Zero Energy/Emissions Buildings Learning Centre

BCIT School of Construction and the Environment

Polytechnics Canada Showcase 2024 – Ready for the challenge

Presentation Outline

- Context
- Who we are
- Our evolution and lessons learned
- Teaching Net Zero – What's included?

Why are we here? (the Net Zero transition)

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Climate Change and Fossil Fuels

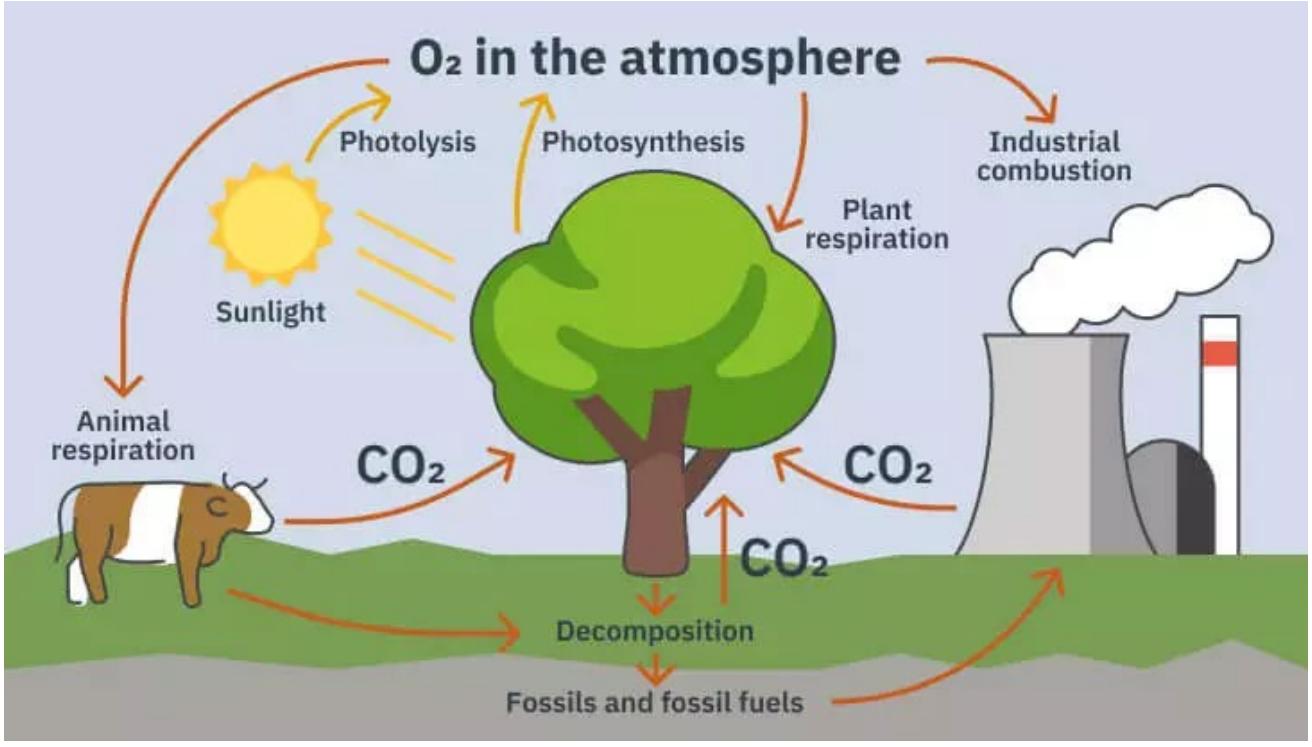


Image from EOS Data Analytics

Disclaimer

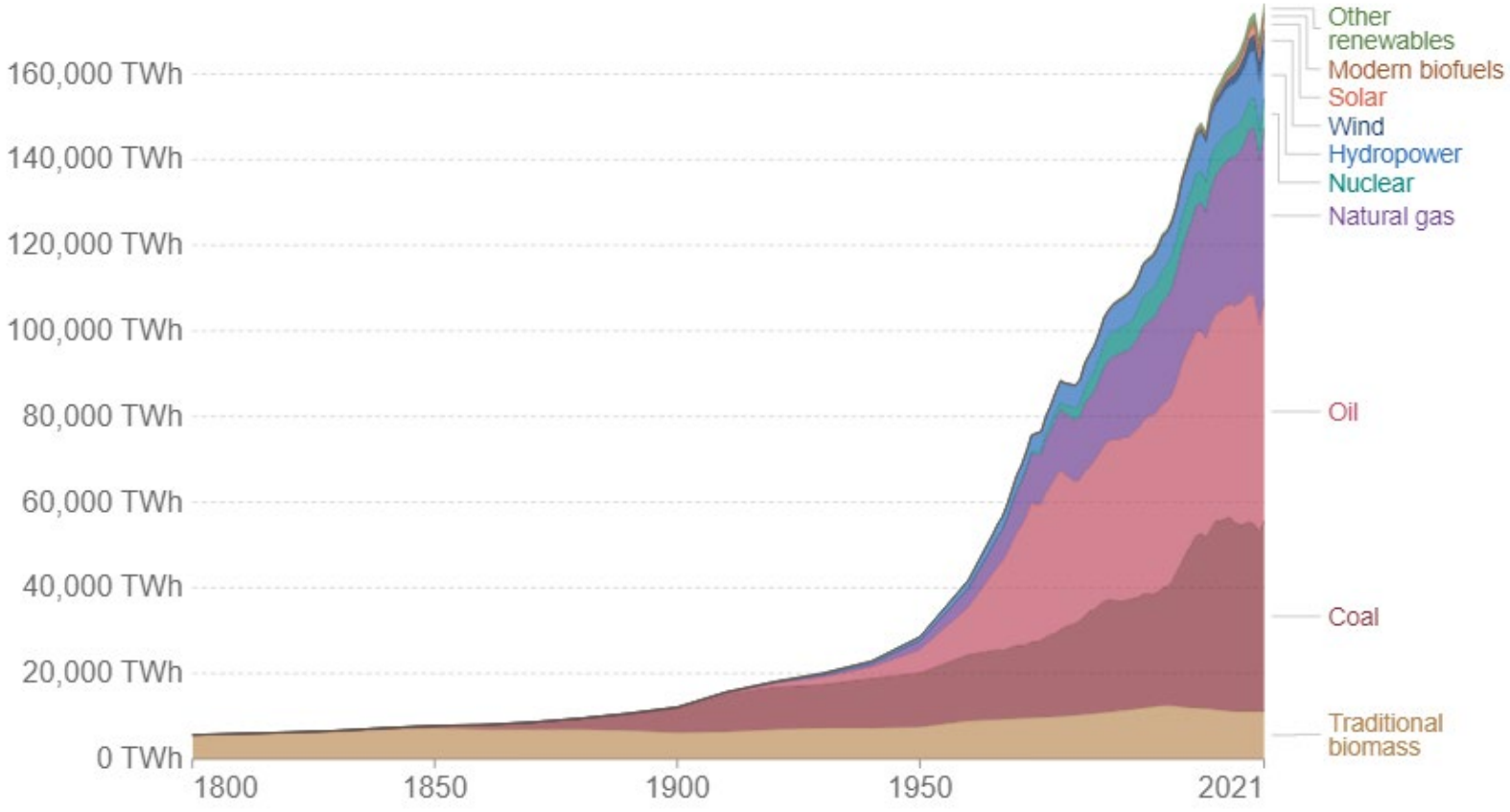
Source: Heritage Auctions

Source: NOAA Fisheries

