Advanced Energy Efficiency Requirements for Buildings in BC

Produced for:

Provincial Advisory Committee on Energy Efficiency

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Produced by:

INTEGRAL GROUP

Partnerned with:

BC hydro

CITY OF VANCOUVER

UDI Urban Development Institute Pacific Region

PEMBINA institute

Problem Statement

Both the Province of BC and the majority of local governments in BC have adopted aggressive Greenhouse Gas (GHG) reduction targets. Many of these targets at the local government level were a direct result of the Province's Climate Action Charter. This combined with the fact that GHG emissions from building operations represent a significant and growing portion of local government emissions[1] has resulted in more and more local governments developing green building and energy efficiency policies and incentive programs.

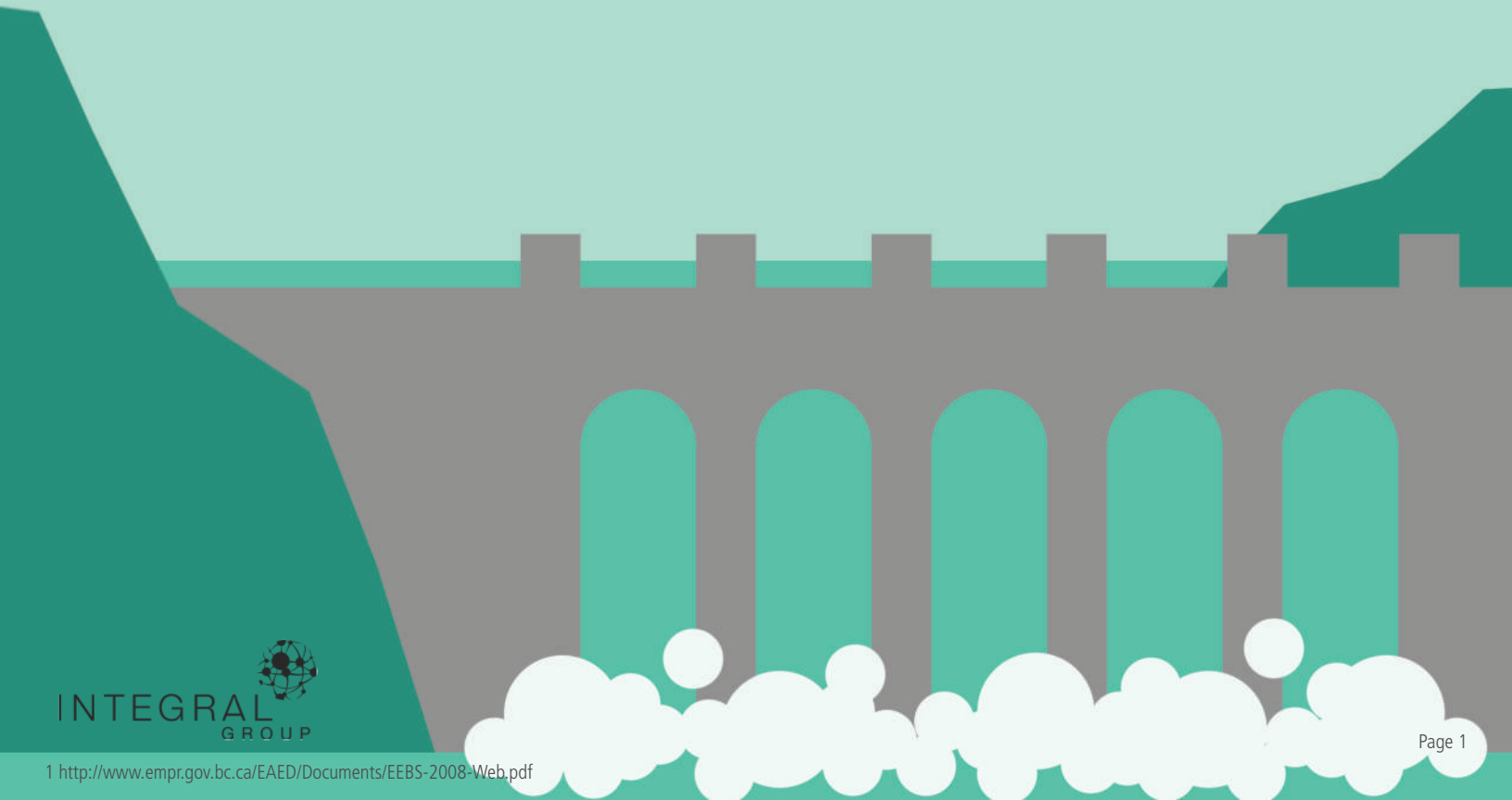
Concurrently there are also requirements that utilities provide demand side management programs which has resulted in utilities offering incentive programs for buildings to exceed current code requirements.

These green building policies and incentive programs overlaid on one another have resulted in a "patchwork" of better than building code programs and policies with regards to energy use in buildings. This collection of disparate requirements is difficult for the development industry to navigate and adds complexity to an already complex regulatory environment.

