



Are We Ready?

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Climate change is now, and will continue to be, the single largest global challenge of the next decade.

The consequences of inaction are already readily apparent. Both extreme weather events and environmental degradation have become commonplace and affect the daily lives of Canadians from coast to coast to coast. Climate change and the principles of environmental sustainability have challenged us to rethink how we work and the skills that employers need.

Canada's colleges, institutes, cégeps, and polytechnics make up the largest post-secondary network in the country. At more than 680 locations, their collective engagement to support Canada's transition to a low-carbon economy goes a long way. They provide students with job-ready skills, develop innovative solutions for small and medium enterprises through applied research, and serve as examples of campus infrastructure that can reduce greenhouse gas (GHG) emissions and contribute to Canada's net-zero ambitions.



The research in this report seeks to understand better climate and sustainability-related initiatives across Colleges and Institutes Canada's (CICan) member institutions.

With the support of the Canada Green Building Council (CAGBC) and the Delphi Group, CICan undertook a set of broad environmental scans of:

1. **Curriculum**
2. **Campus Infrastructure and Indigenous Approaches to Sustainability**
3. **Applied Research and Community Engagement**

The findings of this report will form the research base for CICan's ImpAct – Climate project, a five-year pan-Canadian initiative aimed at increasing awareness of and promoting behavioral change to reduce GHG emissions within the college and institute sector.

While much has been achieved, as a society, we must get serious about reducing emissions in a big way, right now.

As a country, we are heading in the net-zero direction. As a sector, colleges and institutes are standing out. They are ensuring that industries, skills, learners, and the economy are better equipped to face the challenges of the future; and there is no future without net-zero.



This report is intended as a showcase of sustainable design and initiatives, a resource to inspire more leaders in the post-secondary sector to take action and as a means to support collaborative approaches – one of our greatest tools in the fight against climate change.

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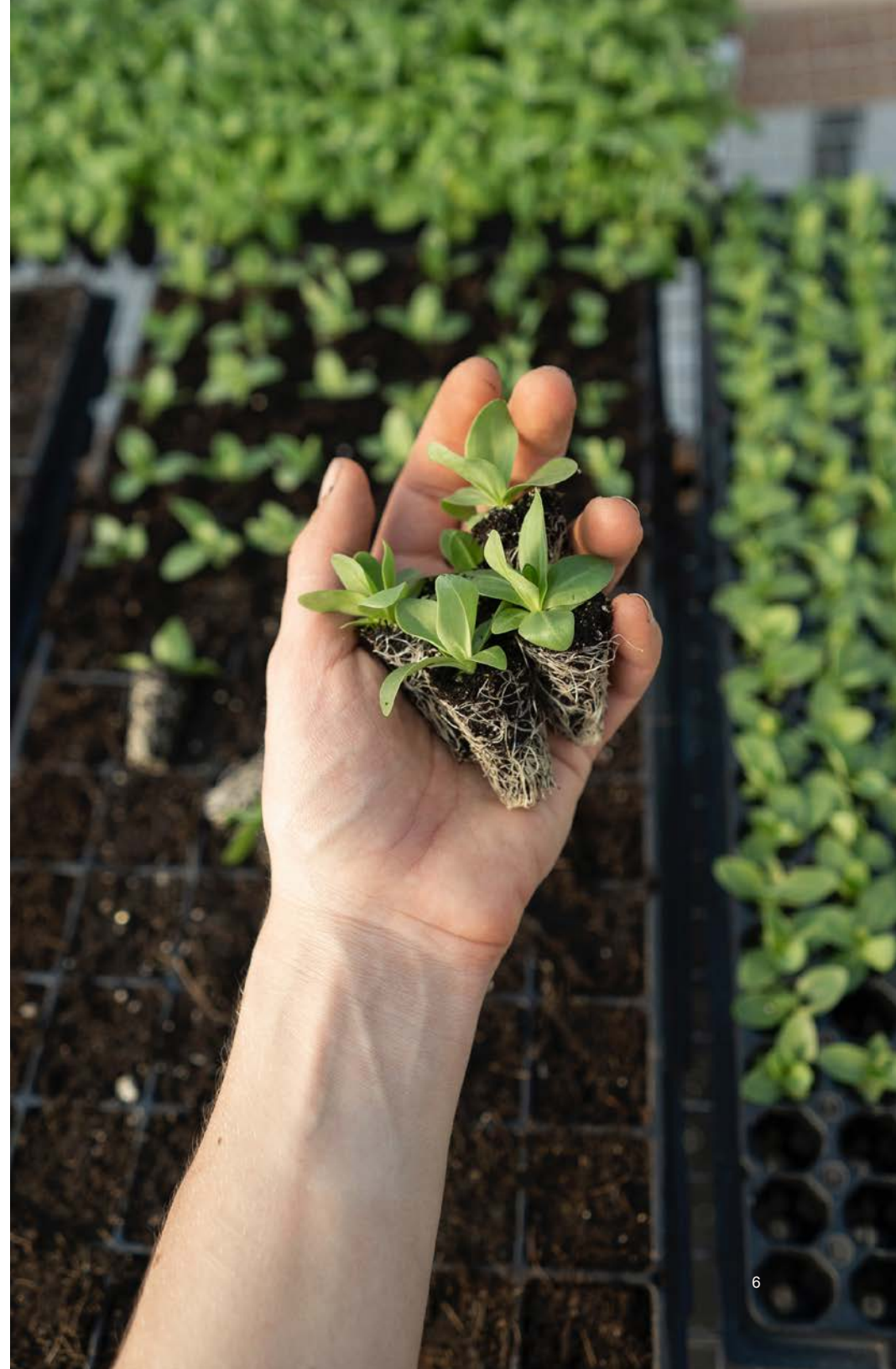


