

The Current State of Sustainable Building Practices in Toronto: An Analysis of the Toronto Green Standards

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A final research paper submitted in conformity with the requirements of SSM1070

For the Degree of Master of Science in Sustainability Management

Institute for Management and Innovation

University of Toronto

Word count: 13,170

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Abstract

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The building sector has been identified as one of the largest contributors to greenhouse gas emissions, but also as one holding great potential to lower its emissions. Due to the concentration of the built structures in cities, green building has become a major component of urban climate change plans. The research aims to understand the impact of the Toronto Green Standards, the building chapter of the City of Toronto climate change strategy, and how it influenced building industry key stakeholders to adopt green building practices. Toronto's building sector contributes to 52% of its total emissions and to address the sector heavy footprint, the City implemented the Toronto Green Standards, a tiered approach with increasingly stringent standards for new building development. The Building industry stakeholders interviewed in this research were asked about their perceptions of the framework, from its design, to its effectiveness and to what impact it had on their professional endeavours. The majority of the industry stakeholders demonstrated a favourable opinion of the framework in its approach and the way its comprehensiveness. However, the results also demonstrate several challenges to the TGS effectiveness, mainly due to the lack of tracking and enforcement of the policy. Therefore, the findings indicate the need for changes in the regulatory framework as well as the need for more collaborative industry-wide participation to improve the adoption rate of standards for high performing buildings.

Introduction

Globally, buildings and the building construction sectors combined are responsible for 36% of global final energy consumption and close to 40% of total direct and indirect CO₂ emissions (IEA, 2018). The *Global Status Report* which tracks and documents key indicators for energy use emissions technologies, policies and investments related to buildings and construction sector globally finds that buildings play and will continue to play a dominant role in the clean energy transition (Global ABC, 2018). Energy demand from buildings due to rapid growth in the global building floor area continues to rise at nearly 3% per year (IEA, 2018). Similarly, in Canada, the building sector accounted for 17% of the country's total greenhouse gas (GHG) emissions in 2015 and the National Energy Board estimates that energy demand will continue to rise in both residential and commercial-institutional market segments through 2040 (ENEV, 2018). Facing these challenges, Canada has implemented nationwide measures and policies to incentivize the construction of greener buildings in an effort to reduce the sectors' total emissions. It has been calculated that to achieve GHG reduction targets in accord with the Paris Agreement targets, emissions reductions from buildings need to be around 25 Mt CO₂ annually (ENEV, 2018). This will inevitably require concerted efforts from the three levels of government, but more specifically from municipalities, as urban areas contribute a disproportionate amount of per capita emissions (IPCC, 2018).

Global commitments such as C40 have emphasized local governments' role in combatting climate change and have led cities around the world to take action to reduce their GHG emissions (C40, 2013). For example, the City of Toronto, through its climate action strategy (TransformTo) is aiming to reduce its emissions by 65% below 1990 levels by 2030, with a goal to set a path that would lead to meeting the target for Net Zero Carbon Emissions for new buildings by 2050 (City of Toronto, 2017). Additionally, all new buildings will need to be built to produce near-zero greenhouse gas (GHG) emissions. In terms of the existing stock of building, the target is to have all the existing buildings retrofitted to improve performance by an average of 40 percent by 2050 (City of Toronto, 2017). These objectives are aiming for the building sector to reduce the City's emissions by 30.6 mega tonnes by 2050, according to the Zero Emissions Building framework.

Efforts to improve the energy efficiency of buildings in Canadian cities such as Toronto, where 52% of the emissions come from buildings (City of Toronto, 2017), will have to be unprecedented and will require the collaboration of a very fragmented industry as well the implication of all levels of government. Globally, some trends are encouraging, countries are continuing to implement and update building codes and certification policies, which led to a 4.7 % incremental increase in energy efficiency investment globally in 2017 (Global ABC, 2018). Canada is one of the 136 countries worldwide to specifically mention buildings and construction as part of its NDC¹ (The Pan-Canadian Framework on Clean Growth and Climate Change), with reference to the introduction of a “net-zero energy ready” building codes to be followed by provinces and territories (Global ABC, 2018). This approach that has been identified by the Federal Government in response to their ratification of the Paris Agreement and intends to develop “*net-zero energy ready*” building codes to be adopted by 2030 for new buildings; retrofitting existing buildings based on new retrofit codes and providing businesses and consumers with information on energy performance; and improving energy efficiency of appliances and equipment (GC, 2017). However, there are considerable limitations to the National Building Code, as changes in the Building Code do not necessarily translate into effective outcomes. Local governments have some jurisdiction to obtain enhanced energy performance in buildings, renewable energy infrastructure, and the disclosure of building energy performance, but there is no clear area of jurisdiction that allows local governments to both require the priority green building policy approaches and enforce their maintenance over time and most municipalities bylaws do not deviate from the standards established in the provincial Building Code. Hence, stronger and effective policies at the municipal are needed to drive the construction of greener buildings (Pembina Institute, 2010).

¹ NDCs are the National Plans developed by each country to reduce their national emissions and adapt to the impacts of climate change in a way that meets the Paris Agreement Targets.

On the private sectors side, energy efficiency and sustainable building practices need to become common practice to ensure the resiliency of our built environment. The building sector needs to incorporate wider sustainability considerations into the design and construction of buildings to create a resilient built environment. Beyond energy efficiency, sustainable building practices include indoor environmental quality, water supply and use, embodied energy and materials, environmentally benign construction materials and construction waste as well as a variety of additional measures to increase resiliency. Although energy-efficiency of new and existing building is necessary and needs to be achieved, in the broader context of climate adaptation, building construction now also need to be looking at other variables influencing its resiliency to specific hazards or extreme weather events, which are projected to increase in most major Canadian cities over the upcoming years (IPCC, 2018). Facing these challenges, the development and building sector needs to quickly react and adopt better practices. However, despite the growth of green building practices, it has been proven to be difficult to scale-up the efforts, partly due to the complex and fragmented nature of the construction and building industry value chain (Global ABC, 2018). In fact, stakeholder coordination- between national and local legislators, international organisations, developers and real estate companies, the certifiers, the designers and financial institutions is lacking (Mulligan T, et al., 2014). There needs to be a better understanding of the relationship between the industry key players, their motivation to build sustainably and how policies are driving or not greener practices.

In this regard, the Toronto Green Standards, which makes up the core of the city's effort for green buildings is an interesting example as it involves both mandatory and voluntary standards and builds upon the current Ontario Building Code (OBC). As defined by the City of Toronto, the TGS is a tiered system with both mandatory and voluntary components and strives to reduce "future infrastructure demands and environmental impacts making a healthier, more livable city" (City of Toronto Planning Division, 2015). This research will analyze the impact of the City of Toronto's tiered approach framework in order to answer the following questions: *What is the impact of Toronto's Green Standards on Toronto buildings industry? How did the TGS influence the building industry stakeholders to adopt green building practices?*

This research will first consist of a literature review that will assess the state of green building practices in Canadian cities, by looking at key industry trends, by analyzing the TGS and by comparing it with other jurisdictions policies as well as market-based programmes. Then, this research will describe and discuss the results of interviews conducted with key industry stakeholders such as energy modellers, architects, developers and building experts, in order to understand the influence of TGS over the industry practice in building green and sustainable buildings in Toronto's context. The expected outcome of this research is to identify industry trends, such as the level of motivation to adopt green building standards

required by TGS and policy effectiveness of changing industry practices. In turn, this analysis will help to suggest policy improvements for better policy-industry collaboration towards pathways to sustainable building design and construction. The results of this research will help development and building stakeholders work toward sustainability and resilience of the built environment by understanding drivers and barriers to sustainable design and development.

2. LITERATURE REVIEW

Looking at how Toronto's municipal policy frameworks drive the construction of sustainable buildings is relevant in terms of Toronto's goals in transitioning to a lower carbon economy and to meet the city GHGs reductions targets, but also in terms of urban sustainability and urban adaptation to climate change. Keeping in mind that cities will be the place of residence of 70% of the global population by 2050, efforts should be concentrated on enhancing building industry practices that achieve social and environmental benefits with minimized environmental impacts. The multiple benefits of energy-efficient, resilient and sustainable buildings are significant and include local benefits such as job creation, increased productivity, reductions in local air pollution and poverty alleviation (Global ABC, 2018). Additionally, the ability of green buildings to create healthier environments for building occupants has also been another critical factor influencing the green market in Canada (CGBC, 2014).

According to the Canadian Green Building Council, the Canadian green building market is growing. In fact, trends are positive, and Canada saw 282 new LEED Certifications in 2018, bringing the total projects certified to 3712, with 36.6% of those buildings in Ontario. Additionally, 56% of developers in 2014 were doing at least 30% of their projects green and that number was projected to be above 60% by 2019 (CaGBC, 2014). This positive trend suggests that green building practices are starting to become more commonplace, as our cities continue to explore ways to be more energy-efficient become more resilient. However, the main issue remains the need to scale up the number of new builds and retrofits by a whole new order of magnitude (Coleman, S, Touchie M, Robinson, J, Peters T, 2018). For this reason, it is imperative to research this gap to gain a better understanding of how policies and industry relationships are preventing this scaling up from happening. Even with more stringent building codes and mandatory policies, the current adoption of green buildings standards is stagnant or barely increasing in Canadian cities. This is particularly true in Toronto, where despite a vigorous building development industry, it is estimated by industry experts that less than 10% of the new commercial and institutional buildings in the Toronto area are LEED registered (Tessaro, 2019). Although there is a number of research and studies in the literature looking at the barriers and drivers of sustainable building development (e.g. Ahn Y, Pearc A,

Wang Y, Wang G., 2013, Kang et al., 2014), this research will add to the literature on green building policies by conducting a case study of the City of Toronto Green Building Standards.

