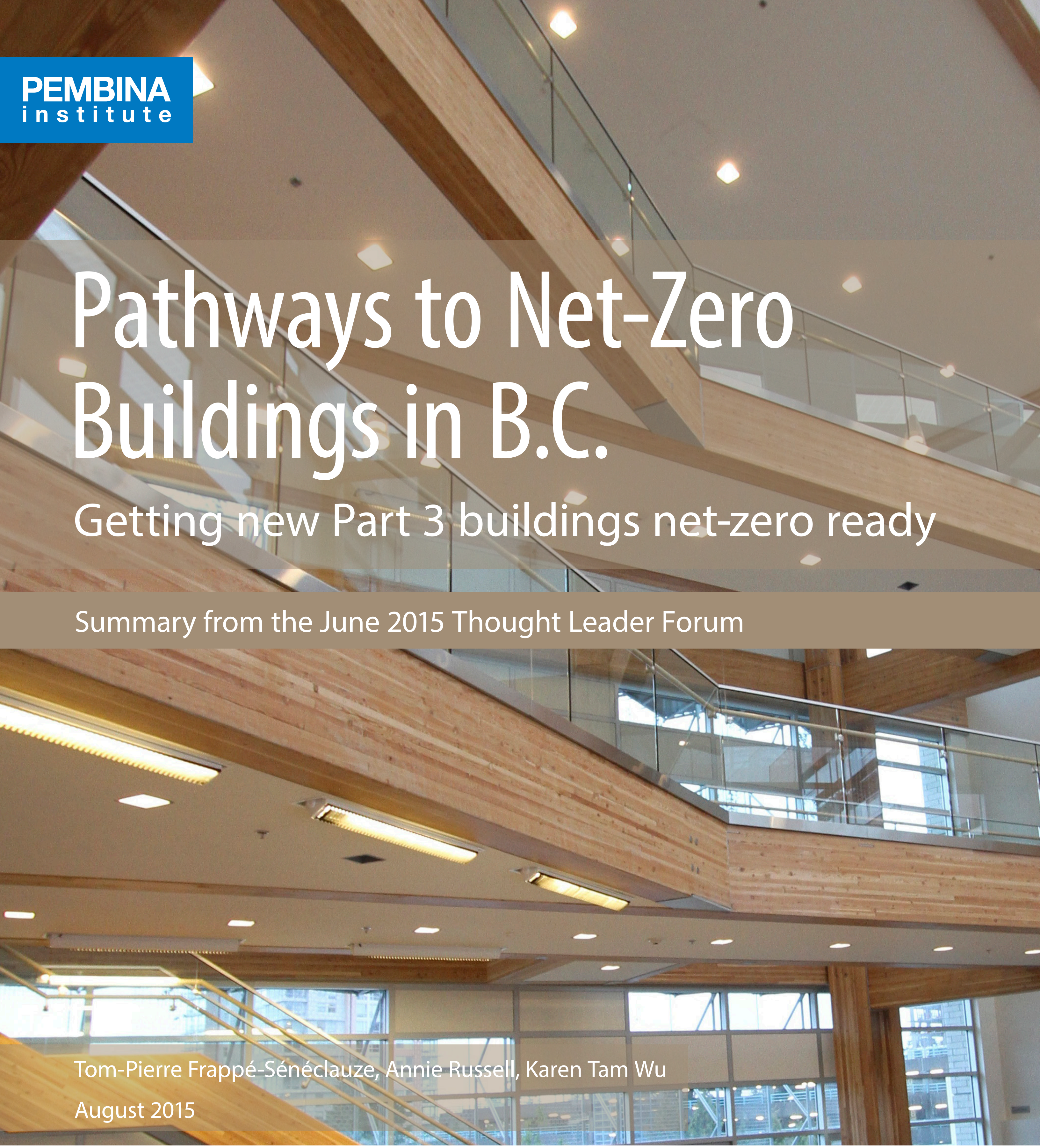

PEMBINA institute

Pathways to Net-Zero Buildings in B.C.

Getting new Part 3 buildings net-zero ready

Summary from the June 2015 Thought Leader Forum

Tom-Pierre Frappé-Sénéclauze, Annie Russell, Karen Tam Wu

August 2015

real estate foundation BRITISH COLUMBIA

TD

BC hydro powersmart

MEC

Acknowledgements

The Real Estate Foundation of British Columbia, TD Bank Group, Mountain Equipment Co-op, BC Hydro, Pacific Institute for Climate Solutions, DIALOG, the U.S. Consulate, BCIT and the Climate Action Secretariat provided funding or in-kind support for the Pathways to Net-Zero Buildings in B.C. Thought Leader Forum.

The authors would like to thank the following reviewers, whose comments were helpful in preparing this summary: Dave Aharonian, Cimarron Corpe, Jeff Fisher, Nat Gosman, Katherine King, Zachary May, Jonathan Meads, Andrew Pape-Salmon, Hurrian Peyman, Murray MacKinnon, John Nicol, Donna Sandford and Graham Takata.

Cover photo: David Dodge, Green Energy Futures

1. Introduction

Along with its Pacific Coast Collaborative partners — the states of California, Oregon and Washington — British Columbia has committed to "lead the way to 'net-zero' buildings."[1] B.C. recently increased the energy efficiency requirements for Part 3 buildings by adopting the ASHRAE 90.1-2010 and NECB 2011 standards into the B.C. Building Code, but it has yet to set a net-zero target and a roadmap to get there.

To test key elements of a roadmap to net-zero, the Pembina Institute hosted a thought leader forum on "Pathways to Net-Zero Buildings in B.C." on June 4 and 5, 2015. The forum focused on policies and regulations to drive energy efficiency for new, complex (i.e. Part 3) buildings, with a target for all new Part 3 buildings to be net-zero ready by 2030 or so. Table 1 lists the organizations that participated. The event was run under the Chatham House Rule, meaning conversations and ideas exchanged at the forum can be shared, but not attributed. The sole exception was presenters, who agreed to share their materials.

Table 1: Forum participants

Stakeholder group	Number of participants	Organizations
Industry: developers, builders, contractors, manufacturers	7	Urban Development Institute, Ivanhoe Cambridge, Eighth Avenue Development Group, Trillium Project Management, Centra Windows, Mechanical Contractors Association of BC
Industry: architects, engineers, energy modelers, consultants	14	E3 Eco Group, Focal Engineering, Enersys, Cornerstone Architecture, Morrison Hershfield, Recollective Consulting, RDH Building Engineering., Integral Group, Perkins+Will, DIALOG, Ions Engineering, HCMA Architecture + Design
Industry: tenants, utilities, financial inst.	7	BOMA BC, TD Bank Group, BC Hydro, FortisBC
Local government	11	Kelowna, Metro Vancouver, North Vancouver, Seattle, Richmond, Vancouver, Surrey, Burnaby, New Westminster
Provincial or federal government	15	BC Ministry of Natural Gas and Housing (BC Office of Housing and Construction Standards and the Building and Safety Standards Branch), BC Ministry of Energy and Mines, BC Ministry of Environment (BC Climate Action Secretariat), BC Homeowner Protection Office, U.S. Department of Energy, U.S. Consulate General (Vancouver, Department of State)
Education, research, advocacy	10	Canadian Passive House Institute West, UBC, New Buildings Institute, BCIT, Pacific Institute for Climate Solutions, Lighthouse, Canada Green Building Council, Pacific Northwest National Laboratory, Sustainable Cities, Real Estate Foundation of BC
Facilitation and notes	18	PICS, CAS, Pembina Institute, UBC grads, SFU grads
TOTAL		50 organizations

[1] Pacific Coast Collaborative, Pacific Coast Action Plan on Climate and Energy (2013).

