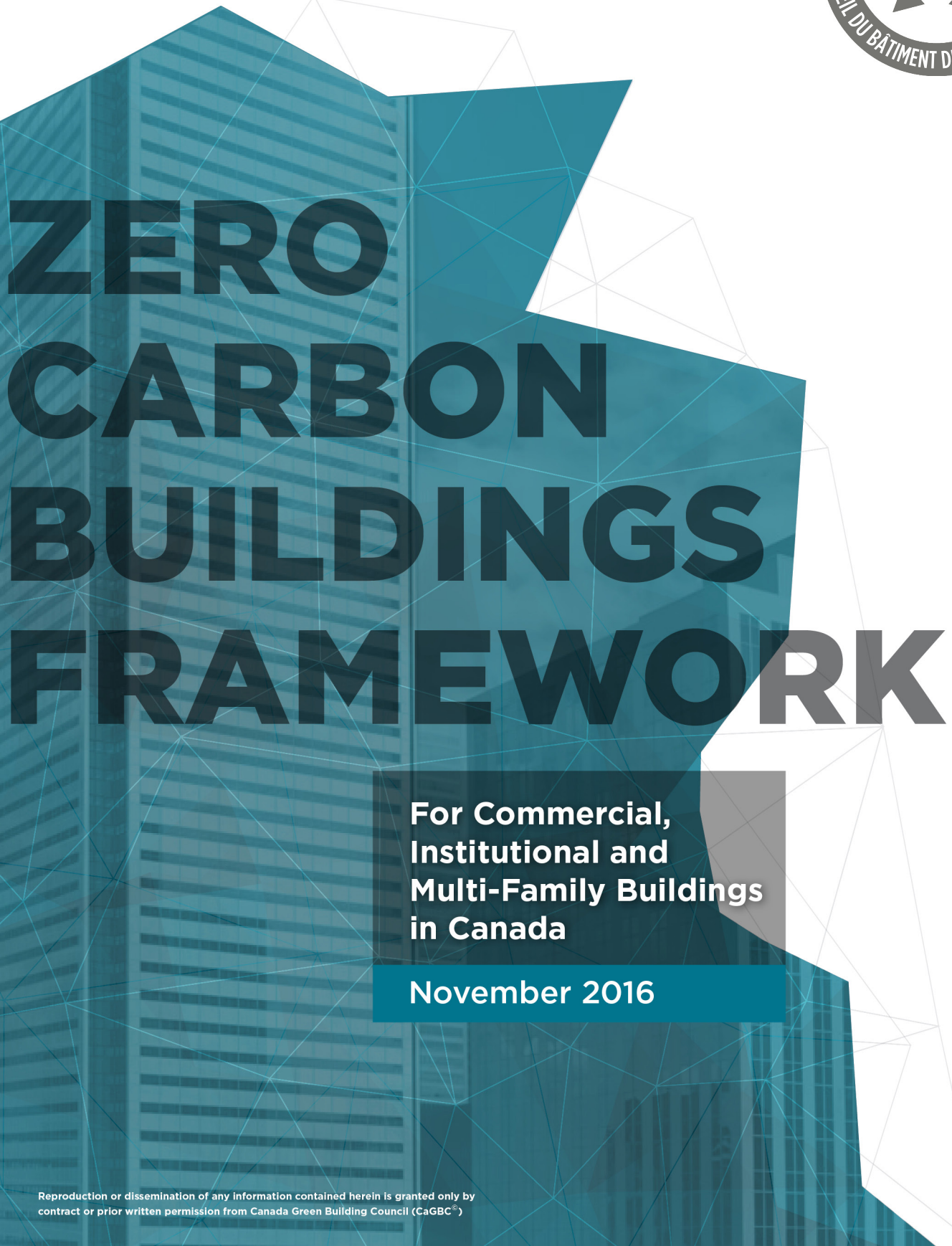

ZERO CARBON BUILDINGS FRAMEWORK

For Commercial, Institutional and Multi-Family Buildings in Canada

November 2016

The CaGBC (www.cagbc.org) is the leading national organization dedicated to advancing green building and sustainable community development practices. As the voice of green building in Canada, we work closely with our national and chapter members in an effort to make every building greener. The CaGBC reduces environmental impacts from the built environment through project certification, advocacy and research, and has helped meet the demand for skilled workers by providing green building education to over 20,000 professionals across the country since 2002. CaGBC is the license holder of the LEED green building rating system in Canada, supports the WELL Building Standard and GRESB in Canada, and oversees the Canada Coalition for Green Schools. We are also a member of the World Green Building Council supporting international efforts to reduce environmental impacts from the built environment.