ImpAct – Climate: Updating Our Approach

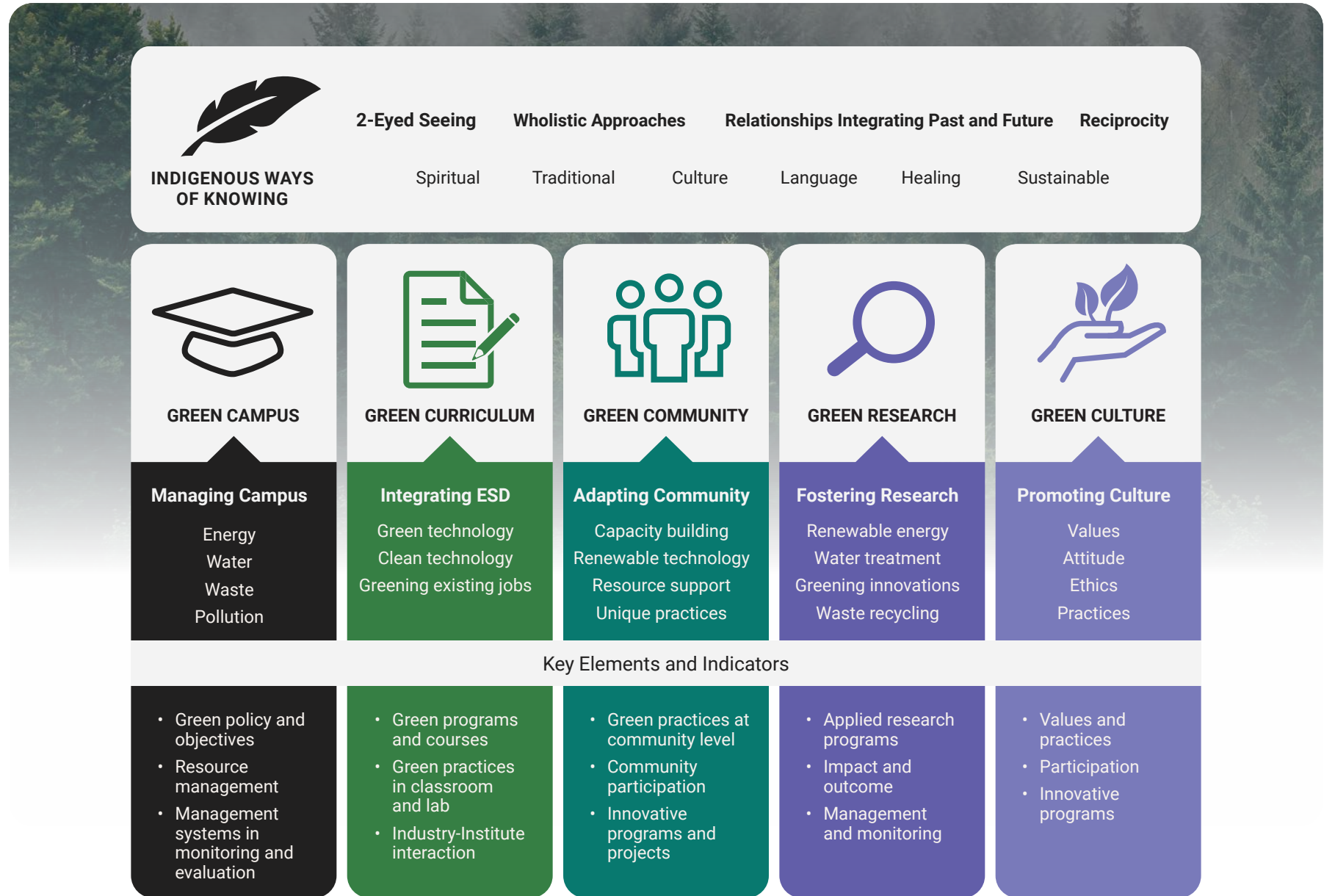
This report was designed to be a useable and reader-friendly update of our 2016 report, *The Role of Canadian Colleges and Institutes in Advancing Education for Sustainability in Canada and Overseas*.