Market barriers versus policy barriers

A policy proposal (see Appendix A) was used as a starting point to explore options and barriers to adoption. It provides options on how B.C. might use the energy code and other supporting policies to accelerate market transformation for new, high-performance buildings. It is not a full-fledged roadmap. Rather, it is a conceptual sketch of possible pathways to be discussed at the forum or through governmental engagement processes. From surface barriers and success factors, participants were asked to discuss strengths and weaknesses of specific elements of the proposal, as well as threats and opportunities to advancing these policies.

Two types of barriers were generally identified in these conversations: market barriers and policy barriers. Market barriers explain why the market is not adopting all economically viable or socially desirable energy efficiency measures on its own. They include issues such as split incentives, the low cost of energy and a lack of consumer awareness. These are the barriers that public policy is attempting to resolve. Policy barriers articulate obstacles to the design, adoption or implementation of effective public policies.[2] Market barriers have been abundantly discussed in the literature.[3] Some of the most commonly cited barriers are summarized in Table 2, alongside the policy tools that aim to address them.

Rather than repeating work that has already been done and re-articulating market barriers, this document primarily focuses on policy barriers: how policies can be designed to minimize them and actions needed to advance these solutions.

[2] Of course, there is overlap between the two, as market barriers also complicate uptake and acceptance of programs and policies.

[3] See for example: Jens Laustsen, *Energy Efficiency Requirements in Building Codes, Energy Efficiency Policies for New Buildings* (EIA, 2008).https://www.iea.org/publications/freepublications/publication/Building_Codes.pdf ; M. Rosenberg, R Hart, J Zhang, and R Athalye, *Roadmap for the Future of Commercial Energy Codes* (2015). http://www.pnnl.gov/main/publications/external/technical_reports/PNNL-24009.pdf; Jennifer Thorne Amann, *Energy Codes for Ultra-Low-Energy Buildings: A Critical Pathway to Zero Net Energy Buildings* (American Council for an Energy Efficient Economy, 2014). http://aceee.org/research-report/a1403

Table 2: Barriers to energy efficiency in new buildings and the public policies proposed to address them

Barrier	Description	Public policies
Focus on incremental costs rather than total/future costs	• Involved parties are often only interested in the construction budget and may be unwilling or unable to account for future running costs • Actors don't have training to analyze a building's lifecycle costs and guide improvements • Construction companies are rarely involved in paying energy bills; occupants are rarely involved in design	• Operational and asset-based • Benchmarking and disclosure • Financing mechanisms • Public sector leadership
Insufficient efficiency awareness among consumers and designers	• Unpracticed buyers are unaware of the cost of low energy efficiency • Energy advisors are not extensively involved in the early design process	• Operational and asset-based • Benchmarking and disclosure • Public sector leadership
Cost structures and lack of capacity	• Specialized, expensive or delayed equipment affect the likelihood of efficient construction • Some builders are unwilling to invest in training	• Energy code roadmap • Stretch codes • Training programs and helpdesk support
Performance gap	• Buildings do not meet the level of performance they were designed to meet • Many buildings do not comply with minimum energy codes	• Commissioning • Operational benchmarking • Outcome-based codes • Compliance and administration
Split incentives, brief occupancy and difficulties marketing efficiency	• Total costs may be reduced by efficiency but the expense is covered by builders while the reward is reaped by owners • Many buildings have short occupancy times; the occupants won't witness benefits • Uncertainty of future profit means the cost of efficiency is rarely included in transactions	• Financing mechanisms • Incentives • Benchmarking and disclosure
Energy is invisible	• Only the status and comfort of using energy are visible • As energy costs are only a small part of the budget for many operations, increasing energy prices might reduce this barrier	• Carbon pricing • Equipment regulation and habitant engagement on plug loads
Building codes set the minimum and maximum standards	• New buildings are rarely better than what building codes require — particularly in the residential sector — even though codes are intended to be a minimum • Building code writing processes are conservative and lean towards the lowest common denominator	• Stretch codes • Incentives • Benchmarking and disclosure

Adapted from Laustsen[4]

[4] *Energy Efficiency Requirements in Building Codes, Energy Efficiency Policies for New Buildings.*

Structure of this document

This document begins with a summary of findings from the forum: section 2 then provides a narrative summary of the event; sections 3 and 4 report back on key points from conversations on the proposed target, energy code schedule, and stretch codes; section 5 summarizes following day's breakout sessions and highlights action items brought forward by participants.

The second portion of the document — section 6 — outlines a revised policy proposal based on discussions at the forum and on the research compiled in the forum discussion papers.[5] The revised proposal includes recommendations for energy code revisions and supporting policies.

2. Narrative summary

The first day of the forum focused on targets and energy code pathways. Opening remarks were delivered by: Mandy Hansen, board member, BC Real Estate Foundation; Mike Bernier, MLA, Parliamentary Secretary for Energy Literacy and the Environment; and Jeff Vasey, ADM, Ministry of Natural Gas and Housing. Edward Mazria, CEO of Architecture 2030, then spoke about the international context for net-zero construction and Mark Frankel, Technical Director at the New Buildings Institute, presented on the state of building policies in the Pacific Coast Collaborative.

After setting the context, the Pembina Institute summarized the policy proposal (see Appendix), which had been circulated to participants ahead of the forum alongside two white papers providing further context and rationale for the proposal. Each table — lead by a staff facilitator — launched into the first discussion of the day, focused on the proposed target (net-zero ready by 2030; see summary in the following section). Whether and how should carbon targets be integrated in building policies was also discussed.

The afternoon focused on the benefits and challenges of two possible pathways for the energy code, to provide context for the proposed energy code performance schedules. Andrew Pape-Salmon, Associate at RDH engineering, presented the results of an RDH study on the costs and benefits of energy efficiency technology currently available. This study showed that the next step in the proposed schedule — roughly 25% better than current code — was already cost-effective under current market conditions. Rob Bernhardt, President of the Canadian Passive House Institute West, presented the case for a Passive House standard, a low-cost and already in-market option for net-zero ready buildings (i.e. the last step of the proposed energy code schedule). He also shared some lessons learned from Brussels, a region that over the course of seven years went from having arguably some of the weakest policies for energy efficiency in Europe to successfully implementing a Passive House requirement for new construction.