This literature review will first analyze green building practices by looking at how buildings are defined and assessed. Secondly, the TGS will be introduced in further detail with some background to its design and implementation. Thirdly, to provide a broader context to the TGS, this literature review will briefly look at building policies in other jurisdictions such as the Vancouver Zero-Emissions Buildings plans and another European approach. Finally, the last section of the literature review other market-based programmes as compared to regulatory and prescriptive approaches such as the Toronto Green standards.

2.1 Green Building Practices: Definition and Assessment

Green building has been defined by many organizations. The World Green Building Council (WGBC) defines it as a “building that, in its design, construction or operation, reduces or eliminates negative impacts, and can create positive impacts, on our climate and natural environment. Green buildings preserve precious natural resources and improve our quality of life.” The Canadian Green Building Council defines it as the “method and practice for addressing climate, minimizing energy and resource demands, and for building more resilient and healthy communities” (CAGBC, 2016). In the recent decades, there has been significant growth in the development of codes, standards, rating, and certification programs to help guide, demonstrate, and document efforts to deliver sustainable buildings (Vierra, 2016).

A green building is defined by standards and codes and mainly assessed by rating systems and LCA methodology (Saleh, 2017). The graph below shows how buildings are first defined and then assessed. A Green building is first defined by standards and codes, which are usually found in regulations such as Provincial or National Building codes. As defined by the ISO, a standard refers to: “*a document, established by consensus, approved by a recognized body that provides for common and repeated use as rules, guidelines, or characteristics for activities or their results*” (ISO, 2004) and, when used in a voluntary fashion they mainly serve as incentives for improved performance. Standards and codes can be prescriptive-based, where the methods of achievement are identified by quantifiable values or performance-based standards (Vierra, 2016). Traditionally, in Canada and in Ontario, green building standards have followed a prescriptive-based approach, where codes are intended to be mandatory and thus represent the minimum standard (Integral Group LLC, 2015). Then, there are two main approaches for assessing building’s impacts and performance, they are the Life Cycle Assessment (LCA) and the Building Rating Systems or a combination of the two (Saleh, 2017). Rating systems for buildings are defined as tools that rate and

examine the performance or expected performance of building with specific environmental goals and requirements (Vierra, 2016).

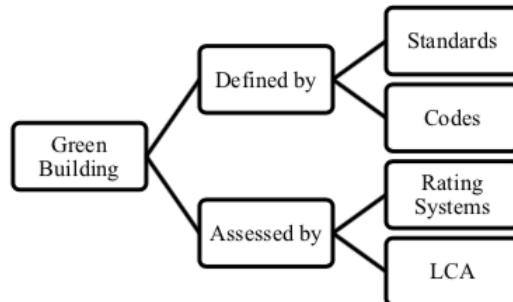


Figure 1: Green building definition and assessment

Globally, the green building movement has involved the creation and adoption of multiple green building standards and rating systems in order to change the design, planning, construction and operation of buildings to create sustainable and ultimately, regenerative built environments (USGBC, 2014). Many rating systems exist around the world such as BREEAM, LEED, Boma, Casbee, Green Globes or the Living building Challenge (Vierra, 2016). In Canada, the green building standards trend started in the mid-1990s, with the introduction of BREEAM as an environmental performance assessment standard released by the Canadian Standards Association. Around the same years, the initial LEED rating system was adopted and LEED Canada for New Construction and Major Renovations version 1.0 was launched in December 2004 (CAGBC, 2014). In 2006, a more stringent set of standards appeared in Canada called the Living Building Challenge and was launched by the International Living Future Institute (ILFI), an organization created by Cascadia Green Building Council (CGBC), a chapter of CAGBC (CAGBC, 2014). In 2011, the International Living Future Institute created the Net Zero Energy Building Certification (NZEB) to verify net-zero energy building performance. Finally, the latest framework of green building standards in Canada is the Zero Carbon Initiative created by CAGBC in 2016 to assess carbon emissions in commercial, institutional and multiunit buildings (CAGBC, 2017). The figure below represents the spectrum of what can be defined as a “green” building, ranging from typical prescriptive building codes to restorative buildings.

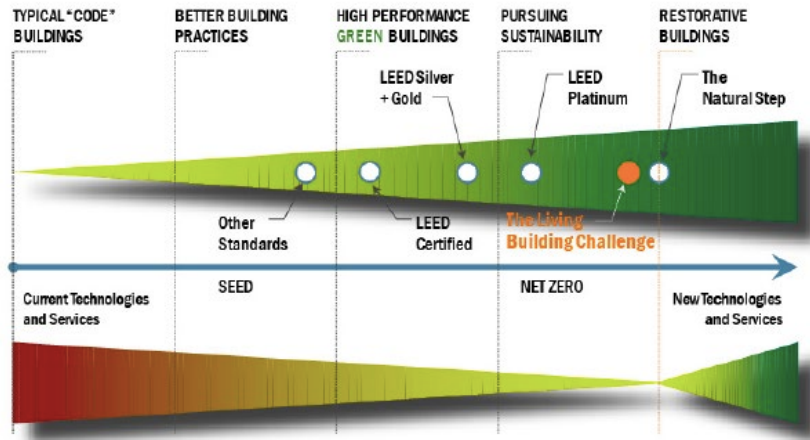


Figure 2: Shades of Green. Source from (Eisenberg et al., 2009)

2.2 Green building in Toronto and TGS context

The City of Toronto implemented the TGS in 2010 as a requirement for all new building's development. Developed by the City of Toronto's Environmental Planning Division the policy strives to reduce "future infrastructure demands and environmental impacts making a healthier, more livable city" (City of Toronto, 2014). But what is the impact of the Toronto Green Standard on industry practices in Toronto? How does it influence the sector's decision-makers and what are the motivations to pursue TGS beyond the mandatory requirements? Do voluntary measures under TGS accelerate the adaptation of greener practices or should the policy be more stringent? Answering these questions in addition to understanding key stakeholders' motivations in building sustainable buildings is necessary to create a proactive regulatory system for building development. A first step in answering these questions is to better understand the Toronto Green Standards, through a document analysis of the TGS main publications and a literature review of other similar policies in other jurisdictions.

As Canada's economic capital and largest city, Toronto's case is significant in terms of environmental impact, but also in its contribution to the discussion of municipal and city environmental policy. Additionally, the last two decades of booming economic activities in Toronto have enabled a growing and prospering building industry fueling both commercial and residential buildings developments. In some regards, this context is what enabled the administration of the City to impose stricter rules on developers. The first version of the Toronto Green Standards was drafted in 2006 at a time where not many other policies in North America were addressing building's performance above the mandatory performance of building codes and regulations. The Toronto Green Standards was innovative in the way that it required new developments to exceed the requirements of the Ontario Building Code (OBC), in many aspects, but mainly in terms of energy efficiency, which is arguably the largest environmental impact of buildings.

Within the bounds established by provincial governments, municipalities such as Toronto have multiple tools at their disposal to encourage green building practices. For example, cities can require green building practices through bylaws or regulations, they can levy fees and property taxes, issue and enforce building standards, provide subsidies to individuals and corporations, undertake information and public education campaigns, to encourage desired behaviour. (Schwartz, 2016).

In the first version of the TGS, the City of Toronto adopted targets for reducing greenhouse gas emissions citywide and to support those targets, the city developed policies and programs to require and incentivize new buildings to be energy efficient. The first mandatory version of the TGS was introduced as a tiered approach in 2010, where Tier 1 standards were required through the planning approval process and Tier 2 with higher-level voluntary targets, which received financial incentives. The second version of TGS came into effect in 2014 with the introduction of the Development Charge Refund, a market financial tool to incentivize projects to go beyond Tier 1. Specifically, projects that are verified to meet Tier 2 requirements are eligible for a refund of development charges equivalent to 20% of the 2014 rate (City of Toronto, 2014). The Version 3 update came into effect in 2018 and included a four-tiered energy framework “for development to achieve near-zero greenhouse gas emissions by 2030 in support of Council’s adoption of TransformTO and goal to reduce community-wide greenhouse gas emissions by 65% of 1990 levels by 2050 (See Figure 3). Finally, the city of Toronto has identified growth in population and density combined with extreme weather events (temperature and storm events) resulting in higher pressure on the city’s energy infrastructure as main drivers for future more stringent building requirements (Integral Group LLC, 2015).

The tiered design of the policy was intended to gradually level the playing field for all development companies to achieve buildings performance above the regulatory requirements of the Ontario Building Code (OBC). Conceptually, the TGS imposes additional rules to developers in order to protect the city’s environment, its residents and future generations (Tessaro, 2019). The framework of Toronto’s Green Standards is intended to promote sustainable building design that addresses five main urban concerns identified by the City: air quality, climate change and energy efficiency, water quality and efficiency, ecology and solid waste. Through the evolution of TGS, additional requirements were added to these five categories, based on consultations and city commissioned research. However, the core component of the TGS remains energy efficiency, as it is arguably the most impactful environmental indicator and because it is directly aligned with the City’s climate action strategy and related GHG Emissions reduction targets. This is not explicitly mentioned by the City but can be observed through the reading and analysis of the TGS V.3. Indeed, the Version 3 has a strong focus on energy and a four-tiered approach that suggests a restructuring of the Energy and GHG Emissions category “to provide a clear path to achieve near zero GHG

emissions buildings by 2030”, in alignment with TransformTO targets (City of Toronto, 2018). With this version, Tier 1 projects must exceed the energy efficiency requirements in the Ontario Building Code by 15% and Tier 2 buildings must achieve at least 25% energy efficiency improvement over the Ontario Building Code. With Version 3 in any given year, a developer can opt to pursue the higher tiers (i.e. Tier 2 or higher), but every four years, they will be required to “step-up” to a higher level of performance until 2030, when the mandatory requirement for new buildings will be a near-zero emissions design (See Figure 3 below). Additionally, this new version introduces *absolute performance targets* for energy efficiency for each Tiers with (3) main measures: Energy Intensity (TEUI), Thermal Demand Intensity (TEDI-heating demand) and Greenhouse Gas Intensity (GHGI). The absolute target-based approach can be defined as “absolute energy use or emissions target for a building usually based on energy consumption per unit of floor area expressed over time” (Integral Group LLC, 2015). This approach, which is common in European codes, is a departure from the *reference building* approach which has traditionally been the approach of the National Energy Building Code (NECB) in Canada and the current approach used in the OBC (Integral Group LLC, 2015). The reference building approach is a methodology to measure energy performance based on the overall performance of a building rather than its components parts. This methodology involves a design team to develop a ‘reference building’ defined by prescriptive elements, to which they propose different design strategies that result in lower overall energy use (Integral Group LLC, 2015). The following section of the literature review will provide an overview of other jurisdictions building codes and policy approaches in order to better position the Toronto Green Standards approach in regard to similar building policies and systems.