Because of how much innovation and progress our members have made, it seemed fitting to update our report just six years later to accurately portray how our sector is responding to the climate crisis.

Not only have we moved the needle in our sector on climate action, but we've also moved the needle on integrating Indigenous Knowledge, moving closer toward Truth and Reconciliation. On Page 7, you will find our updated UNESCO-UNEVOC's Five Dimensions of Greening TVET that we included in our 2016 report, to which we've added a sixth dimension – Indigenous Ways of Knowing.



Dimensions of Greening



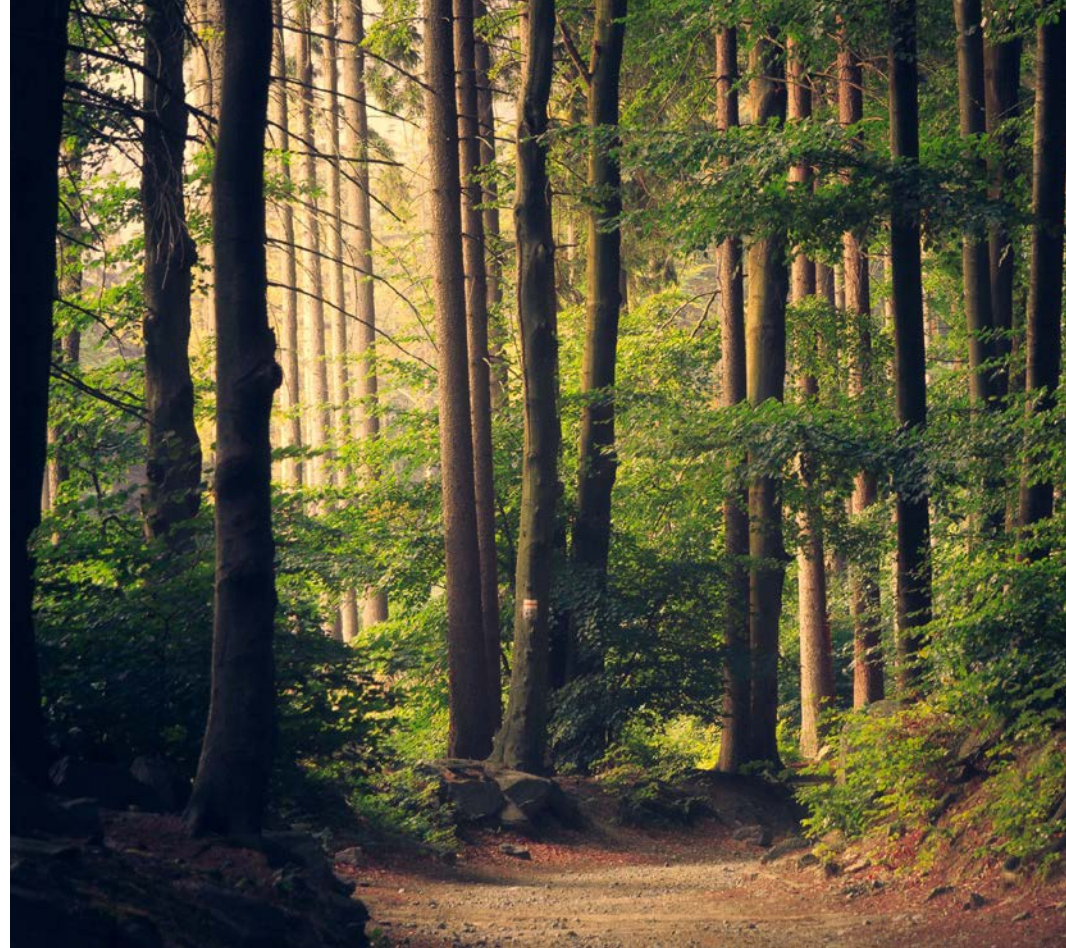
A Framework for Collaboration

The United Nations Sustainable Development Goals (SDGs) give us a framework for collaboration to ensure that our actions contribute to positive change for people, communities, and the planet.

That includes reducing inequalities, contributing to decent work and economic growth, and ensuring everyone has access to quality education.

SDG 13 (Climate Action) calls on citizens and governments around the world to take urgent action to combat climate change and its impacts.

In particular, CIGan's ImpAct – Climate project aims to increase awareness of greenhouse gases and promote behavioral change to reduce emissions within the college and institute sector.



SDG 13 (Climate Action) calls on citizens and governments around the world to take urgent action to combat climate change and its impacts.

Our Members Across Canada



Colleges and Institutes Canada (CICan) is the voice of Canada's publicly-supported colleges, institutes, cégeps and polytechnics.

CICan's members:



Add over **\$190B** to Canada's economy each year.



Provide an **extensive network** of post-secondary institutions that serve students in urban, rural, remote, and northern communities.



Work with industry and community partners to **offer more than 10,000 programs** to learners.

Over 95% of Canadians and 86% of Indigenous people live within 50km of a college or institute.



Overview

As climate change impacts become more apparent, Canada will rely on a workforce that can support the transition to a low-carbon economy and navigate extreme weather events and environmental degradation.

Students will require expanded skills and competencies, while professionals in various sectors will look to continuing education opportunities to upgrade their expertise. From small business owners to farmers, construction workers to travel consultants, an increasingly wide range of professionals will find their industries and roles impacted by climate change.

