

# 01 INTRODUCTION

To avoid the worst impacts of climate change, all nations must focus their efforts on carbon reduction.

In Canada, building construction and operations must effectively eliminate greenhouse gas (GHG) emissions to meet the national target of carbon neutrality by 2050. To achieve this goal, each new building design must target zero carbon emissions to avoid costly retrofits down the line. There is no time to wait.

The Intergovernmental Panel on Climate Change (IPCC) has fixed the world's remaining carbon budget – the maximum amount of carbon dioxide (CO<sub>2</sub>) that can be released into the atmosphere – at 500 gigatonnes (Gt) of CO<sub>2</sub>.<sup>1</sup> This budget has been set to keep global warming to 1.5 C with a 50 percent likelihood. However, based on data from 2019 emissions, at the world's rate of 40 Gt of total GHG emissions per year, our remaining carbon budget will be depleted in less than eight years, risking a global temperature increase that will significantly alter our climate.

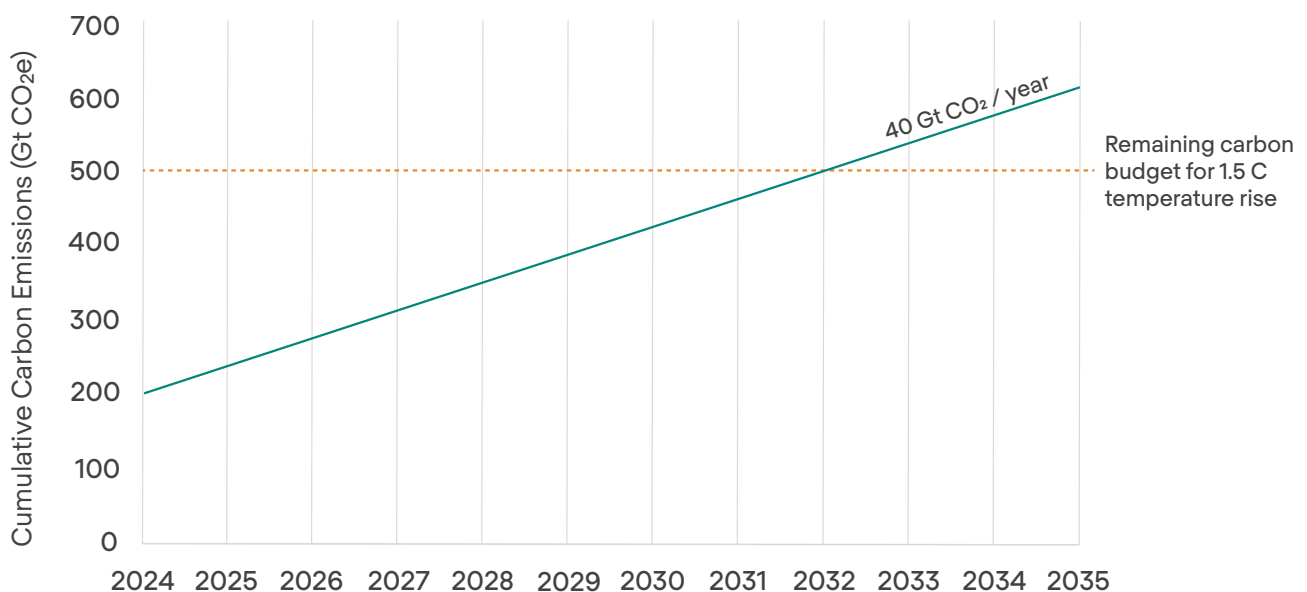


Figure 1 – Estimated cumulative net global anthropogenic CO<sub>2</sub> emissions to limit global warming to 1.5 C.

<sup>1</sup> IPCC. (2021). *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.*

Staying within the remaining carbon budget and mitigating the effects of climate change requires collective action from across the building sector. Every year that passes without significantly reducing GHG emissions erodes the global carbon budget, shortening what little time we have left to reach zero carbon and remain within our planetary boundaries.<sup>2</sup>

Fortunately, the building sector is well-positioned to support Canada's decarbonization efforts. Building operations are responsible for 17 percent of Canada's carbon emissions,<sup>3</sup> with construction and materials representing an estimated 10 percent more.<sup>4</sup> The transition to zero-carbon buildings will generate new and innovative design strategies, expanding opportunities for industry growth and job creation.