Two recent updates to regulations governing building practices in BC have caused local governments to review their approaches to encouraging or incentivising better than building code energy performance. The first is the updates to Part 10 of the BC Building Code (BCBC), and the second is the recently adopted Building Act (Bill 3 – 2015) which, in combination, have substantively changed the legislative landscape for local governments in BC with regard to energy efficiency in new construction. Specifically, the update to Part 10 of the BCBC increases the requirements pertaining to energy efficiency in new construction, and allows applicants to choose between ASHRAE 90.1 2010 and NECB 2011 when designing for energy efficiency.

The Building Act, meanwhile, aims at modernizing the building regulatory system in British Columbia. Specifically, the Act gives the Province overriding authority to define standards regarding building activities such as the construction, repair and demolition of buildings to ensure that building requirements are consistent across British Columbia. The central purpose of the Act is to explicitly centralize the regulation of building activities under the Province's direction, with the goal of streamlining the regulatory process and thereby reducing costs and improving efficiency.

The Building Act is in part a response to jurisdictions developing their own approaches to building regulation and policy in areas like fire and life safety, and it also affects approaches to energy efficiency. As noted above many of these local governments developed these requirements in response to Provincial policy requiring and making allowances for



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1 http://www.empr.gov.bc.ca/EAED/Documents/EEBS-2008-Web.pdf

Problem Statement continued

local governments to take action on climate change. Many local governments have used either the provisions under Bill 22, their Land Use Zoning powers or via process development to demand more energy and/or GHG efficiency from new construction. Many of these same jurisdictions were contemplating raising their green building standards in response to the new requirements under the BCBC. The addition of the Building Act and its intended purpose — to harmonize regulations and process in BC — compels these local governments to work together with the Province to explore how, and under what circumstances can a process be established that meets the intentions of the Provincial Government to both reduce uncertainty and divergent process but continue to enable local governments to use improved energy efficiency in new construction as a tool in meeting Provincially endorsed climate targets.

This white paper seeks to identify the critical components of a new approach that could provide both improved alignment and certainty for the building industry while also allowing local governments to push ahead with improvements to efficiency in new construction. The development of optional, harmonized, better-than-building-code energy requirements, for buildings are commonplace across the United States and typically referred to as "stretch codes." Given this, we will use the term stretch code in this white paper in discussion of application of the same concept in BC.

What will be included in this white paper?

A) A brief summary of the process used to develop the white paper;

B) Recommendations on what the components of stretch code should include; and

C) Recommendations on areas for further study in the development of a potential stretch code.

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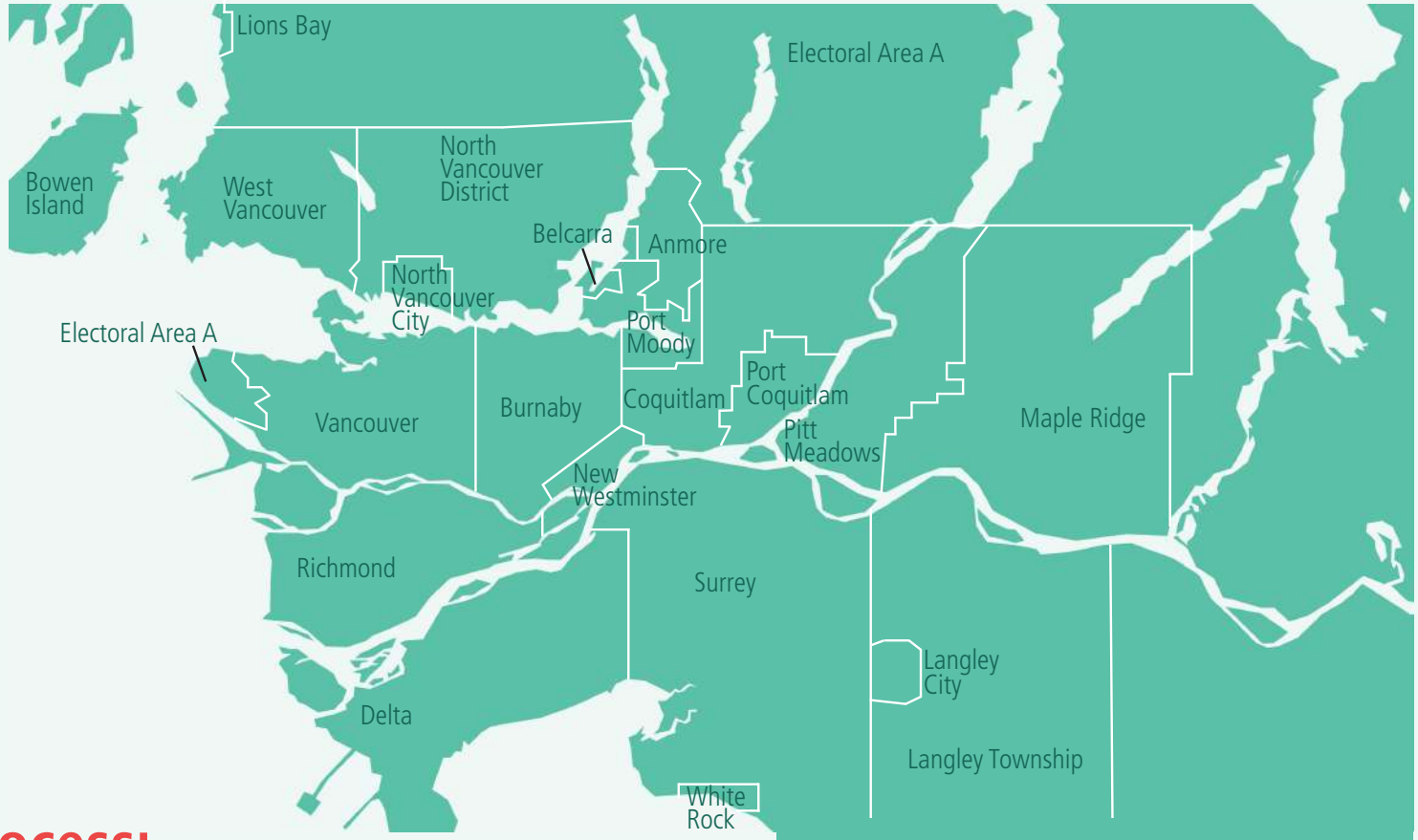

