Energy and Air Tightness Background

Introduction

This attachment provides background information on the energy and air tightness targets recommended for the High Performance Civic Building Policy (the Policy). Setting specific energy and air tightness targets for new civic buildings will reduce energy consumption and greenhouse gas (GHG) emissions. It will improve thermal comfort, provide better humidity and condensation control, and affirm the City of Saskatoon's (City) commitment to high performance buildings.

Energy Targets

Two types of energy targets are being recommended for the Policy, Energy Use Intensity and percent better than code. Energy targets for the policy were developed based on information from multiple sources, including: Canadian national mean values, average Energy Use Intensities for existing City buildings, Passive House criteria, ASHRAE Advanced Energy Design Guide – Achieving Zero Energy, and targets set by other municipalities. The Energy Use Intensity targets are specified for offices and fire stations only due to available performance data and guidelines for these building types. Setting specific Energy Use Intensity targets for other building types would require an in-depth analysis, including energy modelling, feasibility analysis and engagement with industry. For other building types a percent better than code target is recommended.

Energy Use Intensity

An energy use target represents the buildings total energy use per unit of modelled floor area, taking into account electricity and natural gas consumption. Whole-building absolute energy use targets provide clear energy performance goals that leave no room for interpretation.

Some benefits of setting energy use intensity targets are:

- Provide a directly measurable target that enables clear and straightforward determination of energy performance success;
- Compel design and construction teams to realize energy performance goals by explicitly including energy targets in contractual documents; and
- Emphasize the importance of capturing whole-building energy use, as opposed to a subset of building energy uses required for compliance with building codes or certification programs.

Saskatchewan's electricity grid is largely made up of non-renewable sources, because of this Saskatchewan has some of the highest per capita GHG emissions in the world. Setting an Energy Use Intensity for the whole building will ensure that building GHG emissions are reduced though the reduction of electricity consumption.

Percent Better than Code

Percent better than code compares a proposed building to a fictional reference building having the same design but built to the minimum prescriptive requirements of code. The outcome of the process is a statement that the proposed building is a percentage better than its reference building but does not provide an actual prediction of the energy consumption of the proposed

building. This type of target can be applied to all building types which is why it is being recommended for the policy.

National Energy Code of Canada for Buildings

Saskatchewan adopted the National Energy Code of Canada for Buildings (National Energy Code) 2017 January 1, 2019. The National Energy Code 2020 is expected to be published December 2021, with Saskatchewan adopting it within a year of release. One of the significant changes to the 2020 model code is the addition of tied energy performance compliance path. A tier 1 compliant building must consume 100% or less than the modelled reference buildings energy target. Tier 2,3,4 must consume 75%, 50% and 40% of the modelled reference buildings energy target, respectively.

Table 1: National Energy Code 2020 Energy Performance Tiers

Tier	Overall Energy Performance Improvement of Proposed Building Compared to Reference Energy Building
1	100%
2	75%
3	50%
4	40%
Original Tier 4	25%

The original tier 4 target was set at 25%, a target that would have aligned code with the goal of reaching the *Pan-Canadian Framework on Clean Growth and Climate Change* (Canadian Framework) Net-Zero energy ready target by 2030. The Canadian Framework commits provinces and territories to adopt a series of model building codes requiring increasingly higher levels of energy efficiency. Under the plan, by 2030, every new building going up in the country will be required to meet a net-zero-energy-ready level of performance. The 2020 model code introduces significant changes and a path towards a net-zero energy ready building however, it is still falling behind the Canadian Framework goals and we will need to do better to ensure that the City is on track.

Energy Targets across Canada

The Federal government released an updated climate action plan in December 2020 that builds on the *Pan-Canadian Framework on Clean Growth and Climate Change*. The plan included targets for Government of Canada buildings including: ensuring new federal buildings are net-zero, low-carbon building retrofits reducing embodied carbon in construction projects by 30% starting in 2025, and ensuring 75% of domestic office floor space will be net-zero carbon and climate resilient starting in 2030.

The City of Edmonton (Edmonton) adopted their first Sustainable Building Policy in 2007. The policy established the Edmonton commitment to environmental leadership in the design and construction of City-owned buildings. A decade later Edmonton revisited their policy and provided an update to renew their position as a municipal leader in sustainable building practices. April 2021 a new Community Energy Transition Strategy and Action Plan was

approved by Edmonton City Council. This plan included a Climate Resilience Policy that will integrate climate adaption planning and requirements for City buildings. Table 2 outlines the progression of Edmonton's energy targets.