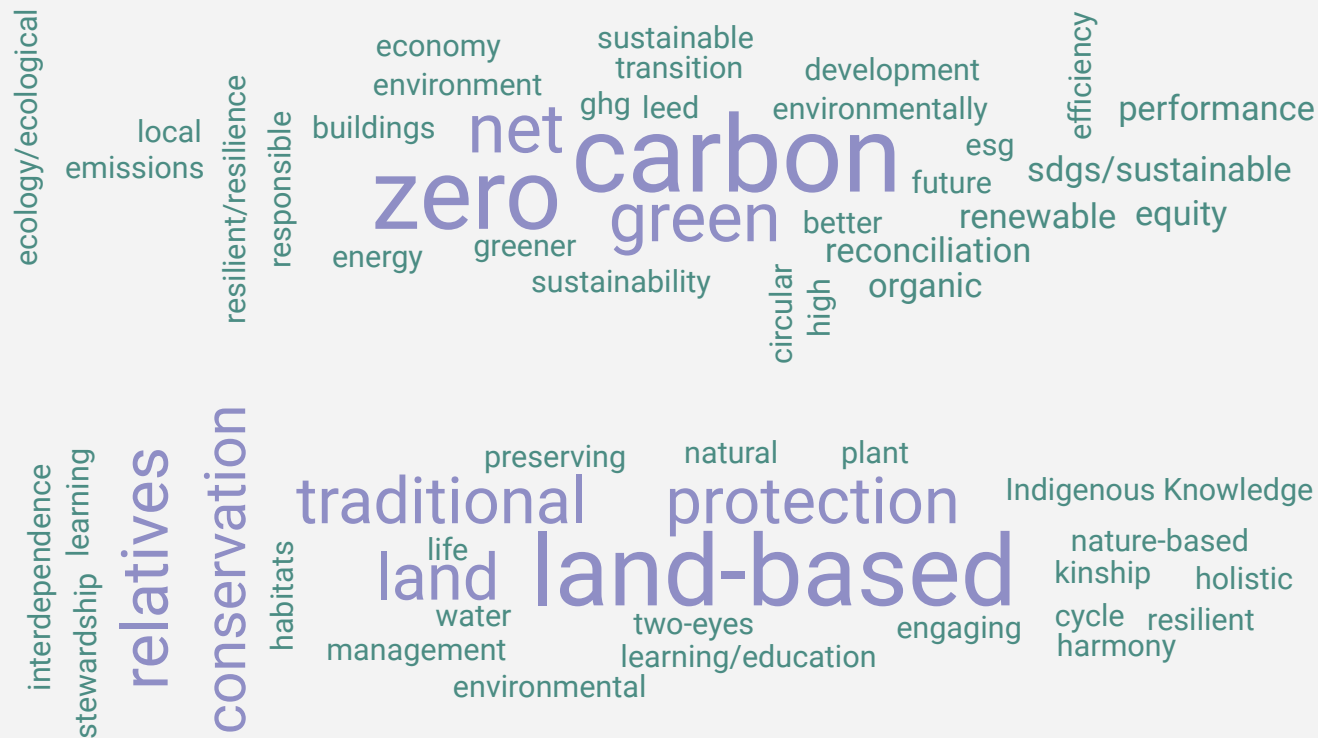
This study undertook a review of course content across Canadian colleges and institutes using an expansive web search with over 75 terms and secondary online research. The research was further complemented through focus groups and interviews with a diverse group, including Indigenous and francophone members. While environmental education has historically been the domain of the sciences, the last decade has been marked by a movement to integrate sustainability across more disciplines by upgrading existing curriculum and introducing new programs. Canadian institutions have become more adept at this, expanding their delivery methods and demonstrating a range of offerings from micro-credentials to certificates and apprenticeships to diplomas. However, while progress has been made, more work must be done to support a rapidly changing workforce.

Everyone is going to need to understand [climate change] the same way you'd assume everyone in business needs to have some fluency in social media today, or that everyone would be able to use a computer 20 years ago.

Andrew Winston, *The Big Pivot: Radically Practical Strategies for a Hotter, Scarcer, and More Open World*

Two-Eyed Seeing

Two-Eyed Seeing (*Etuaptmumk* in Mi'kmaw) acknowledges the importance of learning to see from one eye with the gifts of Indigenous Knowledge and ways of knowing, and from the other eye with the strengths of Western knowledge and ways of knowing. By using both these eyes together, all benefit, as envisaged by Elder Dr. Albert Marshall.



Word Clouds resulting from consultations primarily with non-Indigenous (top) and Indigenous educators (bottom) demonstrate the different but complementary results of integrating both world views.

Coast Mountain College *Terrace BC*

Coast Mountain Field Schools

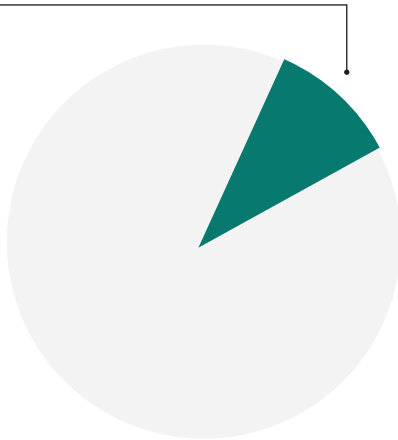
The field schools offer a broad spectrum of intensive one to two-week courses that nurture relationships with local First Nations bands and governments drawing experiences from active field study. They are deeply rooted in the Indigenous worldview and educational practices. The field schools connect students to rich cultures, rugged landscapes, and breathtaking vistas with exposure to the land's history, culture and environment.