Process:

This white paper was developed with advice and input from a broad range of stakeholders with expertise in both local government, green building policy, incentive programs, real-estate development and energy issues, including the following:

- Staff from local governments that have either implemented or contemplated better than building code energy requirements
- Staff from utilities that offer incentives for energy efficiency in new construction and have expertise in developing building codes and regulation
- Representatives from the development industry
- Representatives from environmental NGOs that focus on energy, carbon, and the built environment
- Staff from Provincial Government ministries with an interest in energy, carbon and building regulations

This group met four times between November 2014 and March 2015. The intention of convening this group was to scope issues, identify potential strategies and develop consensus on what the core components of the stretch code should be.

The process used to develop the recommendations was to first develop consensus on what the objectives should be for a stretch code and then review potential energy regulation methodologies, targets, and overall program design. Funding for this study was provided by BC Hydro, and the City of Vancouver. The facilitation and analysis required to develop this white paper was undertaken by the Integral Group LLC.

It should be noted that the Province of BC is launching a formal process to explore options for furthering energy efficiency beyond the building code in May of 2015. It is hoped that this paper will help inform that exploration.

Local Governments:

- The City of Vancouver
- The City of Surrey
- The City of Richmond
- The City of Burnaby
- The City of North Vancouver

The Utilities:

- BC Hydro

Industry:

- The Urban Development Institute

The Environmental NGO Sector:

- The Pembina Institute

The Provincial Government:

- Building Safety Standards Branch
- Ministry of Energy
- Home Owners Protection Office/BC Housing (Crown Corp.)

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The advisory group's first task was to agree on a set of objectives for the stretch code itself. These objectives would inform the deliberations and recommendations of the advisory group and help to guide the evaluation of different options. The objectives are important as they generally indicate the aligned priorities for building energy policy from urban local government staff, utilities, development industry, environmental advocates and Provincial Ministry staff. It should be noted that the development and vetting of these priorities was not an exhaustive process and that the objectives below should be treated more as preference and advice rather than fully endorsed commitments.

Objectives for the Stretch Code:

A stretch code should:

A. Produce consistent and substantial "real world" energy and GHG reductions (scalable over time and for jurisdictions with different market characteristics).
B. Prioritize passive design and building envelope design over equipment design (minimize energy demand first, then maximize efficient equipment).
C. Be a tool that can be used for at least the next 10 years (related to objective "A").
D. Be able to consistently deal with existing and future low carbon energy systems.
E. Lead to improvements in process development that improves compliance and meets the needs and abilities of local governments.
F. Capture and track data on program performance and improve our understanding of building energy use.
G. Be developed by means of consensus among key stakeholders.

Discussion:

Analysis of buildings in the Lower Mainland region has shown that while energy standards in North America for commercial buildings have become more stringent over time, this has not correlated to lower absolute energy use in new buildings. [2] Data from the City of New York's latest benchmarking report also suggests and that energy use in buildings is actually increasing both in intensity and absolute values despite stricter standards. [3] Both findings suggests that if a stretch code for BC is being contemplated then this might be an opportune time to re-examine the current approach to both the standards and the administration of their enforcement.

3 http://rdh.com/case-studies/energy-consumption-multi-unit-residential-buildings/
4 http://www.nyc.gov/html/planyc/downloads/pdf/publications/2014_nyc_ll84_benchmarking_report.pdf

As part of the process for developing this white paper, three general approaches to energy regulation in buildings were looked at.

The Prescriptive Approach:

The prescriptive approach can generally be defined as an itemized list of building performance requirements that impact energy usage. This generally includes requirements for building envelopes, mechanical systems, and electrical systems including lighting. The prescriptive approach is generally either the foundation or included in some way in all modern energy codes such as ASHRAE 90.1 and the NECB.