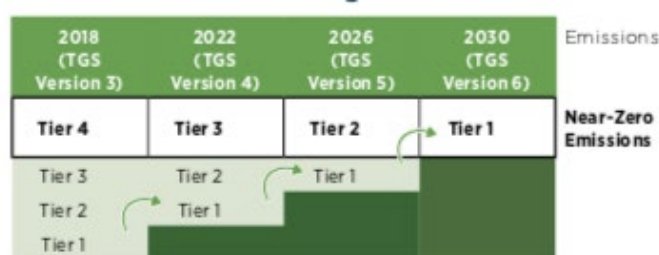


Figure 3: Pathways to Zero Emissions Buildings (City of Toronto, 2018)

2.3 Approaches to Green Buildings: other jurisdictions policies and standards review

Historically, building codes in Canada have used a prescriptive approach to the built environment with prescribed codes, standards and policies based on the discovery of unintended consequences or unrecognized hazards (Eisenberg, 2016). Prescriptive approaches provide itemized lists of building design

requirements for example for mechanical, electrical, and envelope systems that impact building energy use (City of Toronto, 2017). Prescriptive approaches are often either the foundation of, or included in some way into, all modern energy codes including SB-10 of the Ontario Building Code (OBC), ASHRAE 90.1, and the National Energy Code for Buildings (NECB) (Ibid, 2017). Such codes are usually reactive, rather than proactive and are based on minimum requirements establishing thresholds that unfortunately tend to become the accepted standards of practice (Eisenberg, 2016). For example, in Canada, the National Energy Code of Canada for Buildings 2011 (NECB) provides minimum requirements for the design and construction of energy-efficient buildings in Canada. At the provincial or municipal level, provinces and cities can mandate in their building codes that buildings meet or exceed NECB. However, where no provincial or municipal building code exists, NECB is the default standard in Canada. This is the case for many building codes requirements, such as energy standards, water and stormwater retention and window glazing. For example, the NECB does not have specific codes and standards for window glazing and it was only after a decade long trend of reflective glazing windows in Toronto's buildings that bird-friendly glazing standards were implemented through the TGS in order to reduce bird collisions and mortality. In addition, because of their prescriptive nature, building codes are ill-equipped to dealing with and be prepared for the unpredictable nature of climate change impacts (Eisenberg, 2016). For example, with emerging extreme climate events such as storms and changes in precipitation patterns, cities like Toronto are much more prone to flood and the current regulatory system is not proactive enough to account for these unpredictable patterns. Buildings being built today need to be prepared for conditions that are not necessarily known yet, thus the need for a reform of the regulatory approach to building standards.

In that sense, the Toronto Green Standards represents a paradigm shift, in that it changes its approach from its previous "percent above" the Ontario Building Code (OBC) to measuring energy performance to an absolute performance targets approach (City of Toronto, 2017). However, Toronto is not alone, different cities, municipalities and leading building industry players are also starting to develop voluntary absolute measure standards to encourage the construction of higher performing buildings. In fact, several countries and jurisdictions in the world have considered innovative building codes or expanding existing ones to address building's main impacts on climate change and to cover broader lifecycle emissions beyond energy use. This next section of the literature review will look at two other jurisdictions, where innovation to the building code has been employed by governments to increase building performance, specifically this section will describe the city of Vancouver's Building Bylaw and Denmark's BR10 Building Regulation.

2.3.1 Vancouver Zero Emissions Buildings Plan

In 2011, the City of Vancouver developed the Greenest City Action Plan (GCAP) with the intended goal of becoming the greenest city in the world by 2020. As part of the ten goals, the third goal of the GCAP is the ‘Green buildings’ goal, in which two targets are set to be achieved by 2020. The first target aims to reduce greenhouse gas (GHG) emissions in existing buildings by 20% over 2007 levels by 2020. The second target in the green buildings goals is to have all the new constructed buildings (from 2020 onwards) to be ‘carbon neutral’. In order to achieve the greenest city green buildings goals, the City developed and implemented the Zero Emissions Building Plan (ZEBP). Approved in 2016, the Zero Emissions Buildings Plan “is a flexible, phased approach to combat and reduce carbon pollution in Vancouver that establishes targets and actions to achieve zero emissions in all new buildings by 2030” (City of Vancouver, 2016). Similar to the TGS, this policy targets new construction in the City so new buildings progressively use less energy and cause less carbon pollution between its implementation and 2030.

The City of Vancouver must require buildings to meet BC Building Code standards, however the City also has the authority, by way of the Vancouver Charter, to require additional elements over and above the BC Building Code, under the Vancouver Building Bylaw (VBBL) (Integral Group LLC, 2015). For example, since 2011, all rezoning projects are required to achieve LEED Gold with a minimum of 63 points or alternatively, projects may achieve a minimum of 35% performance above the MNECB (Model National Energy Code for Buildings) (Sawatzky, 2011). The Vancouver Building By-law regulates the design and construction of buildings, as well as the administrative provisions related to permitting, inspections, and the enforcement of these requirements (City of Vancouver, 2019). To support Vancouver’s GHG reduction targets, the VBBL thus includes energy efficiency standards that are specific to Vancouver that increase the performance of Vancouver buildings beyond the BC Building Code baseline. Furthermore, this municipal policy in Vancouver is supported by the provincial stretch code, which offers incentives for higher-performance building. The advantage of the city scale code is that it can be better tailored to Vancouver’s building markets, and better informed by the staff that are responsible for enforcing them.

The Vancouver Bylaw, Toronto’s TGS and other actions being taken across the country contribute to a cross-Canadian movement to improve building codes and performance standards (Schwartz, 2016). In turn, these help to support municipalities in raising the awareness and capacity of the industry to realize new levels of building performance. Vancouver and Toronto’s frameworks both have in common a tiered approach with a mandatory component building upon the provincial the Building Code. In addition to these two examples, the following section will look at a European’s best in class mandatory frameworks that is driven by net-zero and near net-zero building performance (Pembina, 2015).

2.3.2 Approaches to Sustainable buildings policies in European jurisdictions

At the core of the EU's climate change strategy is the transition to energy efficient buildings (Pembina, 2015). In the European Union, 36% of GHGs come from buildings and to address it the EU targets emission reductions of 80–95% below 1990 levels by 2050. The transition to energy efficient buildings is formalized through the European Commission's Energy Performance of Buildings Directive (EPBD), which was first introduced in 2002, and redeveloped in 2010 to reflect advances in construction practices (Pembina, 2015). The key strategy of the EPBD to improve energy performance of buildings is threefold: first to set mid-range national targets for “nearly zero energy buildings” by 2020, second to ensure immediate and ongoing improvement in minimum energy performance standards and finally accelerating market transformation by ensuring ongoing data collection (Pembina, 2015). However, each member state is free to set its own operational definition of net zero energy buildings, which leaves each country to decide on the system or framework to adopt. Many EU states follow voluntary certifications and rating systems such as Breaam, Globes and Passivhaus while others such as Denmark and Germany also have strong mandatory approaches. Denmark's approach is similar to the TGS, in that it builds upon regulatory standards and codes to establish more stringent mandatory building requirements.

Denmark's roadmap indicates that the country plans to become a CO₂-emission free country by 2050. In addition, Denmark was one of the first EU member state to set-up its national Net Zero Energy Building (Net ZEB) definition and roadmap for building to use 75% less energy by 2020. The concept of a Net Zero Energy Building (Net ZEB) encompasses two options of supplying renewable energy, which can offset energy use of a building, in particular on-site or off-site renewable energy supply (D'Agostino, 2015). Supporting that objective, the country put in place an aggressive building energy efficiency framework. Denmark's BR10 is a performance-based code that requires a mandatory energy frame calculation to establish maximum energy demand for both residential and non-residential buildings that gradually becomes stricter, starting from the initial Standard, BR10, with an intermediate milestone in 2015 (class 2015, mandatory in 2015) and a final target in 2020 (class 2020) (D'Agostino, 2015). Under BR10, energy use performance is prescriptive requirements and is clearly specified. Additionally, the code includes some mandatory passive design covering building orientation, passive solar, passive cooling, natural ventilation, solar protection and daylighting. An interesting feature of BR10 is that it sets prescriptive values to be achieved for an efficient building envelope based on climate zone. As such, the BR10 Code specifies “*As far as the thermal indoor climate is concerned, the planning of buildings and the choice of materials, window areas, cooling options, orientation and solar screening must ensure that satisfactory temperature conditions are achieved, even in summertime*” (EU, 2013).

In terms of compliance, Denmark's code is legally enforceable with some voluntary low energy classes (EUI targets) for new buildings and mandatory pre-defined EUI targets (LLC Group, 2018). Energy requirements compliance is achieved by modeling the building in a software program specified by the regulation. The modeled building must achieve an EUI Target equal or higher than the specified EUI for its designated building category (LLC Group, 2015). Compliance and enforcement are rigorous, with clearly set out absolute target and consistent, by having one mandatory the software program doing the modeling, which reduces the risks of variabilities of modelling options. Then, the review process of the proposed project and performance methods are done at different stages of the project's completion. Finally, the code has a mandatory review clause and update is required by the legislation, which means that each revision increases the efficiency requirements, in order to move the baseline towards better performance of building (LLC, 2015).