Global primary energy consumption by source

Our World in Data

Primary energy is calculated based on the 'substitution method' which takes account of the inefficiencies in fossil fuel production by converting non-fossil energy into the energy inputs required if they had the same conversion losses as fossil fuels.



Source: Our World in Data based on Vaclav Smil (2017) and BP Statistical Review of World Energy

OurWorldInData.org/energy • CC BY

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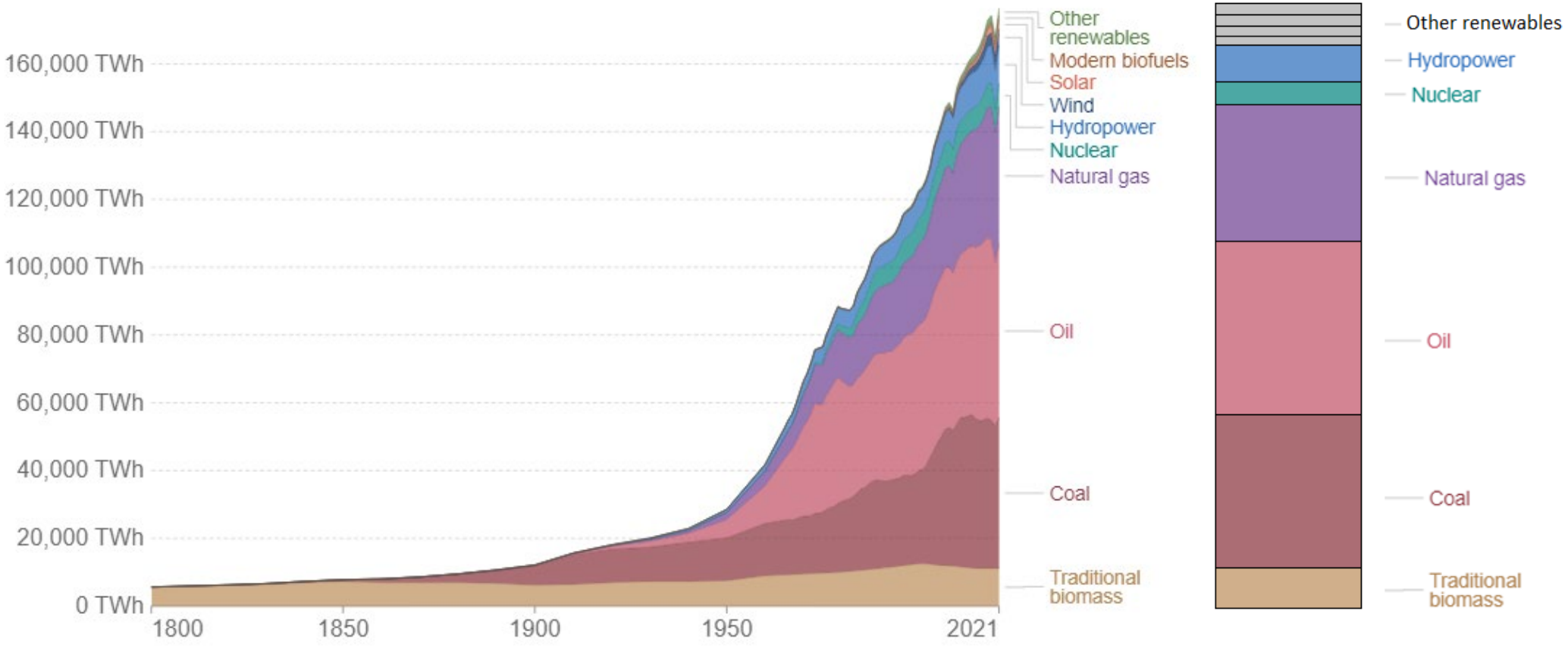
Our World in Data