The Reference Building Approach:

This is one of two methodologies to energy standards that can be defined as a "performance approach". It is referred to as "performance" because it is based on overall performance of a building rather than its component parts. The reference building methodology requires that a design team develop a "reference building," usually defined be prescriptive elements, to which the design team proposes different design strategies that result in equivalent or lower overall energy use.

Target Based Approach:

The second "performance approach" is the target based approach. This approach defines an absolute energy use or emissions target for a building usually based on energy consumption per unit of floor area expressed over time. The most common expression of this is Kilowatt Hours/Square Metre/Year (kWh/m^2/yr). This approach is common in European codes and high performance building standards such as PassivHaus and Minergie. It is also the predominant approach used for designing high performance buildings.

The advisory group, through this process, was not able to fully endorse one specific methodology over the others, but did note that the prescriptive approach should be disqualified as the sole framework for a stretch code due to the limits of its ability to be flexible and scalable for different jurisdictions over time. It was noted that while it may not be the sole framework for a stretch code, having some prescriptive elements incorporated in performance frameworks would likely be useful.

While there was a general preference expressed by the advisory group for a target based framework, because it has shown good traction in Europe in reducing actual energy use, the recommendation is to explore both performance methodologies (Reference Building and Target Based) for a future stretch code and incorporate some prescriptive elements where appropriate.

Setting the Target(s):

As part of the research for setting a target for this project, the advisory group reviewed 16 energy standards from both North America and Europe. We converted all of the standards into an equivalent energy use intensity number for both commercial and residential in order to better compare their levels of performance.

It should be noted that not all energy targets or energy use intensities (EUI) are equivalent. The method by which they are measured can have significant policy and performance impacts.

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There are three general approaches to measuring EUIs:

Thermal Energy Demand

An EUI that includes the total amount of energy to heat and cool a building once all of the passive gains and losses are accounted for. In this way it accounts for lighting as a passive heat source. It does not include energy needed for ventilation or any process or plug loads nor does it account for the efficiency of the equipment used to provide the heating and cooling.

Who uses it?

PassivHaus, Minergie, Denmark

Regulated Loads

An EUI that only measures the energy used that can be impacted by building design. This generally includes heating, cooling, ventilation, service water heating and lighting. It can include some things like elevators in some standards and is excluded in others.

Who uses it?