Image credit: Gordon Weary, Coast Mountain Field Schools

Climate Change and Sustainability in College and Institute Curriculum

Just under 1000 total programs are considered sustainable or approximately 10% of all college and institute programs.



College and institute programs were scanned against a set of keywords, primarily by program title, but in many cases also course content and program descriptions. The results included programs of many credential types and durations, ranging from in-depth post-graduate learning to short skills-oriented microcredentials. Findings revealed different approaches to integrating sustainability and climate change in curriculum. Some colleges and institutes have chosen to focus on a broad range of topics while others have a more specific selection. Both approaches are important contributions towards a more sustainable future.



Climate Change and Sustainability Curriculum

A review of the data found that climate and sustainability curriculum was clustered into six themes, representing a consolidation of various programs and courses.





Building Construction and Performance (5%)

Sustainable or high-performance buildings rely on environmentally responsible construction methods and building operations.

Green buildings are designed to reduce waste, use natural resources more efficiently, and reduce carbon from building operations and materials.

The programs in this category lean towards building trades, construction practices, building performance, and efficiency. Building Construction and Performance accounted for 5 percent of all sustainability programs identified.

Sample Programs in order of prevalence

1. Carpentry
2. Construction Management
3. Renewable Energy
4. Electrical Systems
5. Mechanical Contracting
6. Building Automation
7. Building Science

British Columbia Institute
of Technology (BCIT)
Burnaby BC

Zero Energy Building and Energy Management

The learning center combines many facets of Net-Zero Energy and Passive House construction, Energy Modelling, and Energy Management. Students have the independence to choose from individual courses which build fundamentals and could be applied to micro-credentials which accommodate an integrated overview on multiple topics. With a focus on Energy Modelling, Residential Solar Electricity and embodied carbon courses, the graduates are enabled to help building professionals make performance and design decisions at a preconstruction stage with a focus on whole-building embodied carbon Life Cycle Assessment (LCA).

Technical Skills for Low-Carbon Buildings

Airtightness and Air Versus Vapour Barriers



Plumbing and Pipefitting



Geothermal Heat Pumps and Photovoltaic Systems



Embodied Carbon and Material Selection



Mechanical, Electrical and Building Automation Systems



Insulation



Building Envelope and Thermal Bridges



Commissioning



Engineering and Architecture (42%)

Smart building design with an inclination to well-engineered details often leads to better-performing buildings.

Sustainable design practices inspire students to design low-carbon buildings engineered to mitigate climate challenges sensitively.

This broad category houses architecture, engineering, and design areas. Engineering and Architecture accounted for 42 percent of all sustainability programs identified, a vast majority.

Sample Programs in order of prevalence

- Mechanical Engineering
- Electrical Engineering
- Civil Engineering
- Architecture and Design
- Environmental Engineering
- Interior Design
- Urban Planning
- Chemical Engineering



Photo: Pilikan House at Annapolis Valley Campus is a living lab where students learn how to incorporate sustainability into residential construction work.

Nova Scotia Community College *Middleton, NS*

Energy Sustainability Engineering Technology (ESET)

The course trains for the fields of energy assessment and management, energy-efficient design, renewable energy, sustainable design and energy storage, and greenhouse gas emission assessment. With the use of industry-recognized software and technology, graduates can make technical recommendations for energy optimization in a variety of engineering applications. The program offers unpaid work placement spanning for five weeks as well as co-op placements.



Food and Horticulture (4%)

Human health and well-being are at risk considering climate change's effect on food production, quality, and diminishing food security.

Increasing carbon emissions reduce the nutritional value of crops which affects the entire food chain.

The programs in this category have a strong focus on sustainable practices in agriculture, farming, food production, and the food preparation industry. Food and Horticulture accounted for 4% of all sustainability programs identified.

Sample Programs in order of prevalence

- Horticulture
- Food systems
- Agriculture
- Farming



Photo: Horticulture production students transplanting vegetable seedlings into pots.