Source: Our World in Data based on Vaclav Smil (2017) and BP Statistical Review of World Energy

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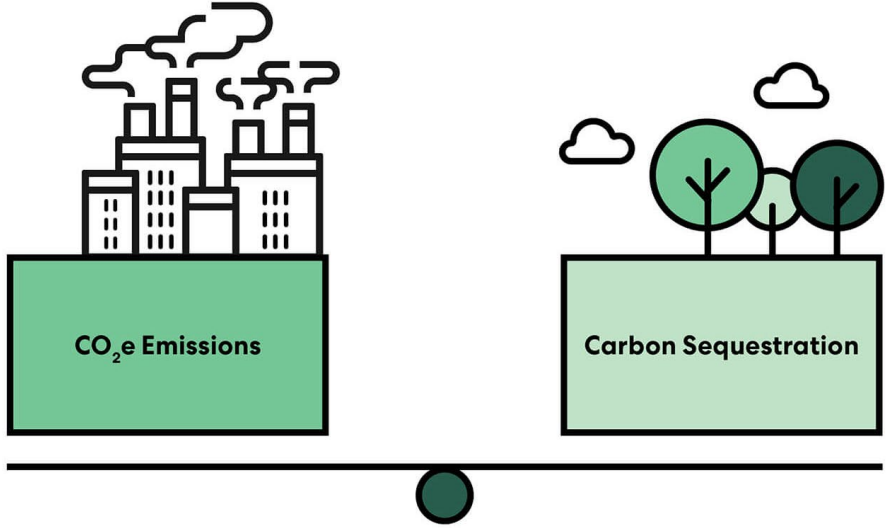
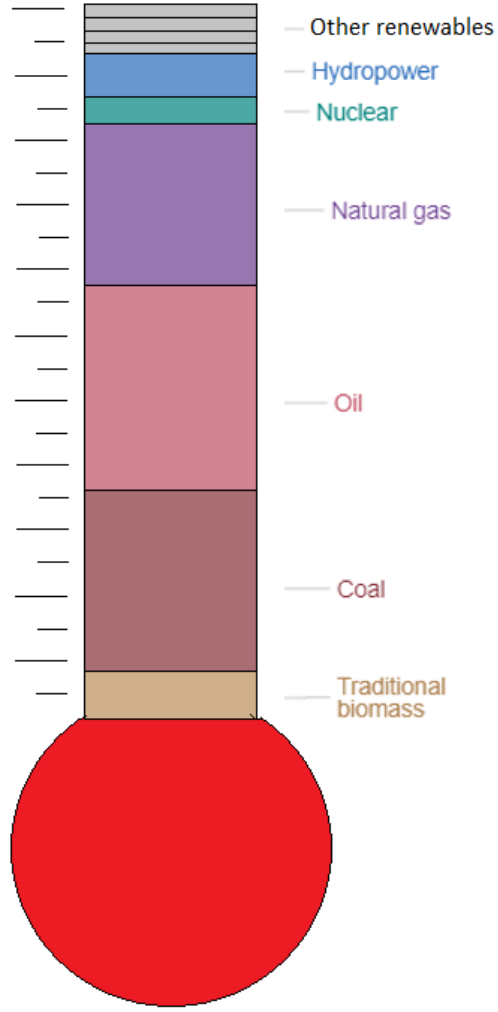
Net Zero by 2050?





Source: Perkins & Will

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Net Zero Emissions by 2050

Canadian economy either emits no greenhouse gas emissions or offsets its emissions by 2050

Includes reductions from all sectors of economy

40-45% by 2030

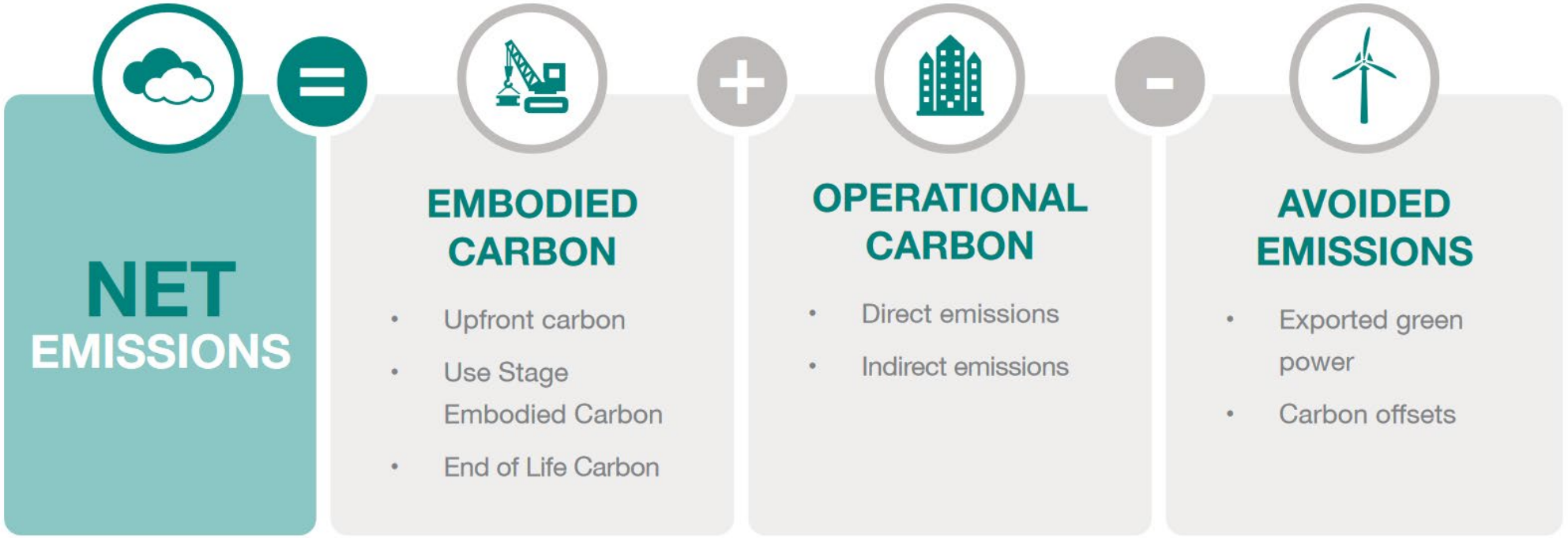
Canadian Net Zero Emissions Accountability Act