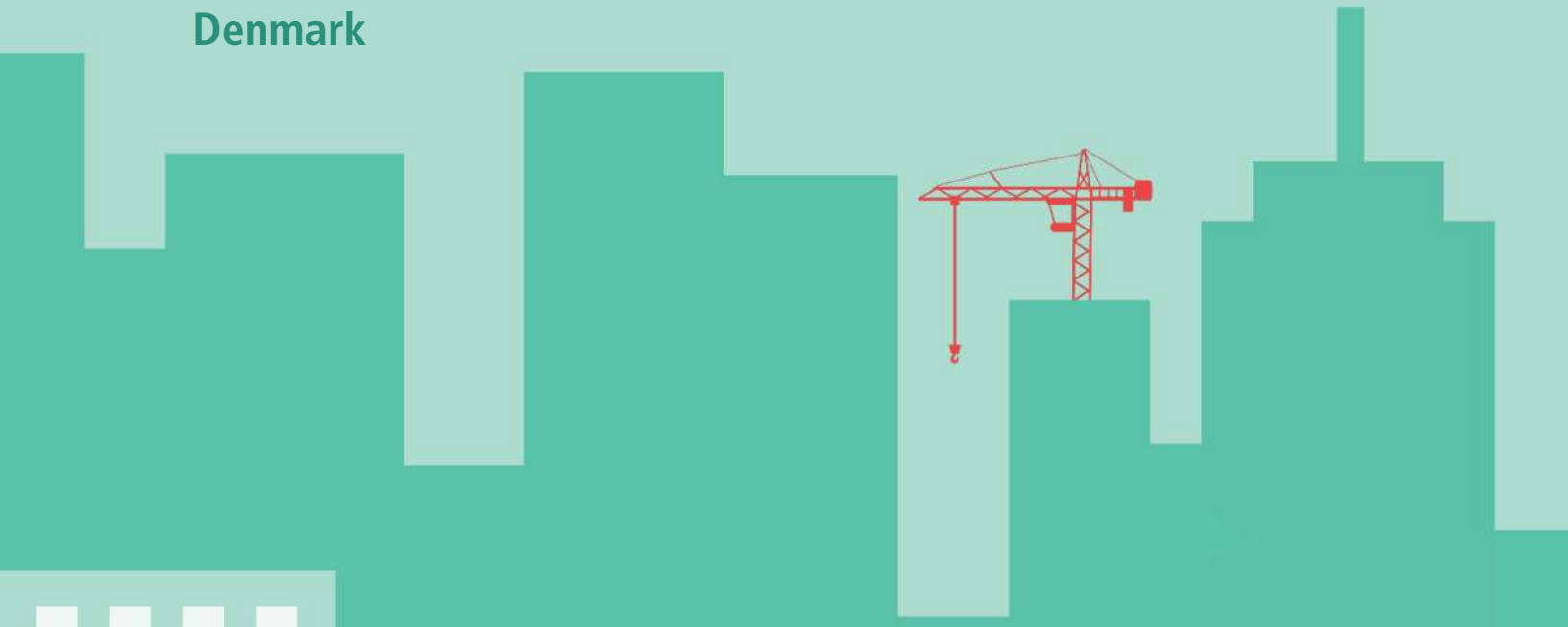
Germany, England & Wales

Total Building Energy Use

An EUI that includes all energy consumed in a building. This includes "plug" and "process" loads. Simply put, if energy is being used on site, it is included in the total energy use.

Who uses it?

Seattle



Recommendation:

There was general consensus from the advisory committee that 'Thermal Demand' or a 'Regulated Loads' approach were generally better approaches to explore for a stretch code given that they focus on the areas that developers and designers can control.

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As part of this research, Integral Group completed a survey of leading jurisdictions and voluntary standards to understand what the current state of leading practice was globally.

Table 1: Summary of International Best Practices

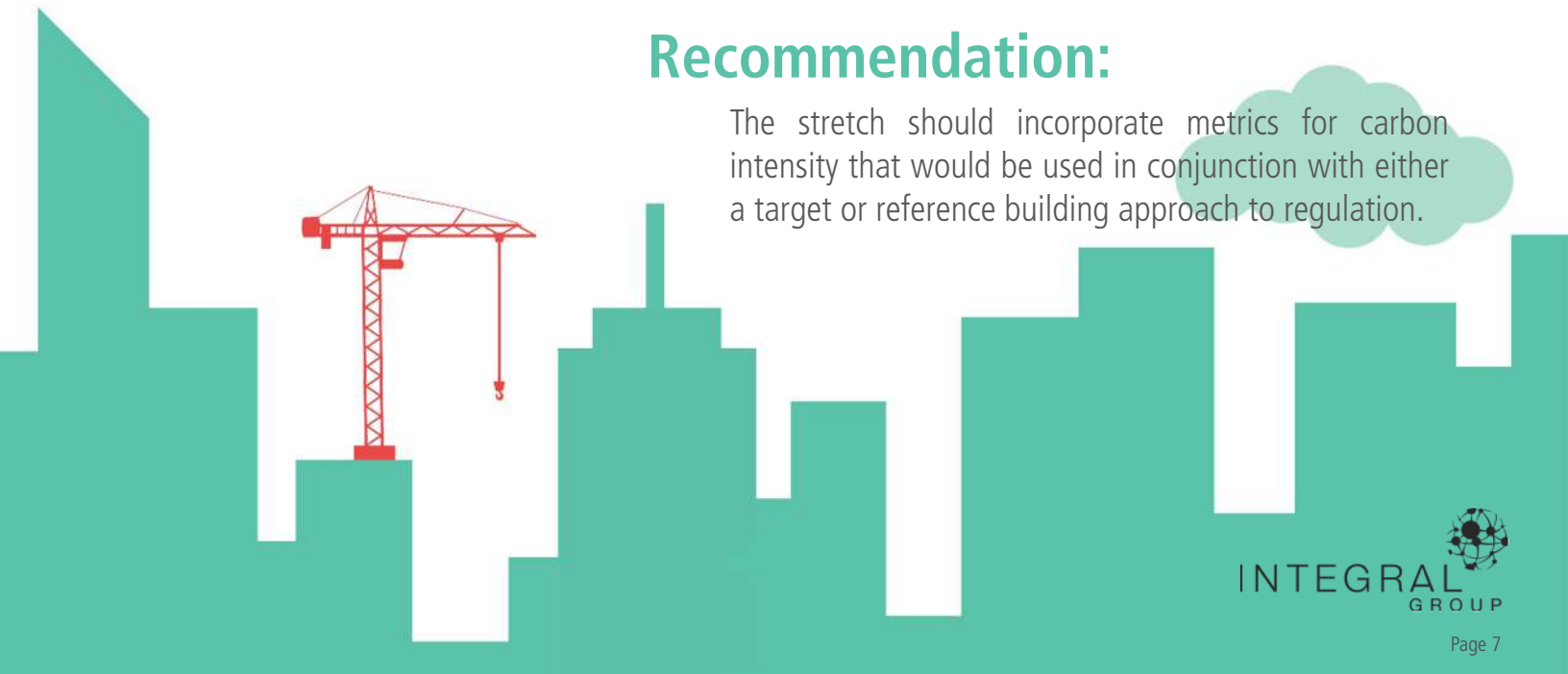
STANDARD	COMMERCIAL	MULTI-UNIT RESIDENTIAL
Denmark Building Regulation 10 (BR10)	Non-Residential, Offices, School, Institutions, other 71.3 kWh/m^2/yr Thermal Energy Demand Intensity	Residential, Student Accommodation, Hotels 52.5 kWh/m^2/yr Thermal Energy Demand Intensity
Norway Tek10	Office building 150 kWh/m^2/yr heated floor area Regulated Loads	Blocks of Flats 115 kWh/m^2/yr Regulated Loads (includes lighting)
France Regulation Thermique RT2012	40-65 kWh/m^2/yr (as per climate zone/altitude) Thermal Energy Demand Intensity	57.5 kWh/m^2/yr Thermal Energy Demand Intensity
England/Wales The Building Regulations 2010 Conservation of fuel and power	Meet or exceed reference building kgCO$_2$/m^2/yr with pre-defined envelope and building systems standards	Meet or exceed reference building kgCO$_2$/m^2/yr with pre-defined envelope and building systems standards
Germany Energy Savings Ordinance (EnEV)	Meet or exceed reference building kWh/m^2/yr with pre-defined standards	Meet or exceed reference building kWh/m^2/yr with pre-defined standards
California Title 24, Part 6	97.7 kWh/m^2/yr Regulated Loads	88.2 kWh/m^2/yr Regulated Loads
Seattle SEC2012 Target Performance Path	40 kBTU/sf/yr (approx: 125 kWh/m^2/yr) Total Energy Use Intensity	40 kBTU/sf/yr (approx: 125 kWh/m^2/yr) Total Energy Use Intensity
Passivhaus	Maximum space/DHW heating demand 45 kWh/m^2/yr Maximum total primary energy demand 120 kWh/m^2/yr	
Minergie	Public/Office Buildings 40 kWh/m^2/yr Thermal Energy Demand Intensity	Multi-Family Housing 60 kWh/m^2/yr Thermal Energy Demand Intensity