2.4 Market-based approach to Sustainable building standards

The previous sections outlined the TGS, Toronto's part-mandatory approach to building standards, as well as Vancouver's Building Bylaws and Denmark code BR10. These three frameworks have in common a prescriptive approach made possible through mandatory requirements explicitly defined by their respective jurisdictions. However, along with building codes approaches, many market-based approaches such as green building programmes, rating systems and certifications also exists. Amongst voluntary market-based approaches, LEED building certification is one of the most common certifications in Canada particularly in the City of Toronto. Briefly, LEED is a sustainable building certification system, beyond energy efficiency, that provides a methodology in order to support design and demonstration of improved ecological, water, energy and indoor environmental performances of a building (LLC Group, 2015). Green building certification is an actionable solution that many developers and real estate companies have decided to follow in Canada and Toronto.

There has been a transformation in the building industry which led the Canadian green building movement to make some significant market advances. The adoption of green building certification or rating systems is popular across Canada and Ontario but varies by building sector. The institutional and commercial sectors seek the most certifications, with 79% and 67% (respectively) of the projects in Canada being certified, while only 49% of new mid and high-rise residential projects seek certification (CAGBC, 2014). Certifications and rating systems has also proven to be an effective solution with positive environmental outcomes. For example, a study by McGraw Hill Construction along with the Canada Green Building Council found that, as of 2015, LEED buildings have eliminated 1,261,016 CO₂e tons of GHG

emissions, diverted over 1.5 million tonnes of waste from landfill, and saved 12.8 billion liters of water per year in Canada (CAGBC, 2017).

Other programmes in Canada includes for example the Zero Carbon certification program, which was released in 2016 by Canada Green Building Council through the Zero Carbon Building (ZCB) Framework. This pilot project is currently in place with 16 selected projects over the country in order to “inform further the development of the Standard as well as tools, resources and education to accelerate market transformation (CGBC, 2019). The ZCB programme, which is using the NECB as a baseline, is characterized by four key components: the building demonstrates a zero-carbon balance in its operations (over the course of a year) its operations contribute zero carbon emission, design prioritizes reducing energy demand and meeting energy needs efficient, onsite renewable energy is used and finally the embodied carbon of the structural and envelope materials (primarily carbon associated with manufacturing) is evaluated as part of the design (CBGC, 2019). This market-driven approach is going beyond most other certification programmes in Canada, especially by considering the embodied carbon of the building envelope. However, in order to achieve these higher and more progressive targets, there is still a lot of work to be done to raise awareness in the building industry governments and the real estate sectors with regards to implementation and the business case of adopting the ZCB standards (CBGC, 2019). As municipalities across Canada introduce updated performance-based building codes, with an increased emphasis on energy efficiency and renewable energy, market-based frameworks are an important tool companies can use to guide the design and construction of their building to achieve the maximum efficiency for their buildings.

METHODOLOGY

This study seeks to contributes to the discussion of cities and urban building policies that tackles GHG emissions reduction in an effort to combat climate change. As it was mentioned in the introduction, cities are major contributors to climate change and considerable regulatory transformation is required to reduce cities’ environmental burden and prepare them to the threat of extreme weather and other climate-related events (Eseinberg, 2016). Toronto was chosen as the region of study because as Canadas’s largest city, it illustrates an important case for potentially impactful and replicable municipal environmental policy. Additionally, Toronto’s rapid condominium development often came at the cost environmental and ecological preservation, which makes it an imperative for the City to find effective solutions to orient the industry toward better practices (Tessaro, 2019). Thus, with a better understanding of the impact of the

TGS, the perception of industry stakeholders and by assessing its limitations, new policy recommendations can be developed to further improve green building practices within the development industry.

Research design

This study data collection and analysis involved a combination of qualitative methods. First, through primary data collection, involving a series of eight qualitative interviews, then with secondary data collection via literature review and policy analysis of existing legislatives documents from the City of Toronto Planning Division. The literature review and policy analysis of documents was conducted first, starting in November until January, which informed and provided background to the researcher when they started conducting interviews. Then, the interviews were conducted to identify and assess the impact, influence and implications of the TGS in the development industry practices. The use of multiple methods allowed for a broader coverage of data and for a nuanced analysis.

Secondary data collection

In order to develop an understanding of the barriers and drivers of green building policies as well as understand the Toronto Green Standards as it relates to other municipal policy on green and sustainable buildings, this research conducted a literature review and a policy analysis of TGS main documents. First, the literature review allowed the researcher to assess the current state of green buildings in the industry in the Canadian context, specifically in Toronto and to look at other jurisdictions for similar policies. This involved reading industry and associations reports, other jurisdictions main documentation, scholarly articles on sustainable building practices and regulatory framework. Additionally, one report prepared for the City of Toronto by industry consultants was shared with the researcher as a result of an interviews.² This document allowed the researcher to align its literature review with previous research made that looked at other jurisdictions policies that were similar or comparable to the TGS. Second, the policy analysis of the main TGS document enabled the researcher to ask relevant questions during the interviews and grasp the full policy context in which the development industry operates in, within the City of Toronto. The document analysis of TGS documents also allowed the researcher to better understand the strategic actions of the City, which facilitated the data analysis and assessment of the policy effectiveness. In turn, this provided the basis for new policy recommendations pathways for the promotion of a sustainable built environment.

² Integral Group LLC (2015). Global Best Practices in Energy Efficiency Policy: prepared for the City of Toronto

Primary data collection

To understand the perception of the Toronto Green Standards framework and its impact within the industry, an interview questionnaire was developed, and eight semi-structured interviews were conducted throughout the month of January and February. The structure of the interview falls within the category of semi-structured interviews in which both prepared questions were answered by interviewees and additional questions were asked during the interview to clarify and/or further expand on certain issues. In regards of interviewee recruitment, most of the initial interviewee's contacts were introduced to the researcher by the researcher's supervisor, who kindly offered to send an email to his contacts, consisting mainly of building professionals on the board of Sustainable Building Canada, which has been heavily involved with the development process and implementation of TGS (See appendix 3). More specifically, the interviews conducted consisted of six industry stakeholders with experience working with the TGS and two City of Toronto planners involved with the TGS design and implementation. Amongst the industry stakeholders, three are energy modellers, one is an architect, one is the senior vice-president of a development company, and one is the executive director of Sustainable Building Canada, and all of them had extensive knowledge on TGS. The City of Toronto planners interviewed were introduced to the researcher through snowball criteria sampling method. The selected sample used was tailored to the needs of this research with people highly knowledgeable of the TGS and directly involved with policy, either in the past or present.

Two sets of questions were created: a first one targeted at City of Toronto staff such as city planners of the Planning division and the Environment and Energy division and a second one targeted at developers and other professionals in the industry such as consultants and energy modellers, directly involved with the TGS. This first questionnaire was centered around the development and framing of the Toronto Green Standards, the City's vision of what the policy targets and the City's sense of the overall effectiveness of the policy. Two interviews were conducted with the City of Toronto staff: one with City Planner Joshua Wise and a second one with David Macmillan, a Program Manager at the City's Environment and Energy division. The second questionnaire was targeted to industry key stakeholders that are on the receiving end of the Toronto Green Standards and need to comply with these regulations for their professional practice. The second questionnaire was centered around their perception of the policy, its impact on their professional endeavours and the influence it had on industry practices. The interviews were all recorded, and the data was transcribed, then qualitatively analyzed for main themes. Qualitative methods of interviews allowed the researcher to collect detailed information pertaining to perceptions and motivations of industry stakeholders, which are not always available through secondary research.

Ethical procedure and limitations

The methodology utilized in this research projects required to develop a consent form that was distributed to the interviewees either via email or by providing a hard copy signed the day of the in-person interview and followed the template provided by the course instructors. (See Appendix 5 for consent form). Instructions were read to interviewee them before the start of the interview and before they signed the form (See Appendix 4 for interviews instruction). Interviews were conducted with a low risk population of developer's industry stakeholders within the city of Toronto, thus did not required an ethics form.

All research methods entail its own specific set of limitations. By using both primary and secondary methods of data collection, this study tried to mitigate the limitations of each methods if they had been used alone. For example, primary data collection technique has its limitations, first of which is the relatively small dataset and therefore being unable to draw statistically significant results or generalizable results. Additionally, the nature of the recruitment process for selecting the interviewees has inherent biases in that it doesn't necessarily yield a representative sample. Similarly, using only secondary methods would've limited this research to textual evidence and the interpretation of it. However, by conducting interviews, the researcher was able to gain significant industry knowledge and personal experiences of people that contributed to the TGS and its incremental influence on development industry practices.

4. RESULTS

The following result sections will lay out the main findings from the interviews conducted in January and February with key stakeholders from the building industry in Toronto that were involved and knowledgeable of the TGS. The first section of the results will provide a look at the impact of TGS in Toronto, specifically by: providing an overview of TGS implementation, by diving into industry stakeholders' perception of the framework, by looking at the resulting changes in industry trends as well as the newly inclusion of resiliency within the TGS framework. The second section of this result section will look at the main challenges mentioned during the interviews such as the regulatory landscape and the lack of enforcement.

