied by a public agency. ▪ At least 10% of the gross floor area is occupied by a data centre, television studio, or trading floor. ▪ The building is owned by a corporation listed in the regulation. **One-year exemption:** ▪ The building is a new construction and the building's certificate of occupancy was issued during the calendar year for which reporting was required. ▪ The building owner is experiencing financial hardship. ▪ Any owner of the property is an insolvent person.	No penalties.
New York City – Local Law 133 (2016)	Report all required data in ESPM and run ESPM Data Quality Checker.	Information not available.	Building owners or managers that miss the May 1 benchmarking deadline may be fined $500. They may be fined an additional $500 for failing to benchmark for each subsequent quarter (maximum of $2,000).
Chicago – Energy Use Bench-marking	▪ Prior to the first benchmarking deadline and prior to each third benchmarking deadline thereafter, the owner of a covered building shall ensure that reported benchmarking information for that year is verified by a professional engineer, architect, or holder of a city-recognized training credential. ▪ Applicable buildings must disclose their 1-100 ENERGY STAR score, EUI, and GHG emissions.	▪ A list of buildings required to comply with the ordinance is available. ▪ Requirements do not apply to any building with more than 10% occupancy use classified as class D open-air assembly units, class G industrial units, class H storage units, class I hazardous use units, or class J miscellaneous buildings and structures. ▪ The building is experiencing financial distress. ▪ The building or areas of the building subject to the requirements have been less than 50% occupied during the calendar year for which benchmarking is required. ▪ New construction when the certificate of occupancy was issued less than two years prior to the applicable benchmarking deadline. ▪ The city will not publicly share data for buildings that contain a data center, television studio, or trading floor that together exceed 10% of gross area.	Building owners are subject to a fine of up to $100 for the first violation and additional fines of up to $25 per day.
Boston – Building Energy Reporting and Disclosure Ordinance (2013)	Register data in ESPM.	▪ A list of buildings that are required to comply with the ordinance is available. ▪ Performance exemption: ENERGY STAR rating of 75 or above, LEED certification, patterns of significant improvement, inclusion in a comprehensive energy management plan.	Building owners are subject to a fine of $75 to $200 per day. The maximum annual fine is $3,000. Non-residential tenants may be fined up to $35 per day for failing to supply building owners with energy data. Residential tenants are not subject to fines.
Philadelphia – Building Energy Bench-marking Ordinance (2012)	▪ Register data in ESPM. ▪ The seller or lessor of an eligible building must, upon request, provide prospective purchasers or lessees with a copy of the building's most recent Statement of Energy Performance.	▪ Buildings where, in any calendar year, more than 50% of the indoor floor space is unoccupied for more than 180 days in total. ▪ Buildings where benchmarking or transparency would cause exceptional hardship or would not be in the public interest. ▪ Buildings used primarily for manufacturing or other industrial purposes for which benchmarking results would not meaningfully reflect building energy use characteristics due to the intensive use of process energy. Process energy refers to energy used in the current manufacturing, production, or processing of a good, commodity, or other material.	The city may issue a $300 fine for failure to comply within 30 days of the compliance date, plus $100 for every day thereafter.

Table 10: Data access and privacy good practices

Good Practices	Description
Whole-building aggregation	▪ Utility aggregates meter-level energy usage information for all accounts associated with a property and provides the monthly aggregated total energy consumption for all accounts in a building to the property owner. ▪ No authorization is required from individually metered customers to release energy data if the minimum threshold is met. ▪ If a building has fewer than the minimum threshold, the building owner must get permission from all of the building's tenants. ▪ This process requires: (1) defining a minimum threshold of individual utility accounts that must be inventoried to allow for aggregate data collection, generally between two and five utility accounts; and (2) considering a cap on the percentage of total energy used by a single account. Based on this percentage, utilities would require authorization from the tenant.
Authorization via leasing documents	▪ This procedure allows tenants to authorize the release of energy data through their leasing contract documents to avoid requiring additional authorization for future benchmarking purposes. ▪ The utility recognizes the lease agreements and does not require further authorization.
Opting out	▪ This procedure allows tenants and owners to opt out of publicly releasing data if publishing the data would reveal trade secrets or create security risks. ▪ A process will have to be established in parallel to enable tenants to show that the concerns are warranted.
Missing data	▪ Establish a methodology for filling in data from missing results. ▪ ESPM default values are used by some program authorities, i.e., Chicago.
Delivered fuels	▪ Coordinate with local delivered-fuel trade associations to establish workable data access provisions for delivered fuels with unregulated fuel providers.
Limiting data usage	▪ Restrict redissemination of aggregated data by building owners for uses other than benchmarking and facilitate participation in energy efficiency programs to further protect tenant privacy.