Generally, the standards surveyed used a target based EUI approach for managing building performance. Most of the jurisdictions surveyed used either a thermal demand calculation or a regulated loads approach. This approach has not been used widely in North American codes. Seattle is currently the only jurisdiction that allows for and energy target approach to be used as an optional pathway for compliance.

One finding of note is that the United Kingdom and Ireland use both an energy use intensity and a carbon intensity metric. This could have excellent application in the Province of BC context where GHG emissions are key driver for building energy regulation for local governments. Having GHG emissions explicitly called out in the requirements of a standard would bring focus to this issue of key importance to local governments.

Recommendation:

The stretch should incorporate metrics for carbon intensity that would be used in conjunction with either a target or reference building approach to regulation.



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With regard to what type of prescriptive requirements might be incorporated into a stretch code, there was support for prescriptive elements particularly targeting lowering of overall energy use, gathering important data, and enabling buildings to be better operated in the future. These options were developed out of the best practices review and also seeded by members of the task force based on their own experience. The advisory group recommended the exploration of the following:

Recommendations on the Prescriptive Requirements:

1. Minimum Lighting Power Density Values:

The requirement for lighting power maximums becomes important only if a "thermal demand" approach to target setting is selected. Both the reference building and the regulated loads approach would already incorporate lighting requirements.

2. Sub-metering Protocol:

Similar to measurement and verification requirements within LEED, the inclusion of sub-metering within a stretch code can serve as a useful tool to optimize buildings and measure operational performance. There are sub-metering requirements that are readily available from LEED and other building standards. There is also excellent guidance on disaggregation of loads in California's Title 24.

3. Commissioning Requirements:

While unconventional for North American energy codes, there is consensus support from the advisory committee for mandatory building commissioning as a requirement of a stretch code, using an existing standard for commissioning.

4. An Administrative Requirement for Mandatory Air Tightness Testing:

Experience in the Seattle building market, which has for almost a decade required air-tightness testing for part 3 buildings, indicates that this provision has led to a better understanding of building science and better envelope performance in general.

5.Energy Model Reviews:

The final prescriptive administrative requirement is to compel mandatory third-party review of energy models. This is similar to the process in place for structural review for Part 3 buildings. Having these energy models reviewed by technical experts will relieve the burden faced by building approvals staff at the local government level and lower a local government's exposure to risk.