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About the Researchers

Integral Group is a global network of Engineering, Architecture and Planning professionals, all collaborating under the single umbrella of deep green engineering and professional services practice that aspires to the be the best in the world. We are a mission-driven corporation that seeks out clients interested in pushing the boundaries of resilience, regenerative design, and deep carbon emissions reductions. Integral Group's Research and Planning Team specializes in the development of strategic plans and polices for cities, districts, neighbourhoods, and campuses to achieve net zero emissions and other energy and environmental goals. Through this work, we have acquired experience in all aspects of city-scale energy planning, from the development of high performance building codes and distributed energy systems, to existing building retrofit roadmaps, to building energy disclosure policies and green building standards. With a staff of over 330 located in 15 offices across the United States, Canada, and the UK, Integral Group is widely regarded as a pioneer in building design, sustainability and energy system transformation.

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EXECUTIVE SUMMARY

At the first ever "Buildings Day" hosted at the COP21 event in Paris, the Canada Green Building Council (CaGBC) committed to developing a net zero verification program, and offered its support to the World Green Building Council's goals that all new buildings are constructed to be "net zero" by 2030, and that all buildings achieve net zero by 2050. This report presents the results of the first phase of the development of a verification program for commercial, institutional and high-rise residential buildings as part of a broader Zero Carbon Buildings initiative.

A zero carbon approach to new construction can play an important role in meeting Canada's GHG reduction target of 30% below 2005 levels by 2030, as established in 2016 through the Vancouver Declaration on Clean Growth and Climate Change. Indeed, if all new buildings in Canada over 25,000 square feet were built to achieve a net zero carbon level of performance between now and 2030, GHG emissions for this sector would be reduced to 17% lower than 2005 levels, saving 7.5 megatonnes of GHG emissions annually by 2030.[1]

In recent years, increased industry efforts to understand zero energy or zero emissions buildings has resulted in the emergence of various approaches that diverge in the definition and measurement of "net zero". In the spring of 2016, CaGBC embarked on a process to improve the understanding, clarity and consistency around the meaning of "net zero" across the Canadian building and construction industries, through the creation of a zero carbon buildings (ZCB) framework for Canada.

[1] CaGBC, 2016. Building Solutions to Climate Change: How Green Buildings Can Help Meet Canada's 2030 Emissions Targets.

A set of broad principles were established to guide the development of the framework, including 1) efficacy in driving lower carbon design and construction; 2) flexibility to ensure broad applicability; 3) adaptability to provide longevity in the face of changing conditions and policies; and 4) transparency to ensure clear and effective communication of performance.

A Working Group composed of government bodies, industry members, and academia was created to inform the identification of needs and challenges associated with the development of a zero carbon buildings framework in Canada. To ensure the inclusion of additional sources of expertise and guidance, a series of workshops with the CaGBC's Energy and Engineering Technical Advisory Group and the LEED Canada Steering Committee were held between June and August, supplemented by additional interviews with industry representatives. This consultation process included approximately 50 individuals representing 40 organizations in the building sector. Research, facilitation and reporting were all provided by Integral Group.

This report presents the findings of this process, including a review of the key components of established "net zero" frameworks (e.g. the metrics used to calculate the energy-carbon balance; the factors used to determine primary energy and associated carbon; and acceptable forms of renewable energy procurement), as well as a review and assessment of nine prominent frameworks for net zero buildings.

The outcomes of this process of research and consultation with Canadian industry representatives were used by the CaGBC to formulate a Zero Carbon Buildings framework for Canada. The framework sets forth a definition and establishes five key components for evaluating the extent to which a building's design meets the objective of reducing the carbon footprint of buildings, as detailed below.