The Canada Green Building Council® (CAGBC) launched the Zero Carbon Building Standards™ (ZCB Standards) in 2017 to assist the industry's transition to zero carbon. Every day, projects pursuing certification under the ZCB Standards are pushing the boundaries and demonstrating that there is a zero-carbon future for all buildings. Certifying under the ZCB Standards mean taking responsibility for all carbon emissions over a building's life cycle. It is an ambitious but nonetheless critical objective, because within the context of a global carbon budget, every kilogram of carbon counts.

Published in 2019, CAGBC's *Making the Case for Building to Zero Carbon* report confirmed that zero-carbon buildings are both technically feasible and financially viable.<sup>5</sup> On average, zero-carbon buildings can provide a positive financial return over a 25-year life cycle when considering national carbon pollution pricing. They also require only a modest capital cost premium. The financial returns for zero carbon buildings will only increase as the cost of carbon rises, while they also help mitigate future costs from utilities, regulations, retrofits and extreme weather.

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<sup>2</sup> Rockström et al. (2009). *Planetary Boundaries: Exploring the Safe Operating Space for Humanity*.

<sup>3</sup> Environment and Climate Change Canada. (2016). *Pan-Canadian Framework on Clean Growth and Climate Change. Canada's Plan to Address Climate Change and Grow the Economy*.

<sup>4</sup> Global Alliance for Buildings and Construction. (2024). *Global Status Report for Buildings and Construction*.

<sup>5</sup> Canada Green Building Council. (2019). *Making the Case for Building to Zero Carbon*.