Climate Change Accountability Act

To prevent global temperatures from exceeding 1.5 °C increase, emissions from buildings need to be reduced by about **50% by 2030** and reach **net zero by 2050.**

-IPCC

Net Zero Emissions - Buildings



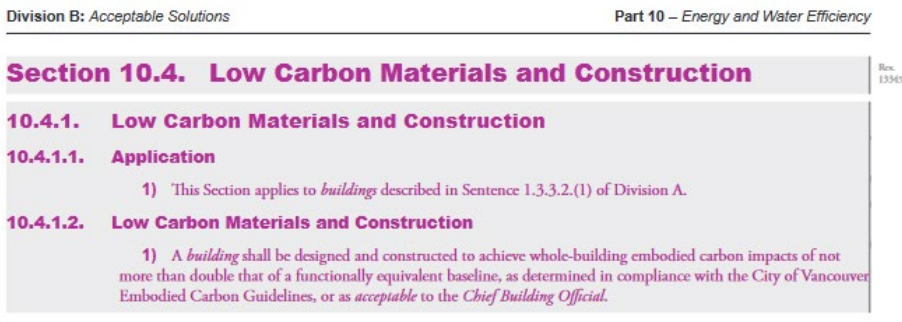
Source: Zero Carbon Building Performance Standard Version 2 (CAGBC, June 2022)

Operating Energy and Emission Limits in BC Building Code

ENERGY STEPCODE
BUILDING BEYOND THE STANDARD

ZERO CARBON STEPCODE

Embodied Carbon Guidelines and Bylaws



Division B: *Acceptable Solutions* — Part 10 – *Energy and Water Efficiency*

Section 10.4. Low Carbon Materials and Construction

Rev. 13345

10.4.1. Low Carbon Materials and Construction

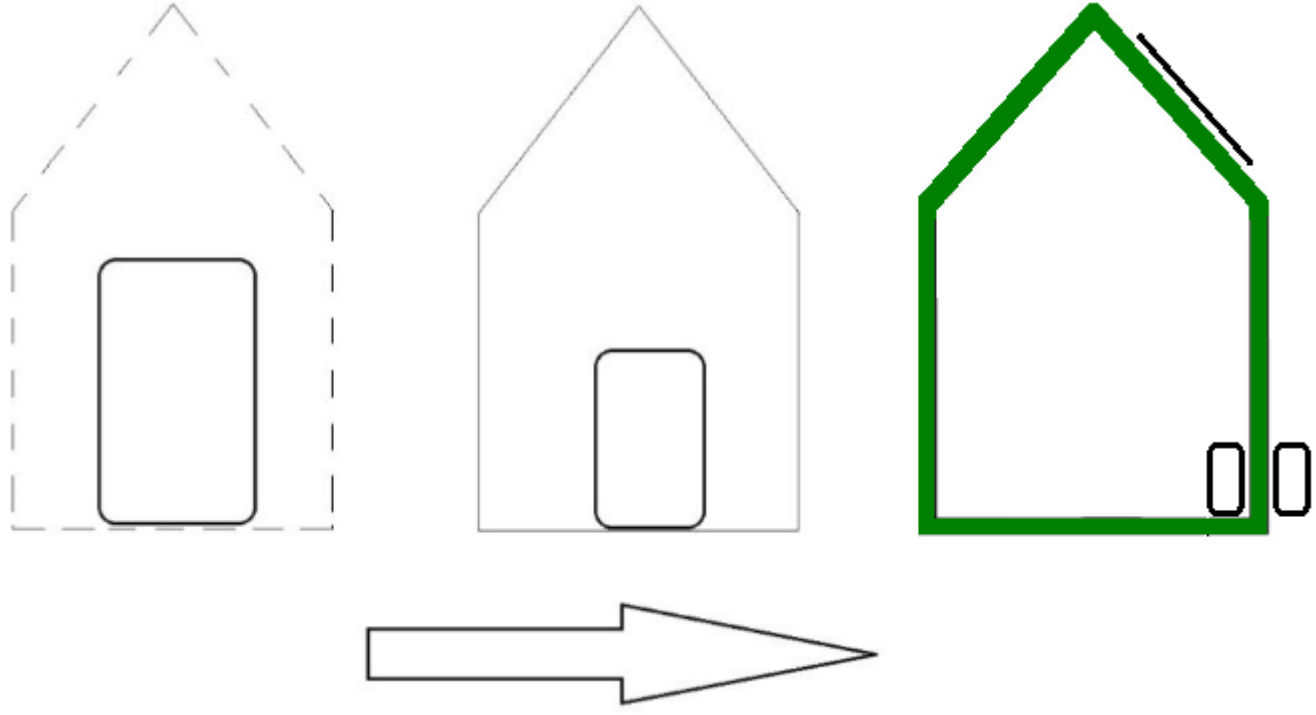
10.4.1.1. Application

1) This Section applies to *buildings* described in Sentence 1.3.3.2.(1) of Division A.