Zero Carbon Buildings Framework

Definition of a Zero Carbon Building:

A highly energy efficient building that produces on-site, or procures, carbon-free renewable energy in an amount sufficient to offset the annual carbon emissions associated with building operations

Key Components

1. A greenhouse gas intensity metric for assessing a building's emissions, calculated using regional emissions factors

   Rationale: To meet the primary goal of reducing building emissions, a greenhouse gas intensity (GHGI) metric should be used to calculate the zero emissions balance in order to effectively incentivize a shift toward low-carbon buildings. Although there is a strong case for the adoption of a national emissions factor, a regional emissions factor more accurately reflects actual building emissions, drives innovative and adaptive design decisions, and more readily integrates into provincial regulatory frameworks.

2. Energy intensity metrics to incentivize the design of highly efficient, reliable and resilient buildings

   Rationale: To incentivize good building design as well as reduce GHG emissions, the GHGI metric should be accompanied by additional measures to encourage high building performance. This will include both a total energy use intensity (TEUI) metric to obtain a measure of a building's total energy performance, as well as a thermal energy demand intensity (TEDI) metric to encourage the use of passive design strategies better able to ensure reliability and resilience.

3. A peak energy demand metric to encourage the use of "peak shaving" measures

   Rationale: While it is not commonly used in existing frameworks, the inclusion of a measure of peak energy demand can encourage the use of building systems that respond to grid supply and demand fluctuations, improving grid integration and alleviating stress on the grid during times of high demand. A peak energy demand metric will initially be used to track building energy performance.

4. An embodied carbon metric

   Rationale: While this work focuses on the GHG emissions associated with building operations, as these emissions decrease, a greater focus will be placed on carbon emissions associated with the materials used in building construction. As such, it is recommended that building designers should begin to track the carbon emissions embodied in the building structure and envelope to help foster the industry's ability to consistently and accurately measure embodied carbon.

5. A requirement that renewable energy included in the zero emissions calculation be either generated on-site or procured directly from a renewable energy generator

   Rationale: For a zero carbon buildings framework to drive down the GHG emissions of the local energy system, it is important to ensure that it actually incentivizes the added generation of carbon-free renewable energy connected to the local grid. As such, the energy-carbon balance should be calculated by considering only renewable energy that has been generated on-site or procured through a direct contractual arrangement from a renewable energy supplier.

The focus on carbon emissions (as opposed to energy) in this framework flows from the increasing urgency of addressing climate change by reducing GHG emissions from buildings. Although energy remains an important component, this work has prioritized the exploration of a suitable framework capable of influencing the building industry toward low- and no-carbon building designs.

While these five components represent the result of careful research and consultation, they are only a first step towards a program to support the adoption and verification of Zero Carbon Buildings in Canada. Next steps will include an investigation into:

- Setting targets;
- Pathways to Zero Carbon Buildings;
- Verification requirements and processes;
- Methods of recognition and disclosure; and
- Broadening the applicability of the framework

The CaGBC expects to launch a Zero Carbon Buildings verification program by the end of the second quarter of 2017. The need for support tools, education, outreach and advocacy will be evaluated, and the CaGBC will seek input from stakeholders throughout.

Finally, though this framework has been developed with a focus on new construction, an important area for later expansion is the assessment of ongoing building performance, which is critical to optimizing and maintaining performance over time. Similarly, the framework will require refinement and adaptation in order to ensure its applicability at the campus, neighbourhood or community levels.

Five Key Components of

Zero Carbon Buildings

Renewable Energy Generation

A requirement that renewable energy be generated on-site or procured directly in order to ensure the addition of clean power generation.