In the second and third table discussions, participants discussed the pros and cons of the two pathways, how energy code development would need to change to support such schedules and the role of stretch codes in priming the market for higher-performance buildings. Tables also tested whether municipalities should be able to adopt a provincial stretch code as their base code. The range of perspectives on this issue was discussed in plenary using a "human gradient" exercise — asking participants to physically situate themselves along a spectrum ranging from strong support to strong opposition to this idea. The need to integrate carbon targets along with energy targets was similarly tested.

---

[5] Tom-Pierre Frappé-Sénéclauze, Josha MacNab, *Evolution of Energy Efficiency Requirements in the B.C. Building Code* (Pembina Institute, 2015). http://www.pembina.org/pub/evolution-of-energy-efficiency-requirements-in-the-bc-building-code
Tom-Pierre Frappé-Sénéclauze, Maximilian Kniewasser, *The Path to "Net-Zero Energy" Buildings in BC – The case for action and the role of public policy* (Pembina Institute, 2015). http://www.pembina.org/reports/pembina-path-to-net-zero-energy-buildings-in-bc.pdf

The day closed with observations from three rapporteurs: Dr. Jennie Moore, Associate Dean, Building Design and Construction Technology, BCIT; Dr. David Hendrickson, Grant Manager, REF-BC; and Graham Takata, Senior Manager, Energy and Sustainability, TD Bank Group.

The second day of the forum focused on supporting policies and the identification of "no regret" next steps — actions necessary to advance energy efficiency irrespective of the pathway selected. In the morning participants broke into two sets of four parallel sessions with each focusing on a supporting policy or strategy (see summaries in section 4). In the afternoon, participants broke into caucuses in which each stakeholder group discussed next steps based on action items identified throughout the forum, and the specific role their group needed to play in accelerating market transformation. Key action items and perspectives from each group were brought back in plenary and the forum was closed by Suzanne Spence (Executive Director, Climate Action Secretariat) and Jeff Vasey (ADM, Ministry of Natural Gas and Housing), who offered remarks on the conversation and on its continuation through the Climate Leadership process convened by CAS and the Energy Efficiency working group to be convened by B.C. Building and Safety Standards Branch (BSSB) of the Office of Housing and Construction Standards.

3. The target: making new Part 3 buildings net-zero ready by 2030

Net-zero buildings are generally defined as highly efficient buildings that produce as much energy as they use when averaged over the course of a year. "Net-zero ready" buildings — also sometimes called near-net-zero or "ultra-low energy" buildings — are highly efficient buildings where the total annual energy use has been reduced to such a level that it *could* be generated on site. There is no common operational definition for being net-zero ready in the literature. A working definition was proposed for the forum: 70% below the 90.1-2004 standard, or a total energy use intensity of 65 kWh/m^2/yr or less.

Table 3 summarizes most common strengths, weaknesses, opportunities and threats raised by the proposed target identified by forum participants.

Table 3: Strength, weaknesses, opportunities and threats associated for the net-zero ready target

Strengths: Common, fixed target with a set date Defensible, achievable, communicable Demonstrated technology exists Predictability allows all parties to plan Similar targets have been set in other jurisdictions Performance-based target drives innovation and creativity	**Weaknesses:** Language is too vague: "aspirational" target will need to be operationalized and adjusted by building types and occupancies Jargon impedes public understanding; "net-zero" may not be most inspiring target 2030 target is too slow Long-term target without interim targets too distant to drive change in industry Applies to new buildings only; also need targets for existing stock
Opportunities: To grow an industry (buildings and clean tech), provide jobs, build local markets To increase competitiveness of our economy To address systemic issues and modernize industry To meet / align with municipal and provincial emissions targets To improve indoor air quality and health	**Threats:** Risk of pushback from developers, builders, etc. Affordability concerns for purchasers Targets may need to change as technology evolves Broad adoption requires ability and interest that are not currently available across industry. Changes in government priority affect consistency and effectiveness. Occupant behaviour threatens feasibility reducing

	total energy use in that timeline Lack of consumer interest (other priorities)

Areas of agreement and divergence

Participants were generally in support of B.C. setting an aspirational target for all new Part 3 buildings to be net-zero ready by 2030 or so. Some argued that the target should be sooner.

The main area of contention was how this end target should be operationalized; should it be set as an Energy Use Intensity (EUI) target, or based on performance above a certain standard (e.g. ASHRAE 90.1 or NECB)? Several participants insisted on the importance of the target being able to reflect differences in building types and occupancies. Some suggested a neighborhood approach — where targets are set by area rather than for individual buildings — that would allow both differentiation between buildings to look for synergies between neighboring buildings, and also facilitate the integration of renewables.

Generally, there was broad consensus that building performance targets should focus primarily on maximizing energy efficiency and not require on-site generation (i.e. require buildings to be net zero ready, but not necessarily net-zero).

Should the energy code and/or stretch code include carbon targets?

About half of the tables discussed this question during the first morning. The question was also asked in plenary towards the end of the first day, and participants were asked to position themselves along a gradient based on their views on the question.

Perspectives on this question were fairly evenly distributed along the gradient, with a few more people supporting the idea of including carbon targets than opposing. The group generally agreed that carbon emission reduction was one of the primary drivers for the policies. Opponents mentioned the difficulty of communicating both carbon and energy objectives to the public, a preference for focusing GHG-reduction policies on the supply side rather than on the demand side, and the possibility of using electricity savings in B.C. to displace coal-fired electricity in neighboring jurisdictions. Proponents of explicitly including carbon targets cited alignment with municipal and provincial goals, the importance of measuring and tracking what you want to reduce, the risk of locking in natural gas technologies in new buildings and the opportunity to incent district energy systems and other low-carbon heat sources.

4. Energy code pathways

The policy proposal offered two possible pathways to get to a net zero ready energy code: an incremental approach (Option A) targeting a performance gain of about 15% over the next four code cycles, and a "leap" approach (Option B) aiming to achieve net-zero ready in one major transition (see Appendix B for details).

Option A presented performance gain as expressed relative to the ASHRAE 90.1-2004 standard, but was agnostic about *how* the energy code should be designed to meet these gains (prescriptive, performance-based, based on ASHRAE, NECB, etc.). Considerations for energy code design were discussed in the white paper, but were left open in the policy proposal to focus the conversations on the proposed pace and scale of change — though of course several code design considerations were raised in table discussions. Option B was inspired by the approach taken by Brussels[6] and proposed using Passive House (PH) principles to facilitate a faster jump to net-zero ready standards.

[6] Karen Tam Wu, *From Brussels to British Columbia: An analysis of the proliferation of Passive House in Brussels* (Pembina Institute, 2015). http://www.pembina.org/pub/from-brussels-to-british-columbia

Table 4 summarizes the most common pros and cons of the two proposed options. It should be noted that a pro or con indicated for one option does not necessarily imply a corresponding shortcoming or benefit exists for the other option.