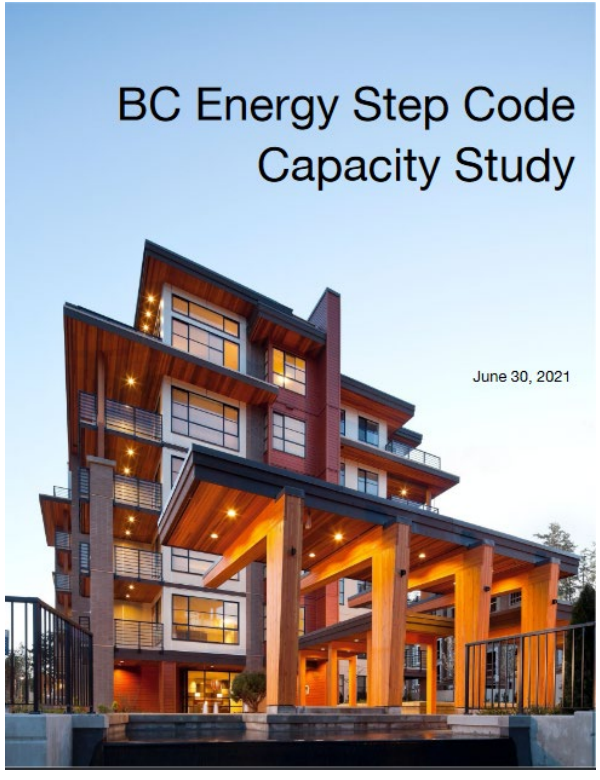
10.4.1.2. Low Carbon Materials and Construction

1) A *building* shall be designed and constructed to achieve whole-building embodied carbon impacts of not more than double that of a functionally equivalent baseline, as determined in compliance with the City of Vancouver Embodied Carbon Guidelines, or as *acceptable* to the *Chief Building Official*.

Transition to Net Zero Construction



Net Zero Education - Construction



Industry readiness by profession

	Urban Centres – Part 3			Province-wide – Part 3		
	2022	2027	2032	2022	2027	2032
Developers	Yes	Yes	Partial	Yes	Yes	Partial
Architects	Yes	Yes	Partial	Yes	Yes	Partial
Engineers (Mechanical, Electrical, Building Enclosure)	Yes	Yes	Yes	Yes	Yes	Yes
Estimators and Cost Consultants	Partial	Partial	Partial	Partial	Partial	Partial
Energy Modelers	Yes	Yes	Yes	Yes	Yes	Partial
General Contractors (Construction Managers, Project Managers and Superintendents)	Yes	Partial	Partial	Yes	Partial	Partial
Carpenters, Framers, AVM Barrier Installers & Envelope Trades	Yes	Yes	Partial	Partial	Partial	Partial
Insulators	Yes	Yes	Partial	Yes	Yes	Partial
Electricians	Yes	Yes	Yes	Yes	Yes	Yes

General Contractors - Part 3 (CMs, PMs and Superintendents)

State of readiness	2022	2027	2032
Urban centres	Yes	Partial	Partial
Province-wide	Yes	Partial	Partial

The lack of targeted courses for Part 3 contractors and the lack of requirement for ongoing professional development means that some companies may not be ready for the Higher Steps of the ESC (notably, what is required in terms of high-performance envelope construction, attention to detail, etc.)

Responsible Organization	**None** – There are multiple associations to which membership is voluntary. Part 3 builders are not required to be licensed.
Related or Supporting Organizations	BCCA, ICBA, VRCA, NRCA, SICA, VICA
Step Code Competency Framework	**Partial** - There is no ESC competency framework specifically for General Contractors, although the updated 2017 framework is applicable.
Learning Resources to Support Competencies	**Partial** - There are 9 courses directly addressing all aspects of ESC and a further 17 complementary resources. The majority of the courses are offered online and available across the province. Among the competencies, "design, construction and regulatory process" competency is most widely covered. There is at least one course covering each competency. Many of the courses are not clear about applicability to Part 3 / multi-family construction.
Learning Resources List for this Profession	**Partial** – All the construction associations promote education courses generally and sometimes include ESC related events on an ad-hoc basis. There is no centralized list.
Step Code Status	**No** - There are no incentives or means of encouragement for general contractors to take training. Contractors do not require CPD credits.
Differences Between Part 3 and Part 9	**NA**
Regional Differences	**Minor** - Experienced contractors are usually more concentrated in cities, but travel province-wide.
Identified Obstacles	**Major** • There are not enough training resources for contractors, and they are one of the top groups who were identified as struggling with implementation and needing further support.