Appendix C

Summary Table of Existing Best Practices

Table 11: Summary of best practices

Energy Data Reporting Step/ Attribute	Item	Description
Specify Data	**Specify Data**	Clearly specify to participants which data are mandatory and must be collected.
	Landlord and Tenant Relationship	Provide assistance to building owners in collecting data from their tenants. This could be accomplished, for example, by providing access to already prepared consent forms that explain the importance of providing the data.
	Choice of Tool	Promote a data-collection tool that is easy to set up and use with a user-friendly interface, is affordable, can be used in English and French, and allows changing the metrics. It has to be noted that ESPM is used by most jurisdictions. It is free, online, and provides a consistent approach that reduces development costs and time spent on data entry.
	Automatic Upload	Enable providers to upload utility data directly.
Quality Control	**Data Quality Checker**	Use built-in programs already provided in several applications, i.e., ESPM, to set alerts for incorrect or missing data.
	Third-Party Checking	Involve a certified professional for the first data verification and then at spaced intervals.
	CRM Tool	Use a customer relationship management (CRM) tool to define standards to validate data and send automatic messages to participants who have submitted erroneous data.
	In-Depth Spot Checks	Conduct in-depth analysis of results using sampling methods and graph plotting.
	On-Site Audits	Organize on-site audits to verify and complete the data collected in the data-collection tool. This is also an opportunity to discuss with building owners and managers, and present energy-efficiency opportunities.
Support	**Format**	Promote the use of different support formats and adapt the information and channel of communication depending on the target.
	Training, Workshops	Analyze the most recurrent topics for which building owners and managers need assistance so improvements can be eventually made to the program and more specific guides or training sessions can be developed to address them.
	CRM Tool	Have a CRM tool to communicate with building owners and managers for data quality/missing data/inaccurate data.
	Resources	Carefully estimate the number of resources to be engaged for support and ensure they have the necessary skills to answer building owners' and managers' concerns adequately.
Disclosure And Visualization	**Consent**	Building owners' and managers' consent is essential to enable data disclosure. Modalities associated with data consent should be further investigated, i.e., format used for data consent, the entity responsible for gathering data consent, the entity responsible for data, etc.
	Format	The data visualization format should be properly selected based on the aim of the program authority, i.e., create emulation among building owners and managers regarding building energy efficiency, provide an overview of building energy performance situations, targets, etc.
	Individual Report	Combine synthetic public reports with a detailed scorecard per building addressed to each participant for their own buildings.
	Economic Related	Results such as unemployment and economic growth associated with energy efficiency in buildings can also be presented to include economic and social benefits from energy data reporting and disclosure processes.
	Periodic Disclosure	Promote annual restitution of results to enable comparisons from one year to another and have enough time for data collection, quality control, and benchmarking.

Energy Data Reporting Step/ Attribute	Item	Description
Compliance Requirements	**Definition**	Provide a clear definition for compliance by defining how to be compliant, i.e., only provide data, also validate data checks, etc.
	Barriers	Collect data barriers to compliance and remedy them for the ensuing year with an adapted strategy to address them.
	Exemptions	Define precisely which buildings are excluded at the first stage. Establish a process for exemptions to ensure that each case is reviewed correctly. Finally, analyze the criteria for why certain types of buildings were first excluded and their characteristics and evaluate if relevant to still exempt them in the long term.
	Criteria	Analyze the criteria for why these buildings were first excluded and their characteristics and evaluate if relevant to still exempt them in the long term.
	Assistance	Encourage building owner and manager assistance and clarify energy data requirements rather than issuing penalties for non-compliance; experience of existing initiatives demonstrates that providing support in multiple formats and step-by-step guidance to meet requirements can improve data compliance.
Data Access and Privacy	**Whole Building Aggregation**	Establish aggregation thresholds. However, if a building has fewer meters than the minimum number of tenants, the building owner must get permission from all of the building's tenants for the meter of their unit.
	Authorization via Leasing Documents	Through leasing documents, encourage authorization from the building owners for the release of energy usage data.
	Opting Out	Allow tenants and owners to opt out of public data releases if publishing the data would reveal trade secrets or create security risks.
	Missing Data	Establish a methodology for filling in data gaps due to missing data.
	Transparency	Be transparent about the shared data; explain the process and do not disclose confidential data.
	Limiting Data Usage	Establish limitations on data usage.

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