4.1 Impact

4.1.1 Overview of the TGS implementation

This section will provide some updates and official numbers from the City of Toronto regarding the effect of TGS on new development applications as well as the main impact of the TGS in terms of GHG emissions reduction in the City of Toronto. As it was explained above, all new planning applications, including zoning and bylaw amendments, site plan approval and draft plan of subdivision are required to meet Tier 1 of the Toronto Green Standard (City of Toronto, 2019). As of 2017, 1500 projects were built to TGS Tier 1 standards and there have been twenty-eight projects pursuing Tier 2 and above. Under version 3, a total of 10 projects have been pursuing Tier 2 standards and one project so far has submitted an application for Tier 4, 11 years before the standard becomes a mandatory requirement (City of Toronto, 2019). Figure 4 shows the annual development applications from 2014 to 2019 with the number of applications for each Tier. The last year recorded (2018-2019) has seen fewer Tier 2 applications, however as it was mentioned during interviews, this is in part due to the fact that under Version 3 all applications were required to meet the performance levels that were equivalent to Tier 2 of Version 2. In that sense, new developments are still stepping-up their performance levels, as the requirements become stricter from Version 2 to Version 3. An additional strategy the City of Toronto put in place in order to monitor the energy consumption of new Tier 2 and above buildings during their first year to see whether they were performing at the required standards. This strategy requires energy consumption disclosure in order to “drive energy savings among building owners most in need of support, and further motivate industry leaders in energy- efficiency” (City of Toronto, 2019). In the City’s latest update report, there was an 82% compliance rate for buildings in Toronto, which is higher than any other municipality as well as over the provincial average of 55% (City of Toronto, 2019). It is important to note that this compliance rate only looks at reporting, not the actual performance of new buildings, which is not currently being measured by

the City of Toronto. Hence, although the City’s Implementation Update for 2017 and 2018 (Figure 4), mentions it has avoided over 10 tCO₂ emissions compared with the Ontario Building Code since it came into effect May 1, 2018, the actual energy consumption reduction from new building is currently unknown. This shortcoming will be discussed further in the limitations section of the result section.

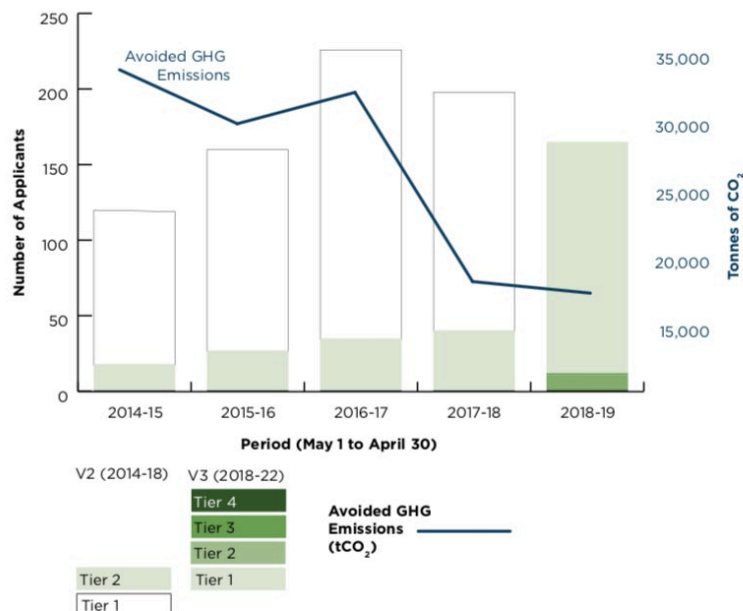


Figure 4: TGS annual applications 2014-2019 (City of Toronto, 2019)

4.1.2 Industry stakeholders’ perceptions of the Toronto Green Standards

This section will describe the perception of industry stakeholders in regard to TGS framework, its effectiveness and the impact it had on building performance. Consistent with the City of Toronto data described above, the industry stakeholders interviewed (the energy modellers, building consultants, the architects, the developers) mentioned that for the vast majority of the projects they have worked on, or consulted on, the project did not go above Tier 1. In fact, as the data shows, the vast majority of projects pursue the requirements of Tier 1, without seeking further improvements. When asked why they did not pursue standards beyond Tier one, the three most common reasons mentioned were: lack of interest from the client, lack of financial incentives for commercial buildings or difficult or unachievable targets for

specific project site (See Appendix 6 for list of reasons). For example, Adam baker, an energy modeller mentioned that when consulting for a client, he realized that if meeting a certain energy target required significant design changes, the developer was usually not ready to the investment. Mike Williams, another energy modeller said that although the development charge refund was an interesting incentive, the certainty around when the incentive would be received or the conditions attached to the incentives, acted as a barrier to pursue beyond tier one standards. More specifically, he mentioned that the refund being a % of development charge, rather than as dollar per square foot, made the incentives much less attractive for commercial and other non-residential developments. Additionally, architects and energy modellers also mentioned the technical difficulty of achieving energy targets for Tier 2 under V.3, which introduced absolute metrics target. A real Estate developer also mentioned that “not all sites were equal”, which meant that financial feasibility of Tier 2 and above was simply not achievable for certain sites, according to her. Absolute metrics targets, as it was explained earlier, represents a new approach in the Canadian context and most developers are not yet knowledgeable or experienced with them. For this reason, these new metrics under Version 3 have been a significant barrier to pursue Tier 2 for new developments. In sum, these were the three main challenges associated with pursuing the Tier 2 and above TGS standards mentioned during the interviews (See Appendix 6 for a complete list).

Stakeholders interviewed were also asked about the effectiveness of the specific building performance metrics within the Toronto Green Standards and their experience in implementing them in building design and development. From the five main components of TGS (air quality, climate change and energy efficiency, water quality and efficiency, ecology and solid waste), energy efficiency was definitely the most discussed component of TGS, and the component stakeholders had the most knowledge about. Overall, three main sets of TGS targets were perceived as successful in improving building’s sustainability and performance: energy targets, bird friendly glazing and stormwater retention. In regard to energy efficiency, stakeholders agreed that the standards were thorough and had a significant impact in terms of energy savings. Many of them mentioned the newly introduced absolute performance metrics under V.3 for Tier 2 projects, however, since only a handful of projects actually implemented Tier 2 under V.3, none of the stakeholders were able to comment on the effectiveness of these new measures once implemented. Nonetheless, energy modellers have been asked by many clients to study the feasibility of achieving Tier 2, although most of the time developers decided it was not financially viable. For example, Leona Savoie, Senior VP of development at a Real Estate Development company said that the energy targets under V.3 were such a big leap from the previous versions that she was questioning whether the targets were practically achievable. The bird-friendly glazing target, which fits under the ecology component of the TGS was also recognized as successful standard that dramatically reduced the number of birds’ collisions in the

city. Stakeholders from the design community also mentioned that it had an impact on how they were designing the building and how windows glazing became a common practice in the City, but that it wasn't necessarily the case in other municipalities yet. Stormwater retention was also highlighted as an area of great improvement due to the TGS, since no baseline was even provided before. However, a few stakeholders also mentioned the need to adopt even stricter standards. For example, Michelle Xuereb mentioned how the requirement for Tier 1 which is to *"retain at least the first 5 mm from each rainfall through rainwater reuse, on-site infiltration and evapotranspiration"* is inconsistent with the requirement for Tier 2 to *"retain 10 mm of each 24-hour rainfall event, or 70% of total average annual rainfall depth, for rainwater reuse, on-site infiltration and/or evapotranspiration."* She rightfully mentioned that with changes in patterns of precipitation due to climate change the City of Toronto is particularly at risks of flooding, and that the minimal requirements under Tier 1 (and even Tier 2) were not aggressive enough to mitigate the potential risks.

Lastly, in terms of TGS general approach, most interviewees agreed that a tiered approach was a beneficial and effective method to introduce gradual and more stringent standards in the industry. In fact, this was the most significant finding that arise from the interviews conducted as it was a consensus amongst all interviewees. All interviewees agreed that TGS is an effective strategy that has allowed to level up the playing field for all sectors within the development industry by sending a clear signal for industry players as to what direction the City of Toronto is going. For example, one industry stakeholder interviewed mentioned that one of the main benefits of the tiered approach was that it was forcing developers to think about TGS requirements early in the design phase, as opposed to during the construction planning phase. On the City side, David Macmillan, explained that the increased stringency of standards over time sends a powerful message to developers and makes them think about what standards they will need to focus on and what processes or operations of their business they will need to adapt in order to meet the regulatory requirements. In addition, Joshua Wise, City Planner from the City mentioned that "TGS was giving the industry a direction for moving forward and that the update every four years was sending a signal pushing innovation further". During the interviews, it was also mentioned that the City is currently conducting consultations with developers in order to understand their perceptions and their understanding of Version 3. Hence, although there was no consensus amongst industry stakeholders about the feasibility of all targets, there was still a consensus that a tiered system was the right approach.

4.1.3 Changes in industry trends and benefits of Toronto Green Standards

This section will describe the perception of industry stakeholders as well as City of Toronto planners in what has been the effect of the TGS framework on industry trends and its main benefits. Two

major industry trends were repeatedly mentioned as positive outcomes of the TGS: one being the growth of skilled energy modellers, making energy modelling a common practice in the industry and a second being the increasing importance of the design community (architects, designers, planners) in changing the industry standards. These findings from the research interviews are aligned with a study conducted by the City of Toronto that highlighted workforce development and economic growth as outcomes of green building construction (Pembina Institute, 2019). This is also supported by the literature which emphasizes superior planning and design processes as essential component of sustainable high-performance buildings (Korkmaz et. al, 2010, Eseinberg, 2016).

Over the last ten years, the implementation of TGS has led the City of Toronto to conduct extensive stakeholders' engagement with industry experts, construction leaders and architects, which resulted in heightened industry knowledge and interest of energy modelling and energy performance of buildings. For example, Michael Singleton from Sustainable Building Canada pointed out how since the introduction of the TGS, the building industry in the Greater Toronto Area witnessed the unfolding of a community of experts in energy modelling and progressive architects and developers becoming more knowledgeable and experienced with achieving stricter energy targets. However, he also mentioned that energy consultants were often hired to consult on a project and provide predictable models for buildings energy consumption, without necessarily actually implementing higher energy standards. However, considering the tiered approach of the TGS and how the upcoming Tier 2 will become Tier 1 shortly, energy modellers building knowledge and expertise is an encouraging trend to observe. The creation of this new sub-sector of energy modellers not only has an impact on the construction of high-performing buildings, but also has some positive socio-economic impact such as an increased the opportunity for good quality jobs within the transition to a green workforce (Pembina, 2019).