Table 4: Pros and cons of an incremental versus leap approach to energy code progression

Option A: Four incremental steps	Option B: Leap
Pros: • Stable, steady and predictable structure with manageable steps • Iterative and flexible, allows feedback and learning • Allows all sectors to adjust over time, leading to broader acceptance High performance standard (such as Passive House) can still be incentivized by stretch codes • More likely to align with national process • Similarity to Washington state's approach	**Pros**: • Fewer steps allows smoother transition and sends clearer signal, especially for industry and markets • Training and education does not require as many iterations • Quicker results, avoiding lock in with less efficient buildings and allowing to dedicate more energy to existing buildings • Can drive a green boom right away • Government will have to give substantial incentives because of the short timeline • Bolder goal makes leadership clear and easier to communicate to the public
Cons: • Too many iterations: each step creates confusion for compliance and enforcement • Solving same problem multiple times; waste time and resources • Changes in government could threaten follow through at each stage • Approach is too slow	**Cons**: • Jump will result in more Industry pushback • Insufficient resources, suppliers — necessary window supply • Significant training needed for industry professionals • Process needs a champion – a major force to move it forward • Proposed timelines are too tight; slower approach needed • More time needed to learn from early pilots • Requires more incentives • More vulnerable to changes in government given lifespan of target

Along with the idea of a leap, these pros and cons were raised with reference to the use of the Passive House standard to define the desired end goal:

Arguments for the use of the Passive House standard

- Buildings are simpler to design, construct and operate, which leads to simpler policy, fewer performance issues and fewer costs over time
- Brings more alignment to international standards and leadership
- Possible to learn from European precedent
- Improves resilience of systems over time, which is important for climate adaptation
- PH philosophy would encourage transparency around health and wellness and allow for simple messaging and unified understanding of the target

Argument against the use of the Passive House standard

- A relatively new standard in B.C. and Canada

    - Metrics might not work for the whole province (climates, energy rates, etc.)
    - Unfamiliar, so it requires a lot of education; skeptics must see successes in their own jurisdiction
    - Can't directly compare components, as windows and HRVs don't undergo the same test standards as in Europe
- Concerns that design flexibility is limited and that standard will lead to boring buildings
- PH criteria might not be suitable for all building types
- PH targets could change over eight years
- Currently does not align with national standard

Areas of agreement and divergence

As could be expected, the group did not converge onto either Option A or Option B. Many tables created a third option — generally a variation on one of the two options proposed. Within these variations, roughly half of participants preferred an incremental approach and half a "leap" approach.

Despite this apparent polarization, several features were commonly deemed desirable:

- **Predictability:** There should be clarity on the desired end goal as well as on the level of performance expected in next code iteration, at the least.
- **Flexibility:** Targets should be adapted to different building types. Variability in climate and regional capacity should also be considered either in performance requirements or in rollout dates.
- **Time to adapt:** Industry needs time to prepare for changes, which is facilitated by having clarity about long- and medium-term targets. Small steps are better than large, and fewer steps are better than many. Ultimately, whether a step is considered small or large depends on the level of familiarity and comfort with the technology, hence the importance of pilot projects.
- **Pilot projects:** An incentive program is needed to create a range of new net-zero ready demonstration projects covering various building types in regions across the province. Public buildings can be used to increase initial demand and educate the public.
- **Data-gathering and case studies:** More research is needed on the cost-effectiveness and economic viability of high-performance buildings, including study of actual building performance. Demonstration projects should be paired with research projects.
- **Provincial stretch code:** Provide a shared basis to align incentives from local governments, utilities and the province. Allow both harmonization and differentiation while increasing industry familiarity with the next code steps (see below for details).
- **Short-term targets:** Set meaningful targets within current mandates and define the roadmap beyond that to mitigate concerns about political changes interfering with target success.
- **National standard:** There is a fundamental tension between the desire to move fast to keep up with Washington and California, as well as meeting B.C. targets, and the desire to align with a national standard that tends to be more conservative.
- **Change management:** There is a lack of consensus on which strategy would be best for industry. However, there is consensus on the need for a change management plan to coordinate with industry, limit pushback, ensure appropriate training and mitigate unintended consequences.

Several of these considerations can be addressed by forming a hybrid of the two proposals considered. See the Revised Proposal section for details.

The role of stretch codes

There was general support in the room for the creation of a provincial stretch code. This stretch code would create a common framework for utilities, the Province and local government to offer incentives for higher-performance building.

There was general acknowledgement that more than one tier of stretch performance was likely needed to meet the needs of different local governments and play different roles along the market transformation curve — though some expressed concern with having too many distinct levels of code to enforce. Stretch codes corresponding to one or two "steps" above the base code already exist: for example, the City of Vancouver's Green Rezoning and Higher Buildings policies.

Most participants considered it important to create incentives for net-zero ready demonstration projects. This could be done by defining a net-zero ready stretch code to be used as criteria to access incentives, and eventually as a requirement for new public buildings. It could also be done through design competitions similar to what was done in Brussels under the BatEx program. In that case, it may not be necessary to define the net-zero ready stretch targets explicitly, because a jury selects them rather than going through a formal compliance process. The general criteria for eligibility and selection could suffice.

Some participants also flagged the need for stretch codes to consider issues beyond energy — particularly indoor air quality and water conservation.

Should local governments be allowed to adopt stretch codes as base codes?

This question was raised in table discussions and tested explicitly in plenary using a gradient exercise. Most participants supported the idea. Arguments for and against are summarized in Table 5.

Table 5: Arguments for and against local government adopting stretch codes as base codes

For	Against
• Stimulate and demonstrate early innovation and provide gradual training • Strike a balance between flexibility for municipalities, allowing them to select target appropriate to local capacity, and consistency for province • Approach successfully implemented in Massachusetts • Supports intention to achieve *regional* consistency by allowing other Lower Mainland municipalities to coordinate policies with Vancouver	• Clarification is needed as to whether utility demand-side management (DSM) incentives would still be available in jurisdictions having adopted the stretch code as baseline • Municipalities with fewer resources might not be able to adopt opt-ins • Different stretch codes may fail to build market demand — little uptake — or spike demand when industry is not ready — large uptake • Collides with intention to achieve *provincial* consistency and harmonization with national code

Making a more explicit link between stretch codes and the next iteration of the building code would help make the case for continuing to provide DSM incentives in local governments that adopt the stretch code as base code. It could then be argued to be a specified proposal facilitating adoption of a new provincial regulation.

5. Supporting policies

On the second day, breakout groups discussed policies that would support the proposed schedule and targets to achieve net-zero performance. High-level recommendations from each breakout group, as well as key follow-up action items, are summarized below.

Compliance, commissioning and airtightness testing

Tim Ryce from the City of North Vancouver, Dave Ramslie from Integral Group and Duane Jonlin from the City of Seattle presented on the key challenges in Part 3 compliance, the rationale for mandatory commissioning and air-tightness and Seattle's commissioning and airtightness experience. Participants were asked to discuss the pros and cons of commissioning and airtightness testing and to examine strategies to improve compliance and streamline code administration. Participants recommended that airtightness testing and commissioning be required for all new buildings and that buildings be re-commissioned every three to 10 years to monitor ongoing performance. It was noted — based on experience in other jurisdictions — that builders would likely learn quickly how to improve envelope tightness after the testing of a few buildings, resulting in the need for an airtightness testing policy to decrease over time.