## INCREMENTAL LIFE CYCLE RETURNS ACROSS CANADA

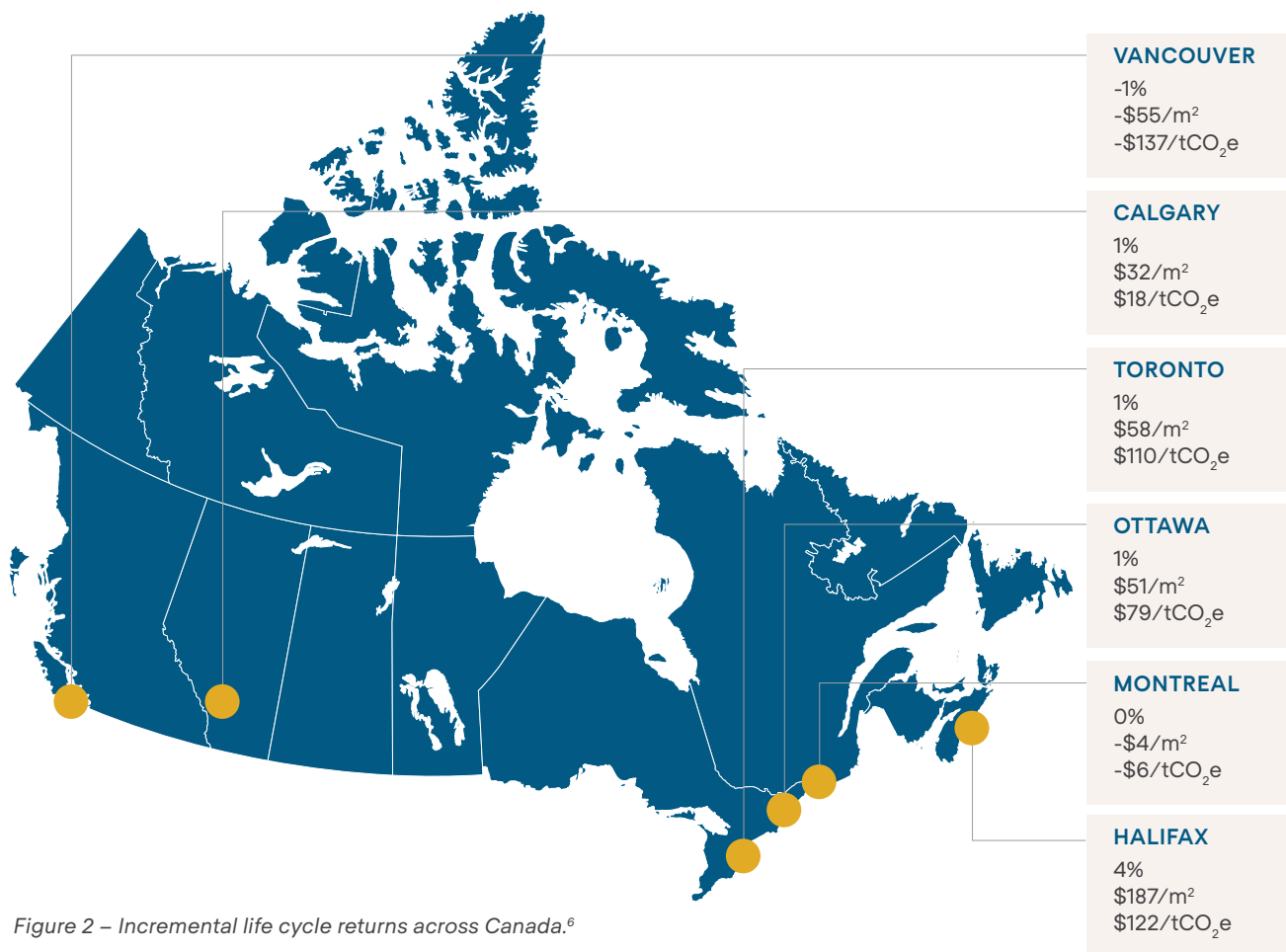


Figure 2 – Incremental life cycle returns across Canada.<sup>6</sup>

In 2021, CAGBC released the *Decarbonizing Canada's Large Buildings* report, which studied the costs of deep carbon retrofits for 1970s and 1990s vintage buildings, identifying key market barriers and solutions. The archetypes within the study can reduce fossil fuel consumption by at least 93 percent, while slashing energy usage by more than 70 percent. Many of the archetypes also yielded a positive financial return on a deep carbon retrofit using a 40-year life cycle, with the remainder becoming cost viable as carbon and energy prices increase.

<sup>6</sup> Ibid.