Net Zero Education - Trades

Envelope Performance

Mass Timber

Material, Product & ZEB Literacy

Building Attribute		Competency	Relevant Trades	Gap Rating
General	Detail			
Advanced electrical systems	Lighting	• Knowledge of LED lighting systems, lamps and ballasts • Installation and configuration of control systems for lighting and mechanical systems	Electricians Control Technicians	
	Plug loads and digitization	• Peak demand and load management • Proficiency in working with Building Automation Systems • Expertise in handling Premium Efficiency Motors, EV Chargers, and Energy Storage		
Envelope performance	Walls, roofs, windows and doors	• Fundamentals for the evaluation, design, and construction of durable and energy-efficient building envelopes (enclosures) • Knowledge of the role of climate and the theory of heat flow, vapour flow, and air flow • Best practice assembly design and detailing fundamentals for above and below grade wall assemblies, roofs, and windows • Insulation and air barrier systems • Detailing approaches for air barrier systems, insulation methods, vapour barriers and cladding attachments • Application of thermal breaks to prevent heat transfer between two materials or components (e.g., balconies)	Carpenters Sheet Metal Workers Glaziers Insulators Electricians	
Mass timber construction	Low-carbon materials and construction innovation	• Wood science (fire behavior, wet wood and seismic performance), • Knowledge of mass timber materials and construction techniques • Expertise in prefabrication techniques specific to mass timber components is essential. This involves knowledge of CNC machining, robotic assembly, integrated digital manufacturing processes, and quality control measures • Ability to read and interpret architectural plans, BIM Model specifications • Skilled use of hand and power tools for cutting, shaping, joining, and finishing wood components • Knowledge of proper lifting procedures, rigging techniques, sequencing strategies, and temporary bracing methods ensures safe and accurate installation	Carpenters Machinists Riggers BIM Modellers	
Materials and products	Materials and products	• Low-carbon product knowledge such as low-carbon concrete, wood fiber insulation etc. • Application of carbon accounting and Life Cycle Analysis (LCA), Environmental Product Declarations (EPDs) and Health Product Declarations (HPDs) • Knowledge of alternative refrigerants with low or zero Global Warming Potential (GWP) and Ozone Depletion Potential (ODP) while ensuring their safety and efficiency in cooling systems	All trades	
Environmental literacy	Whole-building approach	• An awareness of how the trades scope of work can impact the environment and ways to minimize negative effects through energy-efficient design, waste reduction, and use of sustainable materials • A holistic approach to construction that acknowledges the interconnectedness of different trades' activities • Knowledge about local regulations related to environmental protection and compliance with green building standards	All trades	

Who we are and what we do

BCIT and the School of Construction and the Environment

~50k
STUDENTS ENROL EACH YEAR

2,500
EMPLOYEES

205k
ALUMNI AROUND THE WORLD

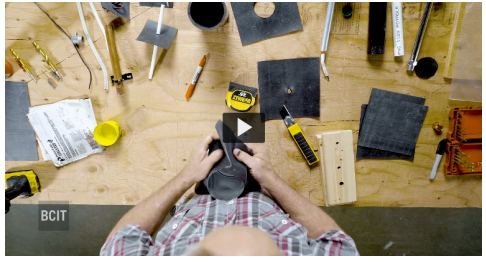
$800M
ECONOMIC CONTRIBUTION

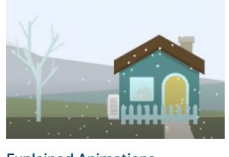
BCIT is located on the unceded territory of the Sḵwx̱wú7mesh (Squamish), səl̓ilwətaʔɬ (Tsleil-Waututh), and xwməθkwəy̓əm (Musqueam) First Nations. BCIT has been educating and inspiring students for over half a century on their traditional lands and for that, we are grateful. We acknowledge that the relationship with Indigenous peoples in Canada has been troubled and must be reconciled; we are deeply committed to working with our partners to address these issues.

ZEB Learning Centre

Established to support industry transition to Net Zero

- Public and private training for upskilling (at BCIT and on-the-road)
- Industry events & workshops
- Support to other BCIT programs
- Open-Source Education





Explained Animations

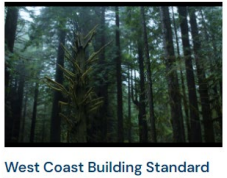
We have created a series of animations to explain terms and systems you may encounter while working on a near zero energy building.

Passive House Videos

We followed and recorded the construction of a passive house in West Vancouver (British Columbia – Canada).

LEEP Walls Videos

Natural Resources Canada (NRCan), through its Local Energy Efficiency Partnerships (LEEP) program, created a series of Net Zero Energy Ready wall design packages.



West Coast Building Standard Videos by Richard and Friends

These 6 videos designed for youth cover key concepts from the West Coast Building Standard to complement the cultural lifestyles of the West Coast people of BC.

Our Instructor Team

BRITISH COLUMBIA
INSTITUTE OF TECHNOLOGY

2021 CaGBC Inspired
Educator of the year

VRCA
Vancouver Regional Construction Association

2022 VRCA
Educational Leadership Award

BCIT

Our funding model

External

$$

- Utilities
- Financial institutions
- Crown corporations
- Grant agencies (provincial and federal)
- Corporations