Some recommended policy design considerations:

- Use different inspectors for commissioning and for energy to increase compliance
- Require airtightness without requiring a target to pass — leave it to owners to be the enforcer
- Link safety and health to energy efficiency concerns to communicate the need for re-commissioning (i.e. "Air Care" for buildings)

Recommended actions included:

- Find appropriate commissioning standard
- Education on value proposition of commissioning to owner
- Implement spot checking program to ascertain the compliance rates of projects by various builders, engineers, architects and developers; increase leniency or tighten spot checks based on level of compliance obtained by the professionals

Building a Passive House MURB in Vancouver: lessons learned and market readiness

Scott Kennedy of Cornerstone Architecture and Ed Kolic of Eighth Avenue Development provided an overview of the design feature and business case for a couple PH construction projects in Vancouver. Participants then discussed how to accelerate the uptake of PH construction.

Recommended actions included:

- Establish building trades training and support
- Provide incentives for PH construction
- Incorporate indoor air quality and water conservation targets alongside PH metrics
- Provide research and development funding to improve availability of B.C.-made, high-performance components

Asset-based benchmarking

Andrew Burr from DOE and Nora Wang from PNNL provided an overview and walk-through of the Building Energy Asset Score, a free online tool developed by PNNL for the DOE to assess the performance of buildings based on assets rather than based on their energy consumption data. The tool was well received by workshop participants and seen as user-friendly and very useful. Participants suggested that the tool could be used to establish compliance, particularly for smaller projects which might not be able to afford full energy modeling, though a verification process would be needed involving a certified professional. The group commented that using Portfolio Manager and the Building Energy Asset Score in combination would be very effective at providing information on a building's potential performance alongside actual operating results. The group also highlighted that incentives and programs would be needed to promote the tool, encourage score disclosure and provide industry training.

Recommended action:

- Undertake an asset-based benchmarking pilot study in Metro Vancouver

Incentives

Participants discussed barriers to high-performance buildings and the type of incentives or financial mechanisms that would best address them. Barriers included upfront capital costs, Strata council processes and engagement, complexity of administration and a lack of public awareness. Participants identified possible financing mechanisms (on-bill financing, PACE and transfer to strata fees) and incentives (density bonus, expedited processing/permitting, development fee rebates, tax exemptions and rebates for passive/net-zero houses). They also identified alternative strategies, such as targeting research and development, manufacturers, or buyers instead of developers; incentivizing labelling and benchmarking; incentivizing demonstration projects; increasing energy costs; working with financial institutions to incorporate operational savings in debt load calculations; and finding a way to factor the use of better design into depreciation reporting.

Recommended actions included:

- Work with local governments to evaluate the benefits of increased density and establish a value proposition for density bonuses
- Expand labelling to Part 3 buildings using operational or asset-based benchmarking
- Gather lessons learned from Manitoba's PACE program

Operational benchmarking

Jayson Antonoff of the Institute for Market Transformation presented on the state of benchmarking policies in the U.S. while Nat Gosman of the Ministry of Energy and Mines discussed policy approaches being considered by the province. As a group, participants discussed the relative advantages and disadvantages of provincial versus local government benchmarking, reporting and disclosure requirements. Participants also discussed the research needed to resolve privacy and disclosure concerns, and how to improve communication with consumers. All participants supported a benchmarking regulation that is either effective province-wide, or available to municipalities on an opt-in basis.

Recommended actions included:

- Research privacy issues to ensure that utilities share information with building owners and that cities can access information
- Improve communication of Portfolio Manager results to influence consumer behaviour
- Strive to create a uniform benchmarking standard aligned with regional and national partners
- Consider how benchmarking can be embedded in broader policies
- Identify how benchmarking data will be collected and analyzed to inform policy and market decisions

Ongoing performance and outcome-based codes

Mark Frankel of the New Buildings Institute presented on the differences in modeled and actual energy use in high-efficiency buildings. Duane Jonlin explained the City of Seattle's optional outcome-based code. Participants then identified potential causes of performance gaps including occupant behaviour, inconsistent modeling and project team communication. Participants suggested ways to address these issues such as pre- and post-construction commissioning; periodic energy audits for office types B and C, energy codes that encourage efficient envelope over complicated mechanical systems; linking system maintenance to indoor health; linking property insurance with operational performance, performance-based contracts; heat/light as a service models; sub metering, including metering of in-suite hot water use, audits at point of sale; tying performance to property tax and insurance costs; mandatory energy audits for the bottom 30% of performers (based on benchmarked data); and public disclosure of benchmarking results.

Recommended action:

- Develop performance-based contracts spreading responsibility for performance between designer, contractor and operator

Pacific Northwest economic region case studies

James Montgomery from RDH engineering presented a series of case studies of new net-zero energy buildings and deep retrofits across the Pacific Northwest economic region (PNWER). The group then discussed the type of information that would be useful to collect from case studies to inform policy development and growth of the industry. Participants flagged the importance of including not just successes but also failures of near net-zero buildings; post-occupancy monitoring to establish performance gaps and analyse their causes; and further cost analysis on payback periods and life cycle costs.

Recommended action:

- Finish cost analysis for PNWER case studies and summarize the key points

Change management

Participants discussed how a change management strategy could be developed to facilitate transition to high-performance buildings across the industry. There was a shared acknowledgement that the current system might not be equipped to support an important systemic change, particularly due to the complex relationship between government and other entities. The factors discussed included approaches to engagement and consultation; the role of local governments as enforcers of provincial policy; the lack of industry capacity to keep up with change in regulations; leakage between subcontractor silos; transitions from pilot projects to the mainstream; the complexity of the code and dependence on interpretations; and the capacity to have honest feedback loops with the industry on change stress. Some key considerations to enable change include:

- Set a simple and easy-to-understand goal for the industry that includes a performance target, not a prescriptive target
- Make sure everyone understands what the potential gaps are and where we are going
- Ensure that the change management strategy is adaptable to change (i.e. change in governance, prices, etc.)
- Ensure key industry bodies have an association to facilitate engagement with government
- Ensure skilled labour buys in by engaging consultants and builders/developers, and also by updating trade certifications and contractor licensing to reflect the change strategy

Recommended action:

- Conduct a gap analysis to assess weaknesses in the system and understand what is working through an ongoing multi-stakeholder discussion, which would be co-facilitated by government and an external party (possibly the Pembina Institute).

6. Revised policy proposal

The proposal laid out here is a reflection of the discussions and opinions heard during the TLF and our research on building efficiency innovation. The proposal does not represent a consensus amongst forum participants. Rather, this is the Pembina Institute's revision that builds on the strengths of the previous two options proposed:

- Option A proposed an incremental increase in performance targets for regulated loads in the next four iterations of the B.C. Building Code, reaching the equivalent of net-zero ready by 2032.
- Option B proposed a leap to a net-zero ready standard inspired by passive principles, starting in 2020 for rezoning in the City of Vancouver, and brought in province-wide between 2024 and 2027.