The second trend observed as a result of the TGS implementation is the increased involvement and direct role of the design community (architects, engineers, consultants, interior designers, planners) in influencing and providing guidance and support for stricter buildings measures. In fact, as Eseinberg explains "*the design community has a distinct advantage of a 'middle out' role as they are situated between policy/regulation and clients/occupants and therefore have the possibility to transmit ideas and insights in both directions*" (Eseinberg, 2016). For example, during the interviews, Michelle Xuereb explained her role as a trained architect and the Director of Innovation at Quadrangle, to bring the design and building industry to achieve higher levels of sustainability in the built environment. In fact, she mentioned how the design community had a role to play in re-thinking buildings design given the new reality of climate change and its impact on the built environment. However, forward-thinking developers, landowners and builders

also have much to contribute to the process as well. Lastly, discussions during interviews highlighted the need for building design changes to be understood by elected officials and City planners in order to be aligned with regulatory reforms.

4.1.4 Inclusion of Resilience Checklist for buildings

This section will discuss the inclusion of resilience standards within building performance frameworks and within TGS specifically. In light of the expected changes in weather patterns and extreme weather events, the city of Toronto developed a resilience checklist, which was added to the already existing checklists for the five components of TGS. The City of Toronto's decision to develop this resilience checklist is supported by the literature which finds that *“the concept of resilience is increasingly recognized by researchers and practitioners as an appropriate framework for thinking about how to deal with the increasing uncertainties tied to a changing climate and could be a useful addition to regulatory thinking”* (Hassler & Kohler, 2014). In fact, the concept of resilience has been gaining momentum in academia and practice in response to “the damage caused by the overexploitation of resources” which causes the earth's climate to change and deviate from historical climate data (Roostaie, 2019). Resilience is a relatively novel concept both in government regulations and in the building industry and whereas the core idea of sustainability is to reduce negative impacts on the environment to avoid changes, resiliency is about adaptation to change (Roostaie, 2019). In that sense, the TGS is integrating a completely new aspect within its framework, which will undoubtedly have an impact on the building design and operations going forward.

The role of resilience within building design and performance metrics to address the hazards tied to climate change was discussed with almost every stakeholder interviewed. Most of the participants were aware of the newly introduced resilience checklist under V.3 of TGS, however the industry stakeholders were not particularly well-versed about it since it is still only a voluntary measure under Tier 2. During the interviews, the City planners interviewed mentioned that the intended goal of this resilience checklist was to integrate the TGS within the broader climate change planning framework (TransformTO and the Zero Emissions Buildings Framework) of the City of Toronto, which guides the development of the city. For the applicants (developers submitting a building development plan to the City), the purpose of this checklist is to help them “consider the impact of a future climate on the well-being of their occupants” (City of Toronto, 2017).

For the moment, the checklist consists of voluntary standards under Tier 2, which encourage building design teams to consider the key impacts of climate change on their design and incorporate measures to

improve building safety and occupant comfort during extreme events (City of Toronto, 2017). The checklist covers energy performance modelling criteria, modelling assumptions on temperature, extreme heat events and flooding events, thermal resilience and safety measures, flood mitigation measures and manager and tenant preparedness measures (City of Toronto, 2017). For developers, the checklists can be interpreted as a breakdown and simplification of potential climate risks into specific and practical guidelines for building construction. It will be interesting to observe if and when these guidelines become mandatory, the industry's adoption rate of more proactive adaptation measures to climate change.

4.2 Challenges and limitations

This previous section discussed the industry perception of TGS, how the framework was perceived by industry stakeholders as well as what the City's vision of the framework, according to City planners. The actual numbers of TGS applications were discussed, as well as some of the reasons for developers to pursue or not TGS standards beyond Tier 2. Three main barriers were discussed: lack of interest from the client, lack of financial incentives for commercial buildings or difficult or unachievable targets for specific project site. Some key components of TGS standards such as stormwater retention, energy efficiency and bird friendly glazing were also highlighted as particularly successful in their implementation, although not always progressive enough according to a few stakeholders. Overall, the tiered approach was perceived as an effective which allowed to level up the playing field for the building industry. The previous section also discussed two main trends observed as a result of the TGS implementation which was the increased expert knowledge in energy modelling and the enhanced role of the design community in designing buildings and shaping policies. Lastly, the previous section discussed the newly introduced resilience checklist, which is a positive trend, but still largely under-adopted within the building industry.

This section will build upon these perceptions and observations from stakeholders to elaborate on two main challenges in the implementation and effectiveness of the TGS. The first challenge that will be discussed is the regulatory gap between TGS municipal application process and the verification and benchmarking by the provincial government. In turn, the regulatory context and the lack of enforcement creates a possible building performance gap, and this challenge will also be examined.

4.2.1 Regulatory landscape

A major challenge facing the implementation of the TGS, especially in verifying the effectiveness of the framework on building performance as it relates to energy efficiency, is the disconnect between the municipal bylaws and the provincial regulation. In fact, this gap exists between the time developers submit

a mandatory Tier 1 application, which is processed and evaluated by the City of Toronto and the mandatory benchmarking requirements from the Ontario Government. In fact, the City itself does not follow-up with developers after the application and commissioning process is done and approved. Hence, there is a time lag between the moment the development application gets approved by the municipality and the moment the Ontario government requires mandatory energy and water reporting.

Ontario has a benchmarking policy in place under the Green Energy Act for energy enabled by Bill 135 for energy and water consumption of large buildings, which applies to all buildings in the province, including in Toronto. This Act that came into effect in June 2016, which is the first provincial scale energy and water reporting initiative in Canada for privately-owned large buildings has many benefits for building developers and building owners. It requires building owners to measure and report the building's energy and water consumption and share the information with the provincial Ministry. Disclosure of building energy performance information can motivate building owners to compete with one another and strive to improve their building performance over the years. It can also allow property and financial markets to compare building performance and value efficient buildings, enabling market forces that can drive efficiency investments (CAGBC,2017).

However, as it was observed during the interviews with City planners, the data coming from this provincial policy is large-scale and anonymized and cannot be used to verify compliance or interpret policy effectiveness of TGS in the development of new buildings. During the interviews, City Planners described this as a dual process where buildings are expected to perform at the TGS levels, but the enforcement only occurs at the provincial level, which results in a performance gap. The following section will describe this performance gap and explain in greater details how the challenging regulatory context and the lack of enforcement of the Toronto Green Standards might explain a performance gap, and in turn how this is an area of the regulation that requires further attention.

4.2.2 Lack of enforcement and performance gap

Regardless of the minimum green building standard, it is vital for a mandatory or incentive-based green building policy to create effective mechanisms for documenting and verifying compliance. It has been highlighted in multiple interviews that the lack of verification and enforcement probably creates a gap between expected performance of the building and actual performance, both in terms of energy efficiency and other sustainable metrics and targets. As explained in the previous section, this performance gap is the result of the disconnect between TGS being a municipal regulatory framework and the reporting and benchmarking being a provincial effort.

In terms of energy performance, energy modelling allows to predict with a certain level of accuracy how a building is going to perform, and this is the assessment for which the City of Toronto officials accept or not development applications. However, once this modelling has been approved, the City currently doesn't conduct any form of verification or tracking of these new buildings, to assess whether or not they perform at the levels indicated by the energy models. During the interviews it was mentioned that a few studies mandated by the City in collaboration with Sidewalks lab had been conducted and were looking at high performing building (building designed respecting higher Tiers of the TGS). According to City planners interviewed, the City determined that the actual performance gap between expected energy efficiency performance and actual building performance, of the buildings monitored, was around 15%. This number is considerable, although still reasonable and expected, given that models are not perfect and variations is normal. However, this gap for building under Tier 1, the mandatory requirements that the overwhelming majority of buildings comply to, is expected to be even larger, according to City officials. Hence, the City is suspecting that some new developments are not performing at the mandatory TGS mandatory level. Since energy efficiency is not currently being tracked by the City, there is a lack of accurate information regarding this gap. To mitigate this issue, the City undertook voluntary energy audit of certain buildings by asking property managers to provide their utility and energy data, where City staff conducted in-house analysis to have a better understanding of the real performance gap. However, this initiative is not systematic and will not provide conclusive and accurate conclusions.

On a more general note, the City does not have any sort of enforcement mechanisms for industry compliance to the Toronto Green Standards for mandatory applications, which consists of the vast majority of the new buildings development. This is different for Tier 2 to Tier 4 applications, which are required to be third-party verified and certified as having met the requirements of the TGS (City of Toronto 2017). This lack of tracking and enforcement has been highlighted by a few industry stakeholders. For example, industry stakeholders mentioned not getting a lot of comments and feedbacks upon the submission of energy reports (required during TGS application) and this in turn creates the risk of energy modellers being able to "game" the system. It is also unclear whether or not the City measures the impact of other specific standards, such as stormwater management metrics, and whether or not they have achieved the targets they set for the City. The lack of enforcement and compliance promotion regarding energy targets and other targets prevents TGS to fully be adopted and for green building practices to become widely accepted amongst the industry. If developers think they can get away with not complying to stricter standards, they will continue to conduct business as usual. To prevent that from happening and to maintain industry's interest and, the City should adopt more systematic measures of tracking and enforcement.