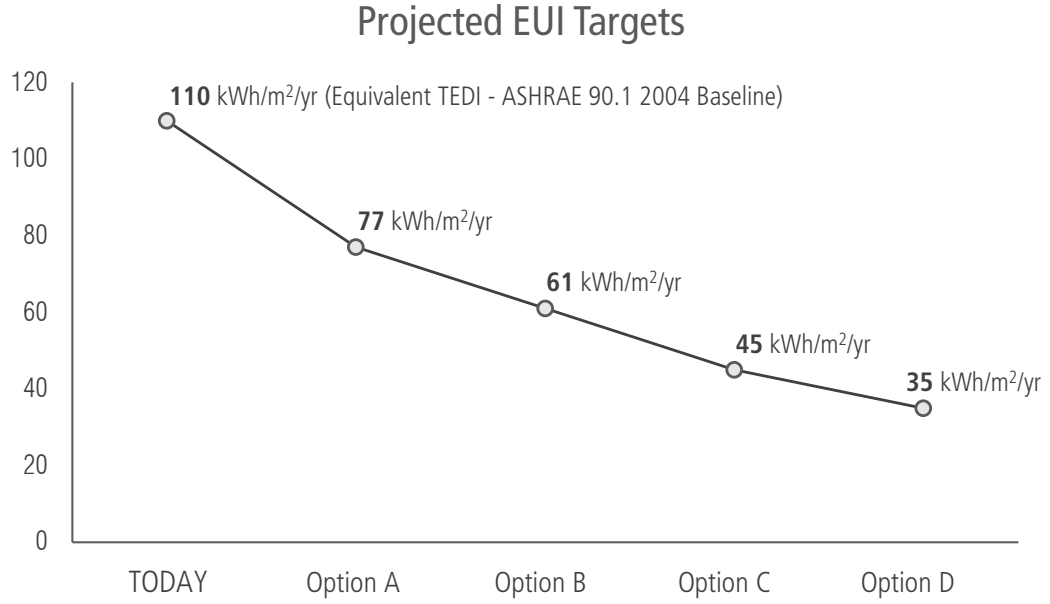
In order to make a single stretch code that is applicable to a variety of building markets across BC and is scalable over time, there was consensus from the advisory committee that any proposal should have multiple tiers that can be adopted by various markets over time. It was further felt that these tiers should be benchmarked against the estimated performance of ASHRAE 90.1 2004 in order to align with current North America-wide base-lining efforts, to have a consistent benchmark against which to compare codes across jurisdictions and programs.

The initial step was set to match the current City of Vancouver energy requirements for rezoning projects, which is approximately 30% better than ASHRAE 90.1 2004. Successive tiers would step up by 10-15% per segment until it reaches Passivhaus [4] levels of performance. Incremental steps of roughly 15% were felt to be a reasonable complement to the incremental levels required by successive iterations building codes. Passivhaus was felt to be a reasonable end goal that has proven itself to be possible in the BC building market and could set jurisdictions up for net-zero new construction if desired. The idea of having an array of options for local governments is to not only allow them to set appropriate targets for their own individual building markets but also provide a road map overtime for industry.

4 http://passiv.de/en/ Passivhaus is an internationally recognized standard for super energy efficient buildings. There are over 3000 Passivhaus certified buildings internationally. It is supported globally by the Passivhaus Institute and applicable to broad range of construction types including commercial and multi-family housing.

Below is an example of potential future targets for multi-family residential buildings expressed in thermal energy demand, which includes space heating/cooling, ventilation, and domestic hot-water. The table also shows the incremental improvement over ASHRAE 90.1 2004 and cites a comparable policy or program that currently exists.

OPTION A	OPTION B	OPTION C	OPTION D
30% Better	45% Better	60% Better	70% Better
77 kWh/m^2/yr	61 kWh/m^2/yr	45 kWh/m^2/yr	35 kWh/m^2/yr
City of Vancouver Rezoning Policy	City of Vancouver Higher Buildings Policy	Minergie	Passivhaus



There was unanimous support from the advisory committee that the stretch code be an auditable process whereby the impacts and savings could accurately be tracked from it over time. This desire was further supported by the background research that found that many of the European high performance building standards had some kind of building energy reporting and benchmarking requirements as part of their overall policy framework. Benchmarking legislation is widely recognized as being beneficial as a research tool and in supporting improved building operations. There is also excellent local precedent to show that collecting data improves building policy. The City of Vancouver's 2009 Building By-law required third-party ratings of all new homes. This data, collected and analysed by the City, transformed Vancouver's understanding how homes were actually performing. For these reasons, the advisory committee recommended that building energy use reporting benchmarking and disclosure should be introduced either as a component of these efforts or as a policy project unto itself.