This revised proposal builds on the strengths of the two options in creating an incremental, market-driven approach to enable a jump to net-zero ready buildings. A key component of the revised proposal emphasizes significant investments in pilot project programs and other market transformation initiatives, including public procurement policy and ensuring supply of high performance components. In this revised proposal incentives are concentrated on the end goal rather than on incremental improvements. This approach is strongly influenced by the example of Brussels (see Appendix A), but adapted to the B.C. context based on input received during the TLF.

The proposed road map and timeline are presented in Table 6 and described in more detail below.

Table 6: Roadmap and timeline to net-zero ready new Part 3 buildings

2016	B.C. government declares a goal for new Part 3 buildings to be net-zero ready by 2030[7] Develop and implement a multi-tiered, performance-based provincial stretch code Launch an exemplary building pilot project program, and research programs to study design options and the performance of occupied buildings Establish a net-zero ready requirement for new provincial public buildings (for major building types)
2018	Update energy code to ASHRAE 90.1-2016 or revised NECB-2015
2020	Require net-zero ready for rezoning in the City of Vancouver Review research on the first wave of exemplary building projects and earlier pilot projects Assess market readiness for a net-zero ready standard Announce a net-zero ready regulation and phased adoption schedule
2025	Adopt a net-zero ready standard in the lower mainland and south coast
2027	Adopt a net-zero ready standard in rest of the province
2030	Almost all new Part 3 buildings will be net-zero ready[8]

[7] An equivalent goal should be considered for Part 9 buildings.

[8] This target assumes that a requirement phased in from 2025 to 2027 will have a four or five year delay between permitting and completion.

2016

- Declare a goal for new Part 3 buildings to be net-zero ready by 2030 and consider an equivalent goal for low-rise buildings,
- Conduct stakeholder consultations on a proposed roadmap drafted by the B.C. Building and Safety Standards Branch energy efficiency working group.
- Develop and implement a multi-tiered, performance-based provincial stretch code, setting interim targets along the path to net-zero ready. The stretch code includes three levels of stretch performance:
    - The first level is equivalent to the level of performance expected in the 2017-2018 base code, or equivalent to the Vancouver Green Rezoning policy (roughly 30% above the 2008 code).
    - The second level is equivalent to Vancouver Higher Building's policy (roughly 45% above the 2008 code).
    - The third level is a net-zero ready stretch level. The stretch code would include requirements for airtightness testing, commissioning, benchmarking and sub-metering, and would also be paired with additional incentives for measurement and verification programs.[9]
- Launch an "exemplary building" pilot program[10] that encourages early adoption of net-zero ready buildings and deep energy retrofits.
    - Focus the program criteria on low-cost, simple, reproducible solutions[11] that allow different building approaches (e.g. Passive House, Living Building).
    - Set key targets for the number of buildings to participate each year, representing a range of building types — schools, offices, residential, retail, etc. — across various regions in B.C., and then adjust the incentives based on annual uptake.
    - Ensure that the pilot program is in place for several years to allow for a substantial pool of buildings from which to learn from, and to drive market demand for products.
    - Provide appropriate training programs for trades, developers, architects and building managers.
    - Collaborate with universities and other research institutions to study design options adopted in exemplary buildings, and to monitor the actual performance of occupied buildings both before and during the program.
    - Conduct an outreach and education campaign to communicate the results of the exemplary building pilot program to the public and industry.

---

[9] Integral Group, *Advanced Energy Efficiency Requirements for Buildings in BC* (2015), 11. http://www.integralgroup.com/advanced-energy-efficiency-requirements-for-buildings-in-bc/

[10] The level of effort needed to pursue this roadmap is considerable and would require significant resourcing for incentives and increase in staff capacity. See Pembina's analysis, *From Brussels to British Columbia*, for more details.

[11] Criteria under the Exemplary Buildings program in Brussels are: (1) be informed by passive building principles and reduce emissions as close to zero as possible; (2) prioritize the use of eco-friendly construction materials, and consider natural cycles (e.g. rainwater) and biodiversity; (3) demonstrate a high architectural quality, good visibility, and a satisfactory level of integration into existing stock; and (4) use simple and reproducible technology (in technical and financial terms) with reasonable payback timelines, rather than using high-tech solutions. Exemplary Buildings qualify a subsidy of 100 euros per m^2.

- As a key component of the exemplary building pilot program, mandate that provincial public buildings meet net-zero ready performance for new construction. Create a fund and program to support construction or renovation of other public buildings considering, in particular for the unique opportunities offered by social housing projects.
- Form a permanent stakeholder advisory committee to provide ongoing feedback on the roadmap to net-zero ready for Part 3 buildings, to advise on change management and to review outcomes from exemplary building projects and stretch codes. Ensure demand-side management (DSM) regulations and allow utility DSM programs to support these initiatives.
- Engage with Provincial/Territorial Policy Advisory Committee on Codes and national Standing Committee for Energy Efficiency to create a national net-zero ready stretch code.

2018

- Revise energy efficiency targets for the next building code revision (2017-2018) based on the adoption of ASHRAE 90.1-2016 or revised NECB-2015, with both targeting about 30% above the 2008 code.

2020

- Require performance equivalent to the net-zero ready stretch code for rezoning in Vancouver.
- Synthesize the research completed on design solutions and business cases from the first wave of pilot projects, as well as actual performance for occupied high-performance buildings erected before the exemplary building program.
- Assess B.C.'s net-zero ready standard and announce phased adoption from 2025 to 2027. Consider the analysis of market readiness and progress made at the national level on the development of a net-zero ready stretch code (see below).

2025

- Adopt the net-zero ready standard in the Lower Mainland and south coast. Allow for leniency and flexibility in compliance over the first two years, as well as exemptions or relaxations for more complicated building types.

2027

- Extend the requirement to the rest of the province.

2030

- Given that there is a delay of up to five years between permitting and completion, a requirement phased in from 2025 to 2027 will ensure than most new buildings in 2030 will be net-zero ready.

Supporting policies and strategies with accompanying actions

In order for the proposed roadmap to a net-zero ready energy code to be successfully implemented — and to ensure that buildings achieve expected levels of performance — supporting policies and strategies are needed. We need to address market barriers, encourage market transformation and inform ongoing code development.

1. Improve energy code compliance

Increase the stringency of energy code compliance and establish the tools to do so.

- Implement spot checking to ascertain the compliance record of builders, engineers, architects and developers
- Require minimum training and ongoing education for building officials
- Require commissioning and airtightness testing (see below)

2. Provide incentives and innovative financing solutions

Well-designed incentives can offset some of the incremental costs and risks associated with new technologies, and motivate developers to go beyond code.