Energy Intensity Metrics

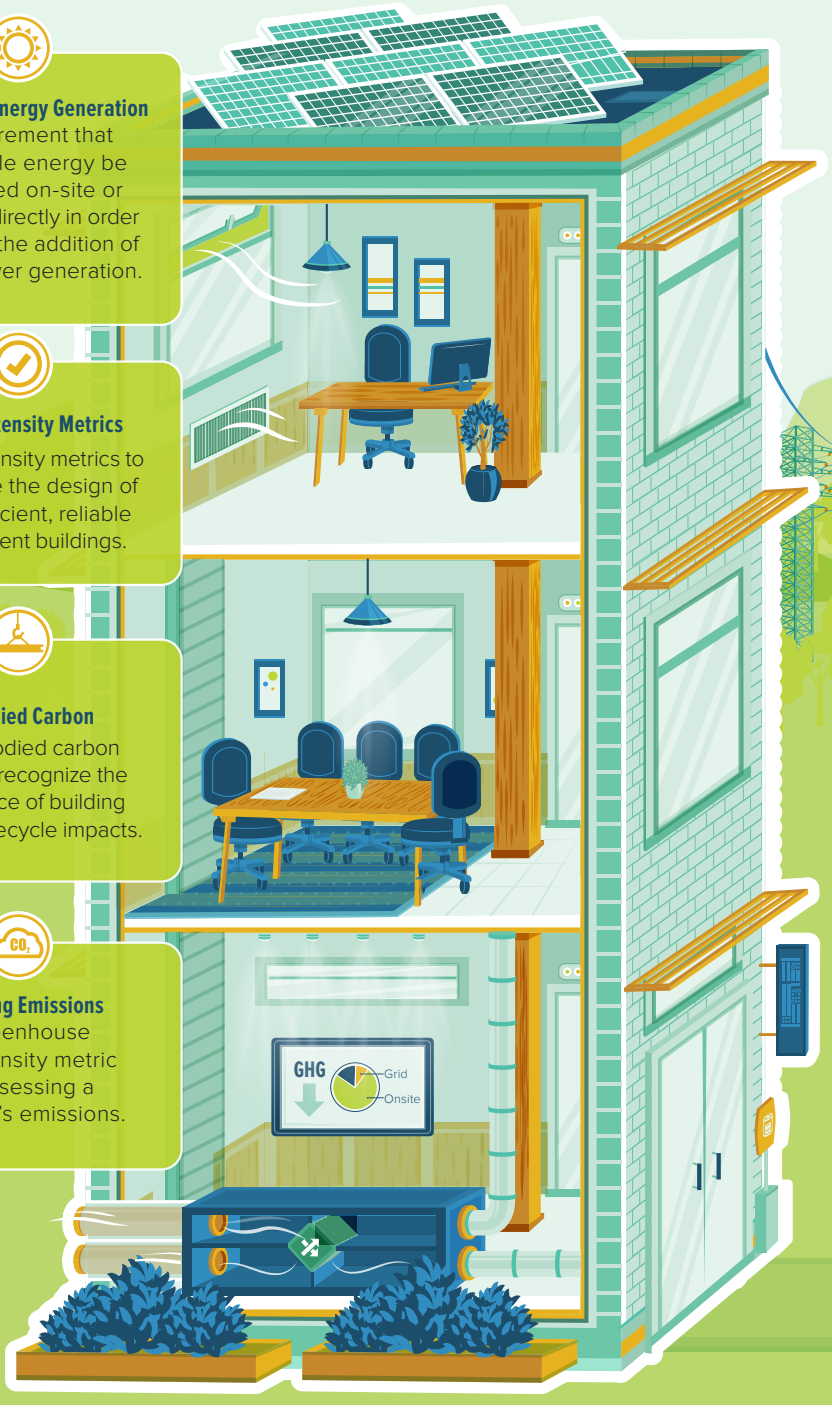
Energy intensity metrics to incentivize the design of highly efficient, reliable and resilient buildings.

Embodied Carbon

An embodied carbon metric to recognize the importance of building material lifecycle impacts.

Lowering Emissions

A greenhouse gas intensity metric for assessing a building's emissions.



A Zero Carbon Building is...

A highly energy efficient building that produces on-site, or procures, carbon-free renewable energy in an amount sufficient to offset the annual carbon emissions associated with building operations.

Reducing Peak Energy Demand

A peak energy demand metric to encourage the use of "peak shaving" measures.