5. Discussion and recommendations

The previous section elaborated on two main challenges TGS is facing in its implementation. One being the regulatory landscape and the disconnect between the municipal and provincial regulation and the other being the lack of enforcement resulting in an energy performance gap. Non-withstanding these challenges that were discussed, the consensus is that the TGS is needed and that the tiered approach framework is effective at signaling upcoming standards to the industry. Expanding on the previous sections, from the industry perceptions of the TGS impact and its effectiveness, to the challenges and limitations of the framework, this section will discuss the main findings in the broader context of green and sustainable building practices. This section will provide some policy recommendations to improve the collaboration between the City and building industry stakeholders. Specifically, this research findings have led to three main recommendations: the mandatory inclusion of resilience standards, the need for increased tracking and enforcement and the need for further partnership between the design community and the City in creating standards and implementation guidelines. Lastly, all findings being considered, this section also discusses how the TGS had an impact on industry green practices and what remains to be seen for improved sustainability practices in the building industry.

5.1 Making resilience standards mandatory

As it was presented above, the City recently implemented a resilience checklist for Tier 2 applications, which is currently on a voluntary basis. Based on interviews discussions and the literature review, this research recommends making resilience standards mandatory, as well as provide the industry guidelines and training opportunities on those standards. However, resilience being a relatively new concept for developers and some stakeholders in the industry, the integration of resilience within the TGS framework requires developing a new combined assessment tool or a thorough refinement of current standards to include resilience indicators that were not initially included. For such a unified framework to be established successfully, the active involvement of different stakeholders in all stages is necessary (Roostaje, 2019). The checklist is a good starting point; however, it is inconsistent to only have higher tiers to implement it. Additionally, creating it as a “separate” set of standards and requirements to follow can create confusion in the industry, which could lower the adoption rate of resilience measures. Hence, this is why the resilience standards should be included within each of the five components of TGS, or if some of them don't belong in any category, add new components to the existing framework. This recommendation is aligned with stakeholder's views, as in most of the interviewed stakeholders mentioned how climate change hazards impact on buildings were significant and needed to be better understood and incorporated

within building design and construction. As such, with the regulatory framework for buildings should incorporate mandatory measures that addresses the increasing uncertainties tied to a changing climate. Lastly, a mandatory inclusion of resilience into the TGS would demonstrate alignment between the framework and the overall goals of the City from their Climate Change action plan (TrasnformTo).

5.2 Tracking and enforcement

Since its implementation, the TGS had an important impact on industry practices, such as introducing energy modelling and over the years has made stakeholders more aware of energy efficiency techniques. With new modelling techniques and especially with the introduction of the absolute metrics as the mandatory metrics this year (2020), it is crucial for the City to make sure developers follow through with their applications. During one of the interviews, one architect mentioned that she believed many developers are going to be extremely surprised at how hard it is to meet those targets. That being said, the City historically performed well at raising the bar for energy performance levels, hence this is in their best interest to continue proactively supporting developers in reaching mandatory targets.

The lack of tracking and verification of new buildings performance is a major drawback of the TGS, as it was previously elaborated on. Although the City currently employs energy modellers to review the applications of buildings, there is no systematic follow-up on the building performance once the building is built. Based on this research findings, it is recommended that City study the technical and financial feasibility of implementing an additional step in the TGS framework, which would seek to verify and track the performance of buildings for all mandatory applications, not only voluntary applications. Verification and data tracking are important for all of the green standards within the TGS, however, considering that energy has the most significant impact on the climate (especially in terms of GHG emissions), energy should be the first component to be audited in a systematic manner. In fact, “requiring the tracking of performance, as well as reporting and disclosing data, will promote a better understanding and evaluation of building performance and the impacts of energy codes, which in turn accelerates market transformation” (Pembina, 2015). In addition, demonstrated building performance compliance by verification and tracking of energy use data will help to improve the performance gap over time.

In addition to recommending the verification and tracking of the TGS energy standards, this research recommends implementing parallel strategies such as researching the feasibilities of the City obtaining energy consumption information from utilities companies. As it was mentioned in previous sections, the current disclosure of energy data is the result of the provincial regulation and is anonymized, hence cannot be tracked directly to specific buildings. If the data is not available from utilities, and if owners

or buildings are not willing to disclosure and share their energy consumption, the performance gap will remain, and it will be difficult to accurately measure the effectiveness of TGS on buildings energy performance and whether or not the City actually reaches its energy targets . Thus, is it recommended that the City studies how energy data can get obtained and benchmarked and how this process can be embedded into the broader framework of the TGS (Pembina, 2015). For the ease of implementation, this could be done on a neighborhood-scale at first, or with a selected number of new building as a pilot for the first year, then deployed to the whole jurisdiction. Another option to enforcement, would be to require developers to use a prescribed modelling software specified by the regulation, following the Danish approach. This method would ensure consistency in energy modelling outputs and would mitigate some of the risks of developers “gaming” the system, as one interview suspected. This option, however, doesn’t replace the need for rigorous and systematic post-construction performance tracking. Lastly, it is important for the City to improve communication with the industry by sharing the results of the benchmarking activities and the industry progress in order to create a collective feeling of responsibility towards the achievement of the targets set out in the TGS.

5.3 Industry-City collaboration

Lastly, the interviews findings from this research indicate the need for enhanced partnership between the industry and the City, especially with the design community. The increased role of the design community has been previously discussed as a positive trend resulting from the implementation of the TGS. Nonetheless, the need for a better partnership exists as to create proper guidelines and implementation measures, given the increased stringency of certain standards. From the interviews, it was gathered that the industry and the design community in particular has been involved in most of the ongoing consultations, hence their input are being considered. However, not all developers are as aware of the best practices in terms of building design and construction as the design community might be, thus it is recommended that the City explores new ways to partner with the design community to bridge this knowledge gap. It is recommended that the City invest in green building training, education and targeted apprenticeship programs that target the standards within TGS which are becoming more stringent over-time such as energy efficiency and stormwater management.

This allows to further level-up the playing field by supporting development companies and other industry stakeholders that might not be as knowledgeable. Fostering industry partnership with the City will also serve to foster innovation and empower more developers to have the skills required to design, build and operate higher performance buildings (Pembina, 2015). Lastly, by providing technical and targeted

advice on best practices at no cost to developers this will increase their familiarity with TGS high-performance standards as well as create a network of industry professional advisors.

6. Conclusion

This research aimed to understand how local government requirement for green building influenced industry practices and trends and how key building and development players perceived and interacted with municipal regulations. Specifically, this research was interested in conducting an analysis of the city of Toronto and its framework the Toronto Green Standards, to understand how the policy was driving or not the design and development of green and sustainable buildings.

The starting point of this research was the recognition of the overwhelming climate impact of cities and of buildings within cities as well as the important role local governments can play by implementing effective strategies and action plans to reduce the carbon footprint of cities. Global movements such as C40 have brought to the fore front local governments' role in fighting climate change, which led many cities around the world to create Climate Action plans, with an important focus on decreasing building GHG emissions. Locally, this led the City of Toronto through its Climate Action strategy (TransformTo) to target 65% emissions reduction below 1990 levels by 2030, with a goal to set a path that would lead to meeting the target for Net Zero Carbon Emissions for new buildings by 2050. At the same time, this research highlighted the fragmented nature of the building and development industry and the challenging regulatory landscape of building policies, making the implementation of such framework challenging in many ways. To understand these barriers and how municipal building policies can influence industry practices, this research analyzed the impact the City of Toronto's approach.

The Toronto Green Standards is an innovative tiered-approach framework, which reflects to some extent what other progressive jurisdictions around the world, such as the City of Vancouver and Denmark are also doing. The TGS has lived many iterations since its first implementation in 2010 as a voluntary measure and its latest version (V.3), which introduced absolute performance metrics targets, allowing the industry to gradually level up to the standards. The framework has been able to incrementally raise the stringency of building requirements and it has certainly been a driver of the construction of more sustainable buildings in Toronto. The latest version of TGS is significantly more progressive and aligned with the City ambitious climate goals. However, given the urgency of climate change and the need to scale-up the industry collective efforts to reduce GHG emissions, this research was interested in assessing how this framework was received by the industry key stakeholders and how it had impacted industry trends. The

industry being so fragmented, this research selected stakeholders from different horizons such as architects, energy modellers, developers and industry consultants to get a holistic perspective.

Through interviews discussions, it was established that the tiered approach had many benefits, such as signaling the next steps companies will have to take in order to fulfill the minimum requirements. The TGS also impacted industry trends in a positive way, for example, by enabling the creation of the energy modelling sector, by involving the design community to create policies that match industry's needs and by raising awareness about the need for the inclusion of resilience measures into building performance. These industry trends show that the framework is partly successful in influencing industry stakeholders in thinking proactively and looking for ways to meet the new requirements, especially the most challenging ones such as energy efficiency. However, as more stringent requirements are introduced, there were some significant doubts about the financial and technical feasibility of achieving those targets. Additionally, the biggest drawback highlighted was the lack of systematic tracking and enforcement, which potentially creates a performance gap in terms of how the City believes new buildings are performing and their actual performance. This is a major challenge for the City because as they don't necessarily have the regulatory power to require energy performance disclosure, which is currently being benchmarked by the provincial government with only aggregates and anonymized information being available. Possible improvements of the TGS to maximize industry adoption rates include; increasing tracking and enforcement measures, creating special partnerships with the design communities to reach a broader spectrum of developers and finally to fully integrate resilience into the mandatory requirements.

The City of Toronto is in a good position to implement these recommendations since they have been leveraging industry collaborations since the start. The important step that remains to be accomplished is in ensuring the vast majority of developers understand new standards and have the necessary tools to design and build high-performing buildings. To conclude, as climate change is forcing us to re-imagine our built environment, bold thinking and bold actions will be necessary and will require the participation of all industry stakeholders.

Appendices

Appendix 1: Literature review questions

- **What is the impact of building construction on GHG emissions and climate change?**
 - What does the IPCC/Industry reports trends say?
 - What is the situation in Canada?
 - What is the specific impact of commercial buildings?