Tuitions

$$

$ $

Part-time studies

Industry services

BCIT

$

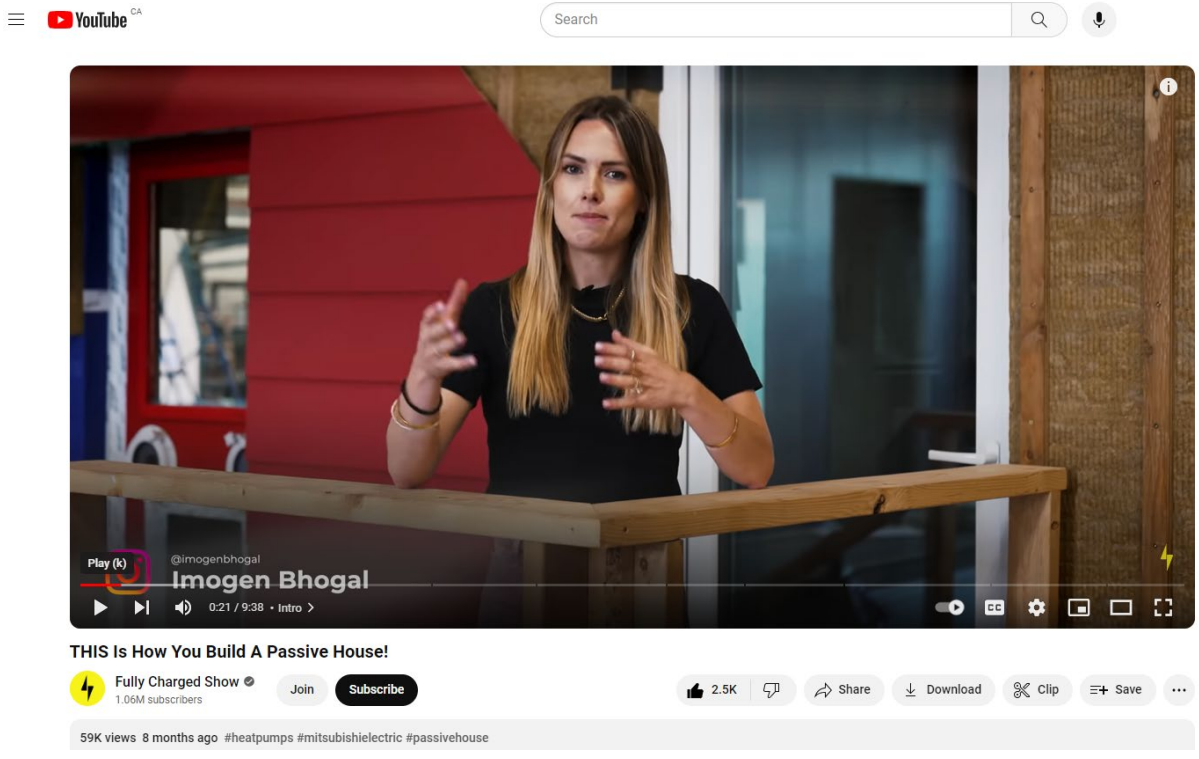
School budget

Our 21st century classroom

A Learning Place

A Gathering Place

An Identity



We reached 1 Million views this year

2020 Switch to Online Course Delivery – Keeping lab as focal point

Examples of MC and PTS course topics

- Passive House, Energy and Zero Carbon Step Code
- Airtightness and Low-Thermal Demand Assemblies
- Mechanical Systems – Net Zero Part 9
- Heat Pump Design and Installation – Net Zero Part 9
- Net Zero & Passive House Site Supervision
- Electrical Systems – Net Zero Part 9
- Embodied Carbon and Whole Building LCA

Example of Industry Services

Rendering from Local Practice Architecture

Example of contribution to FT programs

Lessons Learned and ‘Aha!’ Moments

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Lessons Learned

PEOPLE AND PLACE MATTER

- ✓ Early wins by starting with industry upskilling
- ✓ Create a convening space (lab) able to draw industry and support learning needed (hands-on applied learning for professionals and trades)
- ✓ Gathering a cross-disciplinary expert instructor team from industry is essential

Lessons Learned

PRIORITIZE INDUSTRY CHALLENGES

- ✓ Target priority professions to create momentum
- ✓ Addressing key concerns early
- ✓ Aligned priorities can lead to important seed funding

New BCIT microcredential program addresses urgent need for heat pump installation in BC

May 13, 2024 by Amy Chui

Minister of Post Secondary and Future Skills Lisa Beare visist the BCIT Residential Heat Pump Lab

With heatwaves and cold snaps becoming increasingly frequent in Canada, British Columbians are using more electricity than ever to maintain a comfortable temperature in their homes. According to Statistics Canada, one in seven Canadian are living in unsafe or uncomfortable temperatures due to rising energy bills –increasing the risk of climate-related morbidity and even death.

In response to the sky rocketing demand for energy-efficient heating and cooling solutions, the BCIT School of Construction and the Environment collaborated with the Thermal Environmental Comfort Association (TECA) and Home Performance Stakeholder Council (HPSC) to launch *the Residential Air to Air Heat Pump Specialist microcredential program*, aimed at upskilling existing tradespeople to install heat pumps in residential homes.

Lessons Learned

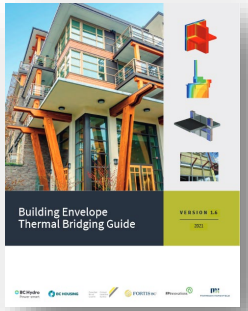
PARTNERSHIPS ARE KEY

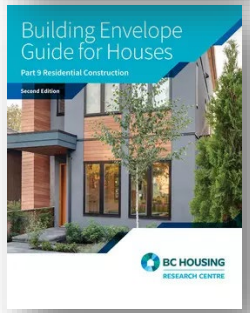
- ✓ Research and knowledge dissemination
- ✓ Creation of shared education resources
- ✓ Support and amplify upskilling efforts of others
- ✓ Grants and donations

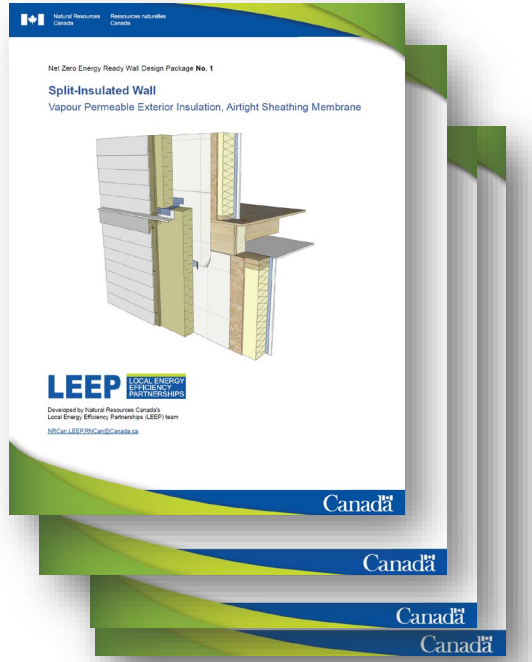
Lessons Learned

LEVERAGE RESEARCH & EXPERTS KNOWLEDGE

- ✓ Alignment with research, industry guides, etc.
- ✓ Upskilling curriculum evolved to enhance full time programs







LEEP Wall Guides – Mock-ups, Videos & Instructor Materials

Natural Resources Canada | Ressources naturelles Canada

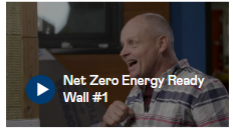
Canada

Net Zero Energy Ready Walls – LEEP Videos

Natural Resources Canada (NRCan), through its Local Energy Efficiency Partnerships (LEEP) program, created a package of Net Zero Energy Ready wall design guides. The four wall assembly guides presented in this series offer a variety of construction approaches to achieve energy efficient assemblies as part of a net zero energy project. Each assembly has it's own unique benefits and drawbacks and therefore must be carefully selected and implemented.