- Implement a Property Assessed Clean Energy program, learning from existing programs in Manitoba and the U.S.
- Remove tax disincentives for increased energy efficiency by addressing current issues, where higher capital costs lead to increased property transfer taxes or property taxes
- Remove barriers to transferring incremental capital costs to stratas or home owner associations
- Increase the carbon tax
- Provide tax incentives for owners, builders and contractors

3. Benchmark, report and disclose building energy performance

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.

- Research privacy issues to ensure that utilities can share information with owners and municipalities
- Commit to a provincial roadmap to mandatory public energy disclosure
- Identify how benchmarking can be embedded in broader policies
- Identify how and by whom benchmarking data will be collected and analyzed
- Improve communication of Portfolio Manager results to influence consumer behavior
- Conduct pilot asset-based benchmarking in Metro Vancouver

4. Require building commissioning and standardize modeling

- Include commissioning and air-tightness testing standards in the stretch code
- Educate building owners on the value of commissioning
- Standardize modeling guidelines and standards

5. Reduce plug loads

Because occupants install most plug loads, it is challenging to regulate their energy use through building codes. As the energy demand from regulated load decreases, plug loads will account for a growing fraction of building energy use. To reduce this demand:

- Include more consideration of plug loads in energy codes, such as controls or energy use feedback interfaces
- Develop stricter energy efficiency regulations to reduce energy demand from appliances and equipment.

6. Address performance gaps through outcome-based policies

Demonstrate building performance and code compliance by analysing energy use data after occupancy, rather than by modeling or through a review of prescriptive requirements. Other code requirements or policies can also help the owner, operator and occupants run their buildings at maximum efficiency after construction. These include control strategies, graphic energy-use displays for troubleshooting by building managers and mandatory benchmarking.

- Tie performance to property tax and insurance costs or audits at the point of sale

7. Develop a change management strategy

This will facilitate a significant systemic change and ease the transition to high performance buildings across the industry.

- Create an ongoing multi-stakeholder panel to advise on energy efficiency in Part 3 buildings and assess gaps in the current change management system
- Set targets for existing and new buildings in Climate Leadership Plan
- Work with the Energy Efficiency Working Group to refine the roadmap to net-zero ready and design stretch codes

8. Invest in industry training and capacity

Fostering innovation as well as the knowledge and skills required to design, build and operate high-performance buildings is essential.

- Provide research and development funding for high-performance components made in B.C.
- Invest in mandatory training programs for industry groups

9. Create a network of professional advisors

- Provide technical, financial and management advice on best practices at no cost to developers, with a focus on disseminating information to key stakeholders and increasing their familiarity with high-performance standards for future projects

10. Develop a national net-zero ready stretch code

- Work with other provinces and the Energy Efficiency Standing Committee to create a net-zero ready national stretch code based on Passive House principles[12]

11. Increase the price on carbon

The low cost of energy and mild climate of B.C. make it more difficult to make the case for energy efficiency.

[12] Similarly to Provincial stretch codes, this national stretch code would support leading jurisdictions in developing net-zero ready incentive programs and regulations while ensuring a level of national harmonization. This net-zero ready standard should be performance-based (with some prescriptive elements). This standard is not a replacement for the prescriptive-based NECB, though uptake of the stretch code could inform future development of the NECB and eventually become the standard base code.

Appendix A: Comparison with Brussels timeline

Table 7: Comparative timeline of Brussels case study and revised proposal

B.C. proposal			Brussels case study	
2014	B.C. has one of the best energy codes in North America. About a dozen Passive House projects are in various stages of completion or construction, and there are several net-zero buildings.	**Year 1**	**2004**	Brussels has some of the worst insulations levels in Europe. There are zero passive or near net zero buildings. Brussels develops a framework to address energy and environmental concerns with the building sector.
2015	Draft climate leadership plan released.	**Year 2**	**2007-2009**	First phase of BatEx project: 117 projects, 265,000 m^2 built or planned, including 80,000 m^2 of passive buildings.
2016	Climate Leadership Plan announced. The B.C. government declares a goal for new Part 3 buildings to be net-zero ready by 2030.[1] A multi-tiered, performance-based provincial stretch code is developed and implemented. Launch of the exemplary building pilot project program and research programs. Net-zero ready requirement for new provincial public buildings (for major building types). Formation of an ongoing multi-stakeholder advisory. Engagement with PTPACC and Standing Committee for Energy Efficiency to create a national net-zero ready stretch code.	**Year 3**	**2009**	Government announced all new public buildings would be passive buildings by 2010, and all new buildings by 2015. BatEx program continued to 2014.
2018	Energy code updated to ASHRAE 90.1-2016 or revised NECB-2015.	**Year 4**	**2010**	All new public buildings required to be passive buildings.
2020	Net-Zero ready is required for rezoning in Vancouver. Review of research on the first wave of exemplary building projects and earlier pilot projects; assessment of market readiness for net-zero ready standard. Announce net-zero ready regulation and phased adoption schedule.	**Year 5**		
		Year 6	**2014**	Change in government, but the new government upholds

				previous commitments.
		Year 7	**2015**	Major building types required to be passive buildings, with leniency in roll-out and flexibility to accommodate complicated building types and sites.
2025	Net-zero ready standard adopted in Lower Mainland and south coast, with allowance for leniency and flexibility in compliance.	Year 10		
2027	Net-zero ready standard adopted in rest of the province.	Year 12		
2030	Almost all new Part 3 buildings are net-zero ready.[1]	Year 15		

Appendix B: Forum policy proposal

This appendix contains a slightly abbreviated version of the policy proposal presented for discussion during the forum. This does *not* capture the changes made in the revised proposal based on forum conversations. It is appended here for archival purposes and to provide context for the forum summary.

Context

This policy proposal is intended to facilitate dialogue at the Pathways to Net-Zero Buildings in British Columbia Thought Leader Forum, June 4 and 5, 2015 in Vancouver, B.C. The goal of this document is to outline possible directions and visions for the future of B.C.'s building regulations, and not necessarily to draft language that would appear in such regulations. Please refer to two papers by the Pembina Institute — *Evolution of Energy Efficiency Requirements in the B.C. Building Code*, and *The Path to "Net-Zero Ready" for New Part 3 Buildings in B.C.* — as well as the stretch code paper by Integral Group — *Advanced Energy Efficiency Requirements for Buildings in B.C.*— for background research that informed this proposal.

Target

All new Part 3 buildings to be net-zero ready circa 2030
Net-zero ready working definition: Total site energy ~ 65 kWh/m^2/yr or less
(or about 70% below ASRHAE 90.1-2004)

What is a "net-zero ready" building?

- A building with an annual energy use low enough that it could be generated on site over the course of a year.
- A survey of net-zero certified buildings shows that their total energy use intensity (EUI) averages about 65 kWh/m^2/yr (NBI, 2014). This is roughly equivalent to 70% below the average EUI for B.C. buildings under 90.1-2004 (210 kWh/m^2/yr; Hepting, 2011). We will use these two numbers as a rough metric for "net zero ready".
- Passive House buildings would generally be considered "net-zero ready." The maximal annual energy use for a PH for which the energy supply is half electric and half gas is also about 65 kWh/m^2/yr.