- **What is a green, sustainable, carbon neutral and resilient building?**
 - What are the characteristics of green, sustainable resilient design?
 - What is the impact of green/sustainable/resilient building as opposed to a traditional building?
 - What are the costs and benefits of Sustainable Building?
 - What are the best building technologies to mitigate climate change?
 - What are the trade-offs and synergies between each other?
 - Why is there a gap between design and implementation?

- **What is the process of commercial building design, construction and operations?**
 - What are the steps?
 - Who's involved and at which step?
 - What is the relationship between the different stakeholders?
 - Who's making the decision regarding green/sustainable requirements?
 - Who is financing the construction?
 - What is the cost structure or commercial building construction?

- **What is the market for commercial buildings construction in Canada and specifically Toronto?**
 - What are the main trends?
 - Who are the investors and developers?
 - What are the main perceived barriers to build green?
 - What are the legislations regarding building development (Ontario Building Code)?
 - What are the financing mechanisms to promote sustainable building construction within TGS?
 - What is the construction industry relationship with TGS policy makers?

- **What are other jurisdictions policies regarding sustainable building requirements?**
 - Is the TGS similar to other municipal policies in Canada? Vancouver?
 - Are other jurisdiction implementing municipal policies going beyond the building code?
 - Similarities/differences
 - What financial mechanisms are employed?

Appendix 2: Interview Schedule

Name	LinkedIn	Contact	Category	Notes	Contacted on	Meeting on
Adam Barker	https://ca.linkedin.com/in/adam-barker-65519124	abarker@eqbuilding.com	Real Estate Development	Participated in the design of Tier 3 TGS	2020-01-15	Meeting: Wednesday January 22nd (2:30pm)
Leona Savoie	https://www.linkedin.com/in/leona-savoie-863b853b/	leona@hullmark.ca	Real Estate Development	Vice-president Hullmark	2020-01-15	No reply
Jiri Skopek	https://www.linkedin.com/in/jiri-skopek-566b0320/	jiri@skopek.ca	Planner	Involved with the original draft of the Toronto Green Standards	2020-01-15	Interview after February 10th
Mike Singleton	https://www.linkedin.com/in/michael-singleton-287b4313/	mike-singleton@rogers.com	Real Estate Development	Executive Director of Sustainable Buildings Canada	2020-01-15	Meeting: Monday January 20th (1:30pm) Will be with Adam Jone
Michelle Xuereb	https://www.linkedin.com/in/michelle-xuereb-b6015010b/	mxuereb70@yahoo.com	Real Estate Development	Director of Innovation at Quadrangle & She's a star	2020-01-15	January 29th-10 am (in person)
Mike Williams	https://www.linkedin.com/in/ec03mikewilliams/	Mike.Williams@RWDI.com	Real Estate Development	Vice-president Buildings RWDI & board member at S.B	2020-01-15	Phone call: Monday January 27th (1pm)
Lisa King / Joshua Wise	https://www.linkedin.com/in/lisa-king-ma-99287442/	sustainablecity@toronto.ca, lking4@toronto.ca	Planner (Senior)	Senior Planner City Planning Division// She has been central in the development and scaling up of the Toronto Green Standard (TGS),	2020-01	January 24th-11 am
Jeff Ranson			CAGC-industry peers			Potentially Jan 1st or February 3rd
Brandon Law			Real Estate Development		2020-01-20	Phone call 2020-01-28 (at 1pm)
David McMillan			City of Toronto	Referred by Brandon Law		Phone call 2020-01-31 (11:30 am)

Appendix 3: Interview questions

Questionnaires

For the purpose of this research, the researcher developed two sets of questionnaires. The intention is to focus the questions according to the two main groups of stakeholders interviewed. First, the aim is to interview 4-6 Real Estate Developers or industry consultants in order to get their perspective about TGS and how they experienced implementing the standards. Second, the goal is to interview 2-3 City Planners or people involved in the design and framing of the TGS, in order to get a better sense of the context and the policy development of TGS.

City of Toronto and Planning division:

Questions on the design and process of implementing TGS

Real Estate Developers:

Questions on their experience implementing TGS or their observation from an industry perspective.

To be asked by the researcher at the beginning of each interview:

1. Have you received the information letter about the study?
2. I will review the consent form with you to seek your informed consent for participation in this study.
3. [Explanation of consent form].
4. Do you understand what this study involves and agree to participate?
5. Make sure that the participant retains your contact information for any follow-up questions.

Questionnaire A: City of Toronto and Planning division

1. Introduction

- What is your role at the City of Toronto?
- What is your involvement in TGS? Past/Present

2. Framing and design of TGS

- To you, what is the main purpose of TGS?
 - Is it to tackle GHG reductions? Climate Targets?
 - Is it a financial mechanism?
- Why choosing a Tier approach? And voluntary/mandatory approach?
 - Was it inspired by other similar policies? (Canada or the rest of the world)
- What are the intended benefits of TGS?
 - As opposed to other approaches/ policies?
 - Environmental? Financial?
 - What is your understanding of sustainability?
- What factors were considered when developing TGS?
 - Was there any significant trade-offs (simplicity vs. complexity)
 - Is one of the (5) categories been given more importance?
- What kind of developers were the main/target market for TGS?
 - Are the TGS equally applicable for smaller and larger developers?
 - Are the TGS targeting different sectors? Commercial/residential?
- In your opinion what is the relationship between TGS and other certification (i.e LEED)?

3. Impact of TGS on green building practices

- What have you learned or observed since the implementation of TGS in Toronto?
 - Did your attitude/understanding towards sustainability changed since the TGS have been implemented?
- How did TGS evolved since its implementation?
 - Did it have many iterations? Added/changed requirements?
- As a City Planner, what do you think TGS changed in the industry practices?
 - Do you have an idea of what % of new construction go beyond Tier 1?
 - Have you seen improvements in one particular category? (out of the 5) Why?

4. Do you have anything you'd like to add?

- Anyone else you recommend I speak to? Any questions you would like to ask me?

B. Real Estate Development

1. Introduction

- What is your role at X company?
- What is your involvement with TGS? Past/Present

2. Adopting TGS practices and requirements

- Did you/your company decided to follow TGS standards beyond Tier 1?
 - If yes, Why? If not, Why?
- Do you believe it should be a tiered approach?
 - Or should it be all mandatory, all voluntary?
- What are the main benefits AND drawbacks of TGS for your company?
 - Environmental? Financial?
 - In principle and in practice? Are there any gaps?
- In your opinion what is the relationship between TGS and other certification (i.e LEED)?
 - Is it complementary to other certification?
 - Did it incentivize your company to seek further environmental certifications?

3. Impact of TGS on green building practices

- What have you learned or observed since the implementation of TGS in your company's projects?
- Did TGS changed your company's practices?
 - If yes, How?
 - What is the impact/effectiveness of TGS in the sustainability performance of your buildings?
 - As it relates to the 5 categories, is there one category that has been easier to implement or that has been particularly successful?
- Did your attitude/understanding towards sustainability changed since you implemented TGS into your projects?
 - Do you think the TGS is aligned with achieving sustainability and climate goals?
- What do you think is the goal of Real Estate Developers in achieving sustainability/climate goals?
 - Is it to follow policies like TGS? Or to go beyond?
 - Is it the municipality's/ government roles to enforce further green building requirements? Or is the industry's role to push for greener practices?
 - What is your industry peers attitude towards TGS?

4. Do you have anything you'd like to add?

- Anyone else you recommend I speak to? Any questions you would like to ask me?

Appendix 4: Interview consent form



Neila Vorano

Master of Science (MSc.) in Sustainability Management
University of Toronto

John Robinson

Professor, Munk School of Global Affairs and Public Policy and School of the Environment
Presidential Advisor on the Environment, Climate Change and Sustainability
University of Toronto

For this study on TGS and green building practices, the researcher will be asking questions about your understanding of the dynamics between municipal building policies and green building practices in the industry.

Participating in the study will take approximately **45 minutes**.

You are under no obligation to agree to participate in the interview/survey. You may refuse to answer any question or stop the interview/survey at any time or withdraw from the study before March 24, 2016.

Your specific answers and comments will be kept confidential and only available to the researcher **Neila Vorano** and her supervisor **John Robinson**. Your name will not be identified publicly unless you give the researcher permission to do so. All data pertaining to this specific interview/survey participation will be destroyed once the study is concluded.

You are free to raise questions or concerns with the researcher, **Neila Vorano**, and her supervisor, John Robinson, the course coordinators, Barbara Murck and Soo Min Toh, throughout the study. You may also contact the University of Toronto's Office of Research Ethics at ethics.review@utoronto.ca or 416-946-3273 if you have questions about your rights as a participant.

I, _____, understand what this study involves and agree to participate.

[If applicable] I agree to have the interview tape recorded.	Yes	No
I agree to be identified by organization in the research paper	Yes	No
I agree to be identified by position title in the research paper	Yes	No
I agree to be identified by name in the research paper	Yes	No
I wish to receive a summary of the research paper	Yes	No

Signature: _____

Date: _____

Appendix 5: List of all barriers to achieving beyond Tier 1 standards

1. Lack of interest from the client
2. Lack of financial incentives (mostly for commercial buildings)
3. Lack of internal knowledge within organization about green standards and strategies to achieve sustainable targets
4. Uncertainty of the timeline regarding the incentives
5. Difficult or unachievable energy targets for specific project site
6. Version 3 Tier 2 switch to absolute metrics target, which are much harder to achieve (whereas Tier 1 do not require absolute metrics)
7. Building air infiltration testing and full thermal bridging calculations are new to the industry and people are not used to doing it
8. Lack of experience working with absolute metrics
9. Difficult or unachievable stormwater management targets for specific project site
10. The gap between V.2 and V.3 was too big
11. Tier 2 energy targets requires significant design changes that may not be financially feasible
12. Lack of knowledge on how to achieve Tier 2 (V.3) targets
13. Perceived as another layer of regulatory requirements
14. Lack of communication and awareness about the TGS (People are not paying attention to the City's updates in targets and metrics)

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