Assiniboine Community College *Brandon, MB*

Sustainable Food Systems

Focuses on improving food security in cold climates with leading edge approach to food production through greenhouse operations, plant breeding, plant propagation and nutrient management. The course has a spotlight on managing the food supply, encourages research on various successful models to benefit current projects in the community at large.

Spotlight on Collaboration

Cégep Vert du Québec offers environmental support and certification for public and private college communities. Since 2004, this program has supported cégeps to integrate environmental education into their institutions.

Canadian Colleges for a Resilient Recovery (C2R2) is a coalition of leading colleges, cégeps, institutes and polytechnics from across Canada. The coalition is working to expedite the rapid development and deployment of new and synchronized curriculum and research initiatives.

The Sustainability Tracking, Assessment & Rating System (STARS) is a transparent, self-reporting framework for colleges and universities to measure their sustainability performance.

Atlantic Colleges Atlantique (ACA) represents public colleges in Atlantic Canada which are supportive and closely aligned to addressing skill shortages; increasing international education and training; confronting climate change and moving to a low-carbon economy; increasing applied research and enhancing infrastructure.

The Sustainable Development Goals (SDGs) Accord Project Working Group, is a pan-Canadian group, that supports the post-secondary sector's collective response to advance the critical role that education has in delivering 17 global targets for reducing inequality, ending poverty and hunger, improving health and education, protecting the planet, and enabling innovation and meaningful work for prosperity by 2030.



Photo: At C2R2's 2022 Connection Conference in Halifax, presidents of colleges and institutes that have signed the SDG Accord pose with C2R2 president & CEO Denise Amyot (far right).

The First-ever Platinum STARS Rated University

Thompson Rivers University
Kamloops, BC

Thompson Rivers University (TRU), a member of CICan, has been a leader in sustainability for many years. In 2017, TRU installed 16 solar modules into a 14-metre stretch of sidewalk on campus. It was the first solar sidewalk of its kind in Canada. The panelled walkway is wired into the university's sustainability office. In a year, the panels produce nearly 1,300 kWh, enough to power all the lights, computers and appliances in the nearby office.

TRU is committed to using more renewable energy – and using less energy overall – building a culture of sustainability on campus, and teaching students to be the sustainability leaders of tomorrow.

In 2019, TRU achieved a platinum rating in STARS, making it the first university in Canada to achieve that status. Their score of 88.31 is the highest ever achieved by any institution. STARS (Sustainability Tracking, Assessment and Rating System) is a transparent, self-reporting framework for colleges and universities around the world to measure their sustainability performance. STARS was developed by the Association for the Advancement of Sustainability in Higher Education (AASHE) with broad participation from the higher education community.





Hospitality and Tourism (17%)

Eco-tourism practices work to minimize the impacts on the environment from travel and tourism by prioritizing conservation and supporting local communities.

The hospitality industry has taken steps to include sustainability in accommodation management by cutting down on food waste, minimizing water usage beyond the hotel room, eliminating plastic, and conserving energy.

This category includes hotel operations and travel. Hospitality and Tourism accounted for 17 percent of all sustainability programs identified.

Sample Programs in order of prevalence

- Hospitality Management
- Tourism
- Hotel Management
- Culinary Arts

Vancouver Island University *Nanaimo, BC*

Masters in Sustainable Leisure Management

A non-traditional approach to ecotourism and innovative leisure practices, the course combines field experience and classroom instruction, within a global context. The program engages students with experiential learning opportunities and prepares emerging leaders to facilitate interdisciplinary knowledge focused on sustainable solutions for the industry.

Indigenous Ecotourism Training Program

This 1-year program instructs Indigenous students on both Western theory and practice and Indigenous values and traditional knowledge to deliver a program that helps foster sustainable, safe, and engaging eco-tourism, focusing on delivery within B.C.'s major market areas.



Photo: VIU Students enjoy experiential learning through the T'ashii Paddle School.



Business Management (6%)

A green business is an enterprise that has minimal negative impact or a potentially positive effect on the global or local environment, community, society, or economy.