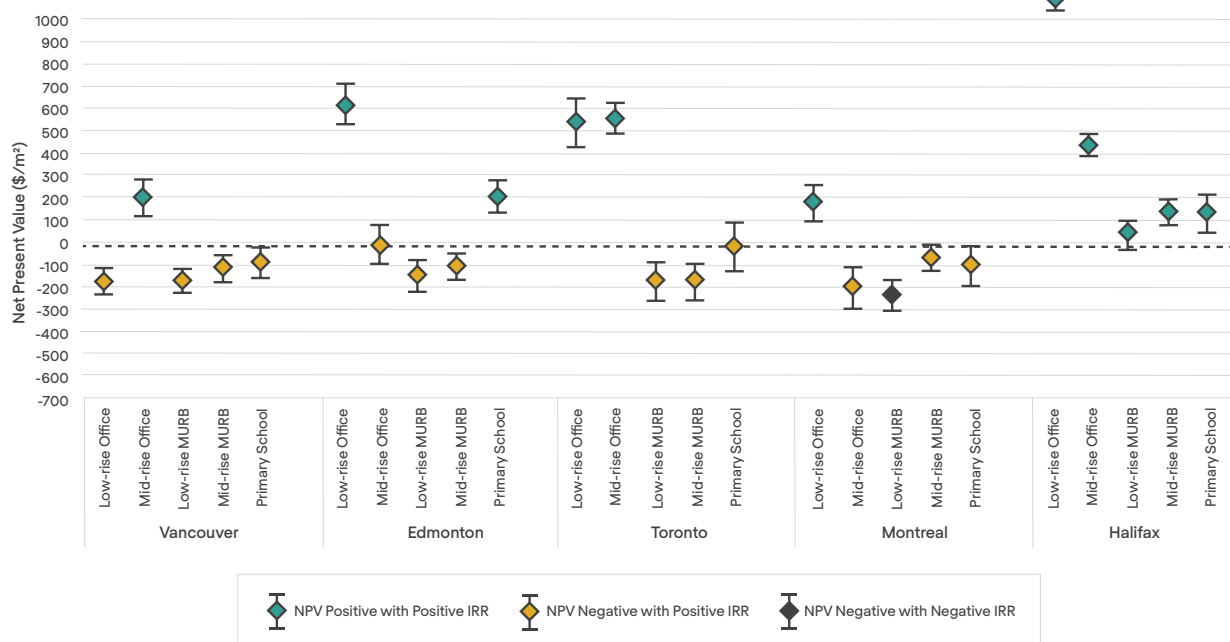


Figure 3 – Net present value of deep carbon retrofits for 1970s vintage buildings.<sup>7</sup>

In 2019, the World Green Building Council called for a 40 percent reduction in **embodied carbon**<sup>8</sup> by 2030.<sup>9</sup> While Canada’s building sector has made strides in designing buildings that operate without operational carbon emissions, addressing embodied carbon remains a significant challenge. In 2021, CABGC released a white paper titled *Embodied Carbon: A Primer for Buildings in Canada* to equip the building sector with essential information to understand and tackle embodied carbon in both new and existing buildings. The paper posits that between 2022 and 2050, embodied carbon could account for over 90 percent of emissions from new buildings. This is a significant source of emissions that demands attention during the design stage of any project.

Lastly, provinces and territories are embarking on a large-scale energy transition to accommodate Canada’s national strategy for a low-carbon future. Buildings can and must do their part to support the transition. CAGBC envisions buildings as “good grid citizens” that ensure energy efficiency, generate renewable energy onsite, and take steps to reduce and manage peak electrical demand, which may include energy storage and active participation in demand response programs.

<sup>7</sup> Canada Green Building Council (2021). *Decarbonizing Canada’s Large Buildings*.

<sup>8</sup> To assist readers, key terms are bolded and defined in the Glossary.

<sup>9</sup> World Green Building Council. (2019). *Bringing Embodied Carbon Upfront: Coordinated action for the building and construction sector to tackle embodied carbon*.

## THE PROCESS OF DESIGNING FOR ZERO CARBON



### INTEGRATED DESIGN

The application of an integrated design process is the first step towards ensuring the success of any project targeting zero carbon. Bring a broad, interdisciplinary team together as early as possible and collaborate throughout the course of the new building or deep retrofit project to find the best, lowest-cost approach to zero carbon.



### LIMITING COMBUSTION

Eliminating onsite combustion is the top priority when designing for zero carbon. A well-designed electric building will have lower carbon emissions in almost all regions of Canada today, and ongoing efforts to reduce the carbon intensity of electrical grids will ensure that the emissions of combustion-free buildings continue to decline.



### MINIMIZING THERMAL ENERGY DEMAND AND EMBODIED CARBON

Project teams must balance the dual goals of minimizing embodied carbon and reducing energy demand – particularly the heating and cooling loads. Improvements to the building's envelope are critical to lower thermal energy demand, enable heating solutions that avoid combustion, and minimize peak demand on the electricity grid. However, envelope improvements can increase embodied carbon, and in many regions of Canada, the embodied carbon of efficient, all-electric buildings already outweighs the cumulative operating emissions over the life of the building. Teams must also consider costs, comfort, passive survivability, and other criteria.



### ENERGY EFFICIENCY

Meeting a building's energy needs efficiently is a critical next step to reduce energy use and save on energy costs. From ventilation, heating and cooling to hot water and lighting, efficiency focuses on meeting energy needs with the least energy and carbon emissions.



### GREEN POWER AND ENERGY STORAGE

Next, consider how a building might generate onsite renewable energy, accounting for grid interactions to ensure real carbon reductions. Energy storage, whether electrical or thermal, is a recognized strategy to help minimize grid impacts, reduce or eliminate the need for fossil fuels to meet peak heating demand, and increase building resilience. Procuring green power generated offsite can also contribute to mitigating emissions.



### CARBON OFFSETS

The residual emissions from embodied carbon, energy use and refrigerant leaks can be mitigated through the purchase of carbon offsets as a final measure towards attaining zero carbon.