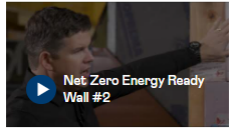
The BCIT Zero Energy Buildings Learning Centre partnered with NRCan and RDH Building Science to fabricate a wall mockup for each guide and produce this video series to provide an overview of the content of the whole package. These videos are a great complement to the original NRCan guides.

Wall Assembly #1 – Split-Wall: Vapour permeable exterior insulation with airtight sheathing membrane



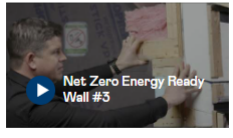
This video is for the NRCan package #1: Net Zero Energy Ready Split Insulated Wall using vapour permeable exterior insulation and an airtight sheathing membrane.

Wall Assembly #2 – Split-Wall: Low permeable exterior insulation as air and water barrier



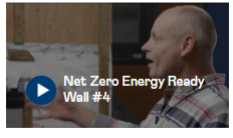
This video is for the NRCan package #2: Net Zero Energy Ready Split Insulated Wall using low vapour permeable airtight insulation.

Wall Assembly #3 – Split-Wall: Low permeable exterior insulation with airtight sheathing membrane



This video is for the NRCan package #3: Net Zero Energy Ready Split Insulated Wall using low vapour permeable exterior insulation and an airtight sheathing membrane.

Wall Assembly #4 – Double Stud Wall: Interior and exterior air barrier with optional service wall



This video is for the NRCan package #4: Net Zero Energy Ready Interior Insulated Double Stud Wall using an interior and exterior air barrier, with an optional service wall.

BCIT Open Education Resource ____ for use of BCIT Expert Instructor NZER Wall Assembly Video Series
Instructor Guide and Associated Learning Activities — *LEEP NZER Wall Design Guide Package (NRCan. 2022)*

ACTIVITY 2: Alternative NZER Assembly Details and Approaches

Activity Summary

Students evaluate alternative details or variations on the base solution shown in the Video Mock-up and why these alternatives might be preferable from a construction, building science, cost, and performance perspective.

BCIT Open Education Resource ____ for use of BCIT Expert Instructor NZER Wall Assembly Video Series
Instructor Guide and Associated Learning Activities — *LEEP NZER Wall Design Guide Package (NRCan. 2022)*

ACTIVITY 1: NZER Wall Assembly Critique and Discussion

Activity Summary

Students compare up to four NZER Wall Assembly types to develop understanding of the merits and considerations of each assembly from a construction, building science, cost, and performance perspective.

Delivery Location

This learning activity can be delivered 100% online in a synchronous or asynchronous learning activity. However, for on campus classes there is opportunity to access the physical mock-ups located on the Burnaby campus in room 101 NW03 (BCIT High Performance Building Lab). Space can be reserved for classroom activities by booking room as a 'resource' in BCIT Outlook calendars. Resource is named "NW03 - BCIT High Performance Building Lab". Please specify in booking request that you "would like to access the LEEP mockups", else they may be difficult to access due to other uses.

Preparations

Students should be tasked to review the following for at least one wall assembly:

- VIDEO: Review 20-40BCIT Open Education Video on assembly
- PDF GUIDE: Review drawings, construction costing, material choices, and building science discussion
- MOCKUPS: models of each wall assembly seen in the videos are accessible at the Burnaby campus (NW03 - BCIT High Performance Building Lab)

Activity Delivery Options

i. Activity be completed in groups or independently
ii. Learners can be assigned one or more assemblies to study and prepare for class discussion/presentations
iii. Discussion/presentations can be completed online or onsite with physical mockups presents
iv. Students can prepare to participate in the activity by watching the videos, reviewing the PDF LEEP NZER Wall Guides, and visiting the physical mock-ups

Leading Questions for Class Discussion or for Instructor Use in Assignments, Discussion Forums, or Quizzes

General Building Science questions

1. Identify the each of the assemblies identify the critical barriers:
   a. Water Shedding Surface (WSS)
   b. Water Resistive Barrier (WRB)
   c. Air Barrier (AB)
   d. Vapour Barrier/Retarder (VB)
   e. Thermal Barrier (TB)
2. Explain the importance of continuity for each of the critical barriers. What is meant by continuity for each of the critical barriers? Where is continuity most problematic and why?

✓ *Continuity of control layers is crucial to avoid water ingress, vapour migration, air leakage and heat loss through thermal bridges.*

BCIT Zero Energy/Emissions Buildings Learning Centre
School of Construction and the Environment [5]

BCIT

Lessons Learned

CREATION OF LEARNING TOOLS & RESOURCES

- ✓ Robust learning resources for diverse audiences (trades, technologist, architects, engineers)
- ✓ Upskilling curriculum modules and learning resources evolved to enhance full time programs

In conclusion…

- Climate change demands a transformation in our construction methods.
- Polytechnic Institutes can drive significant industry innovation.
- Collaborative efforts: seek mentors, use existing guides, build partnerships, and work together.
- Let's stay in touch!

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www.bcit.ca/zeb