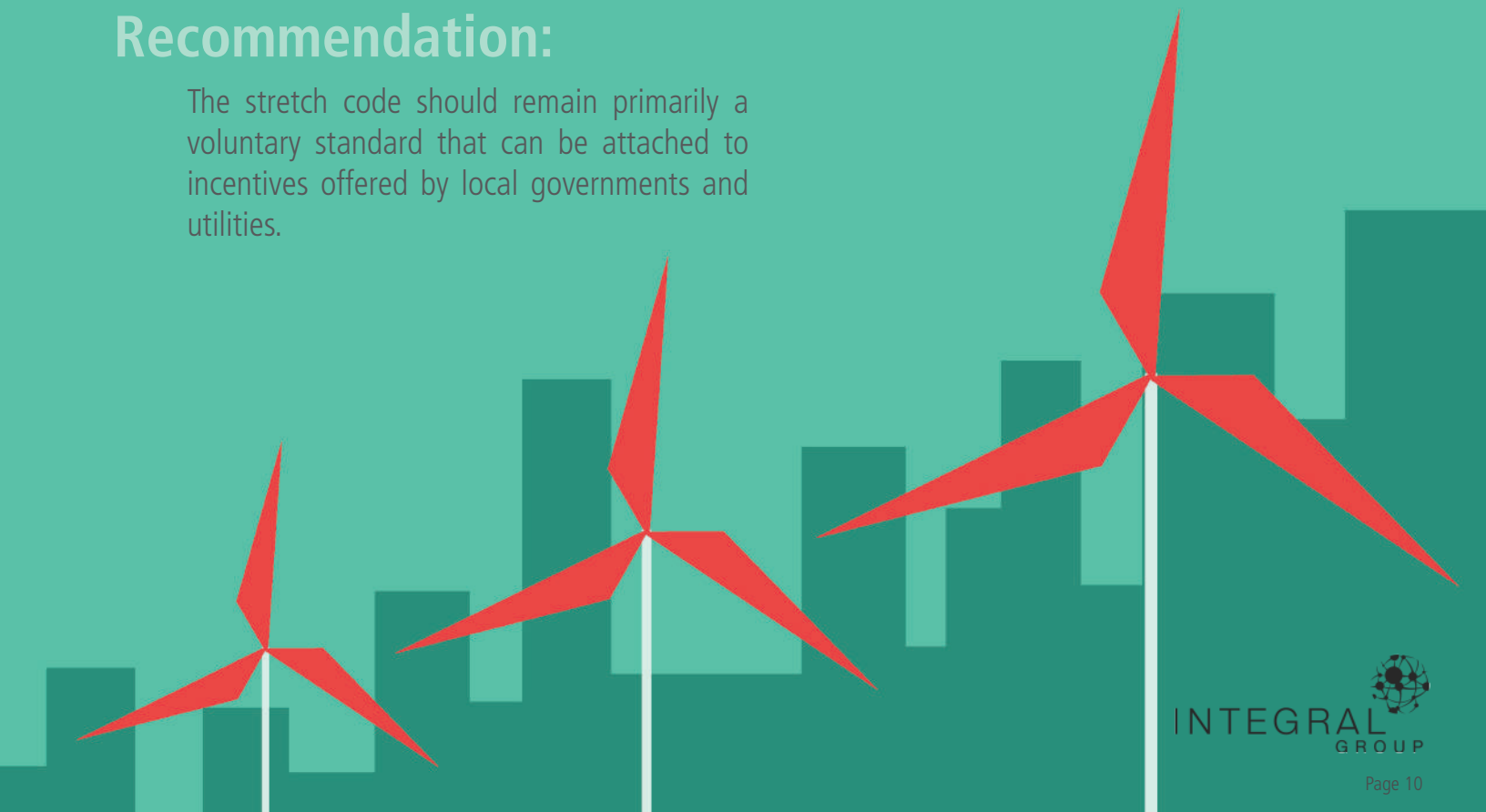
Recommendation:

Integrate benchmarking and reporting requirements into the stretch code in order to monitor and manage program over time.

Finally, it there was strong consensus from both BC Hydro and FortisBC when consulted, and the staff from local government and the development community that the stretch code should remain an "endorsed" but primarily a voluntary standard. By "endorsed" we mean that the standard has be reviewed by utilities and Provincial Government staff with agreement that these are reasonable but progressive standards for high performance buildings. The intention of this is to allow governments and utilities to continue to be able to offer incentives for these higher standards without triggering "free rider" restrictions that usually prevent incentives from being offered to items covered under regulated programs. There was some discussion that if over time a local government wished to adopt one of the lower levels of the stretch code as its base energy requirement that this should be an option as well but that this was not the primary intent of the tool.

Recommendation:

The stretch code should remain primarily a voluntary standard that can be attached to incentives offered by local governments and utilities.



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In summation, it should be noted that this paper only reflects the advice and opinions of staff from local government, utilities, the Provincial Government, development industry and non-profit sector and does not reflect the complete endorsement of those parties. It is also further acknowledged that there is significant work to be done to further develop these recommendations. Given all of these considerations, a key outcome of this process is the finding that there is considerable alignment on:

A) There should be a stretch code for BC, and

B) There is general agreement on what the necessary components of a stretch code should be.

This is encouraging given that there are often divergent views within the groups themselves as well as divergence as a broader group of stakeholders.

SUMMARY OF RECOMMENDATIONS

1	Create a performance based platform that is based on EUIs that are derived from either 'Thermal Demand' or 'Regulated Loads' or some combination of both.
2	The stretch code should incorporate metrics for carbon intensity that would be used in conjunction with either a target or reference building approach to regulation.
3	In addition to the performance requirements include the following Mandatory Prescriptive requirements: 1. Minimum Lighting Power Density Values 2. Sub-metering Protocol 3. Commissioning Requirements 4. An Administrative Requirement for Mandatory Air Tightness Testing 5. Mandatory Third-Party Review of Energy Models
4	Adopt an array of stretch targets that can be adopted by different jurisdictions over time starting at 30% better than ASHRAE 90.1 2004.
5	Integrate benchmarking and reporting requirements into the stretch code in order to monitor and manage program over time.
6	The stretch code should remain primarily a voluntary standard that can be attached to incentives offered by local governments and utilities.

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