Table 2: City of Edmonton Energy Targets for New Construction

	2007	2017	2021
Energy Targets	30% greater than Model National Energy Code for Buildings (~National Energy Code 2011)	40% greater than National Energy Code 2011 TEDI* (ekWh/m$^{2)}$ Offices: 50 Other: 80	Emission Neutral Buildings

*TEDI= Thermal Energy Demand Intensity

The province of British Columbia (BC) developed their own Energy Step Code. The code has five performance steps for new construction, the lowest steps meeting code and the highest step achieving net-zero ready. The step code is not mandatory in BC, however over 70 local governments are now referencing the code in a policy, program, or bylaw. The creation of the step code has removed the need for local municipalities in BC to create their own energy performance targets.

Air Tightness

Building airtightness refers to a building's resistance to air leakage—air flowing both in and out of the building—through areas of the building enclosure not intended to allow air flow. Air tightness is an important factor in a building's performance, a tight building can improve occupant comfort, energy usage, and building durability.

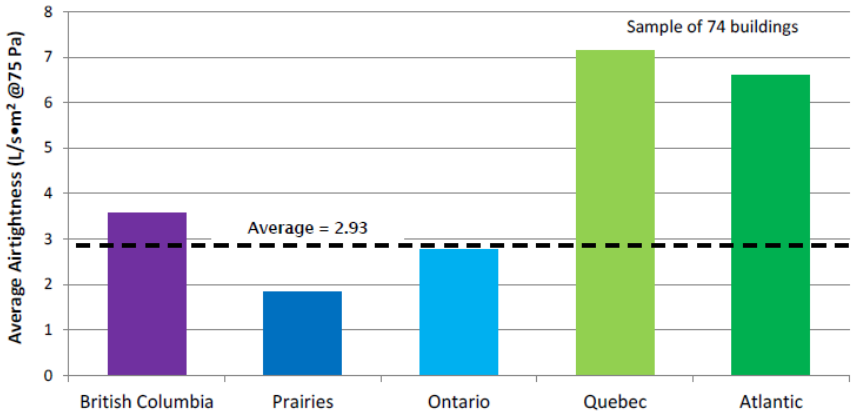
Air tightness can provide the following benefits:

- Reduced heat loss and therefore lower energy use
- Improved thermal comfort (less drafts)
- Reduced noise transmission
- Better humidity and condensation control

It is important to understand that improved air tightness cannot be completed in isolation and construction must also include a well-designed fresh air supply to ensure adequate ventilation.

Drawing courtesy of Touch 'n Foam Insulating Sealants

Saskatchewan is considered internationally as a pioneer in the area of envelope performance and the following figure from a study by RDH Engineering shows that on average the Prairies outperforms other jurisdictions in Canada.



Average Airtightness of Canadian Buildings by Location[1]

While the previous figure shows that on average the City of Saskatoon should expect a reasonable level of air tightness compared to other regions in Canada, the average of approximately 1.9 L/s·m^2 @ 75 Pa for the Prairies is still much higher than what would be considered "high performance". Table 3 provides a comparison.

Table 3: Air Tightness Values

Example	**Air Tightness [L/s·m^2 @ 75 Pa]**
ASHRAE 90.1-2019	2.00
Prairies average in RDH study	1.90
Assumed level of air tightness for an energy model of a LEED building in Canada	1.45
ASHRAE 189.1-2020	1.25
International Green Construction Code 2018	1.25
Passive House	0.5 (0.6 ACH)

The air tightness targets for the Policy were set to match the energy target options. There is a direct correlation between building energy consumption and air tightness. Having a tight envelope is a very important factor to reduce a buildings overall energy consumption. One of the main principles of Passive House, which is considered one of the most rigorous voluntary energy-based certifications, is airtight construction. Passive House requires an air tightness of 0.6 air changes per hour (ACH) @50 Pa. The targets proposed for the Policy range from 1.25 L/s·m^2 down to 0.5 L/s·m^2.

Air Tightness Requirements Across Canada

Air tightness requirements have not yet been specified in Canadian building codes. A proposed change to the National Energy Code 2020 included mandatory air tightness testing and specified a maximum air leakage rate. However, during public consultation the Canadian Commission on Building and Fire Codes directed that the mandatory air tightness testing requirements be removed. Across Canada there are only two jurisdictions that have mandated air tightness testing; the BC Energy Step Code and the Toronto Green Standard v3.

[1] RDH Engineering, Study of Part 3 Building Airtightness, Project 8980.00, http://rdh.com/wp-content/uploads/2016/06/Whole-Building-Airtightness-Testing-and-Results-Report.pdf