Why use 90.1-2004 as baseline?

- 90.1-2004 was selected by ASHRAE as the benchmark to compare future codes. It was also B.C.'s first energy code and was adopted in 2008.

Why focus on site energy and not source energy?

- Simplicity; fuel neutral. Avoids debate about factors.
- Aligns with ASHRAE and Department of Energy (DOE)-proposed definitions for net-zero energy buildings.
- While including source energy might be seen as a way to factor the climate impacts of different fuel choices, climate impacts would be more directly addressed by setting carbon-intensity targets alongside site energy targets.

Energy code schedule

Option A: Four incremental steps (Washington style)

Set performance targets for regulated loads in the next four iterations of the B.C. Building Code (BCBC):

2017: 30% better than 90.1-2004[13] (Stretch Level A)

2022: 45% better than 90.1-2004 (Stretch Level B)

2027: 60% better than 90.1-2004 (Stretch Level C)

2032: 70% better than 90.1-2004 (Stretch Level D)

Option B: Jump to Passive House equivalent (Brussels style)

2016: Announce Passive House targets

2017: Adopt 90.1-2016 or NECB 2015-r2 (~ Stretch Level A), and allow Passive House equivalent as alternate compliance (with incentives). Adopt a Passive House policy for public buildings

2020: Passive House equivalent requirement for rezoning (~ Stretch Level D). Decide whether to update energy code in 2022 or wait for Passive House regulation.

(2024-2027): All new part 3 buildings built to Passive House equivalent (~ Stretch Level D)

Stretch codes:

Develop provincial stretch codes matching these performance targets to encourage early adopters. These stretch codes should be used by local governments and utilities as criteria for incentives, rezoning policies, density bonusing and as targets for new public buildings. They could also be adopted as local base codes through opt-in regulations.

Comments

- The base code targets in Option A match the stretch codes steps recommended by the Stretch Code Working Group (see the end of this document). As discussed above, a PH building would meet the performance of Stretch Level D (70% below 90.1-2004).
- A RDH costing study shows that 20-22% energy saving beyond 90.1-2010 — Stretch Level A — can already be met with a negligible cost increment for mid-rise MURBs and mid-rise offices.
- 60% of large residential and commercial construction projects in Vancouver go through rezoning showing there is already significant capacity to meet Stretch Level A in the Lower Mainland.
- The proposed performance level for ASHRAE 90.1-2016 (~25% below 2004) and NECB 2015-r2 (12.5% below 2011, or ~28% below 90.1-2004) are slightly below the target proposed for BCBC 2017, but are still two options that could be considered for the next energy code.
- Beyond 2017 both Option A and Option B are more aggressive than the targets currently proposed for ASHRAE 90.1 and NECB.
- The 70% below 90.1-2004 target is roughly aligned with the target adopted by Washington State: 70% below 2006 WSEC by 2030.
- Brussels had very little PH capacity — and no Passive House buildings — in 2007 when they launched the first of six calls for projects to incent high energy efficiency buildings. Within a few

[13] The percentage below 90.1-2004 values is used here as a shorthand to indicate the desired overall performance of each code, and is not necessarily suggested as the actual mechanism to assess compliance. Options have been explored through the stretch code process, but more discussion is needed to select the best approach to performance-based compliance (e.g. reference building, hard cap EUI, normalized EUI, prescriptive packages, etc.).

years it announced all new construction will be PH equivalent by 2015 and continued the program. The resulting 243 "exemplary buildings" inspired by PH principles were built or retrofitted, comprising over 350,000 square metres of PH buildings in Brussels. The PH code requirement came into effect this year without great controversy and the policy survived a change of government.

- With good uptake on early incentive programs (2017-2020), we should have a range of built and occupied PH buildings to study starting in 2023 to assess proposed regulations. Regulations could be phased in geographically in 2024-2027 (e.g. Lower Mainland first, then the rest of province).

Table 8: Equivalency tables for past, current and proposed energy-code performance levels

	Historical		**Stretch Level**			
Code (or stretch step)	90.1-2004 (BCBC2006r2)	90.1-2010 (BCBC2012r2)	**A**	**B**	**C**	**D**
Year of adoption in base code (Option A)	2008	2013	**2017**	**2022**	**2027**	**2032**
Year of adoption in base code (Option B)	2008	2013	**2017**	**-**	**-**	**2024-2027**
% better than 90.1-2004[1]	baseline	11%	**30%**	**45%**	**60%**	**70%**
Comparable to:	-	-	Vancouver Green Rezoning Policy[2]	Vancouver Higher Buildings Policy[3]	Minergy	Passive House
Expressed as…						
% better than 90.1-2010	-11%	baseline	21%	38%	55%	66%
% better than MNECB 1997	23%	33%	44%	56%	68%	76%
Thermal load EUI (kWh/m^2/yr)	110[4]	98	77	61	44	33
Regulated EUI (kWh/m^2/yr)	179[5]	160	125	98	72	54
Total EUI (kWh/m^2/yr)	210[6]	190	155	128	102	84
Reduction in total energy, if plug load remain constant	baseline	10%	26%	39%	51%	60%

1: Regulated or thermal load, site energy

2: Requires LEED gold + 22% energy cost savings above 90.1-2010

3: Requires 45% energy savings above 90.1-2010

4: Average for concrete MURBs in Vancouver (Integral, 2015)

5: Average of modeled EUIs for eight archetypes in three regions (Hepting, 2011)

6: Average of modeled EUIs for eight archetypes in three regions (Hepting, 2011); Projections assume plug loads remain constant at ~30 kWh/m^2/yr

Supporting policies and/or strategies

Supporting policies and strategies are needed for an energy code to deliver its expected level of performance, to address market barriers (Table 2) and to inform ongoing code development. The following nine key policies and/or strategies were provided to support Option A and B in the original policy proposal. See the white paper titled "The Path to Net-Zero Energy Buildings in BC" or the Revised Proposal section of this document for detailed descriptions.

- Develop opt-in stretch codes
- Improve energy code compliance
- Provide incentives and innovative financing solutions
- Benchmark, report and disclose building energy performance
- Require building commissioning and air tightness testing
- Reduce plug loads
- Address performance gaps through outcome-based codes and other policies
- Lead with public buildings
- Increase the price on carbon

Recommendations from the Stretch Code Working Group[14]

- 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.
- 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.
- In addition to the performance requirements, include the following mandatory prescriptive requirements:
    a. Minimum lighting-power density values
    b. Sub-metering protocol
    c. Commissioning requirements
    d. Administrative requirement for mandatory air-tightness testing
    e. Mandatory third-party review of energy models
- Adopt an array of stretch targets that can be adopted by different jurisdictions over time starting at 30% better than ASHRAE 90.1 2004.
- Integrate benchmarking and reporting requirements into the stretch code in order to monitor and manage the program over time.
- The stretch code should remain primarily a voluntary standard that can be attached to incentives offered by local governments and utilities.

[14] *Advanced Energy Efficiency Requirements for Buildings in BC*, 11.