It strives to meet the triple bottom line (environmental, social and governance), champion sustainable investing, and consider products and services with a lens to the circular economy.

The programs in this category support entrepreneurship, business management, and governance. Business Management accounted for 6 percent of all sustainability programs identified.

Sample Programs in order of prevalence

- Business Management
- Policy and Public Affairs
- Environmental, Social and Governance (ESG)
- Law

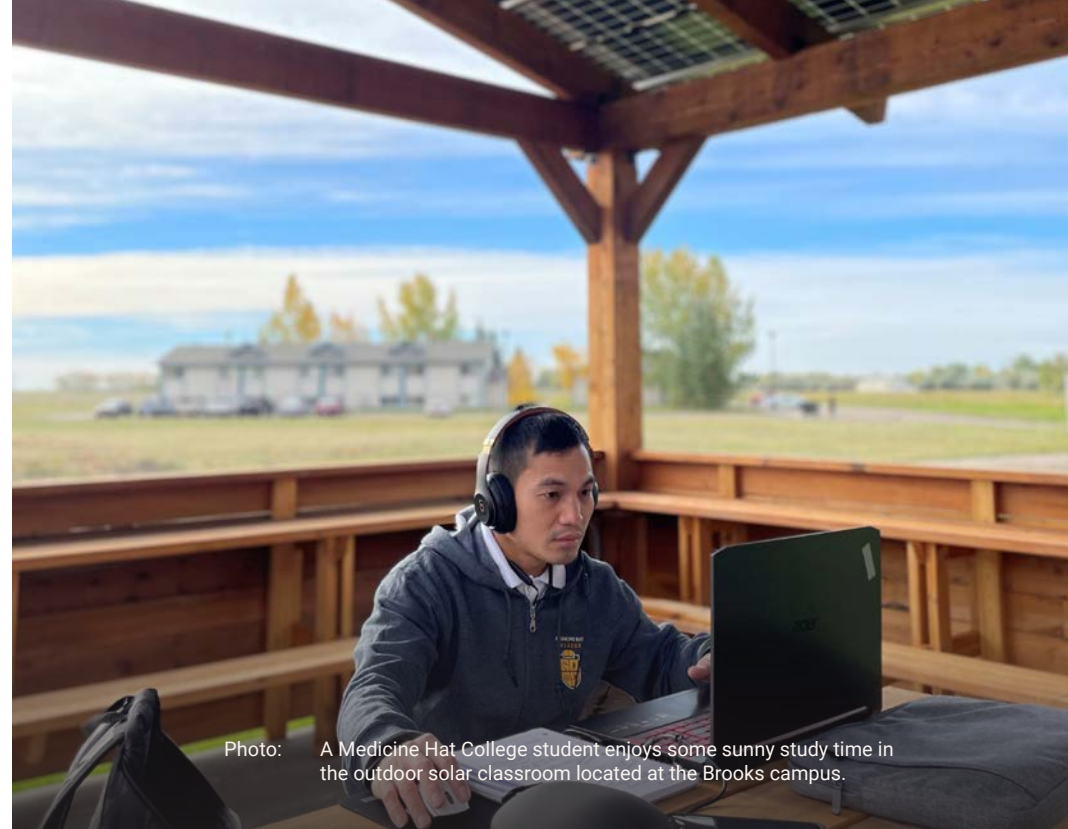
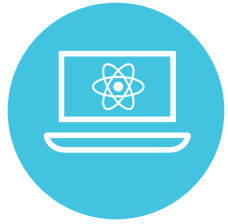


Photo: A Medicine Hat College student enjoys some sunny study time in the outdoor solar classroom located at the Brooks campus.

Medicine Hat College *Medicine Hat, AB* Sustainable Innovation

The program equips graduates to develop, implement and lead sustainable innovation strategies in diverse industries. The two-year program includes an integrated workplace learning experience which challenge existing standards and encourage a positive, innovative, sustainable impact on the community through strategic ways of doing business. The program has a strong focus on the United Nations 17 Sustainable Development goals.



Science (25%)

Increasing carbon emissions pose a threat to ecosystems and habitats.

Scientific innovation and the study of conservation and re-vitalization efforts for existing natural resources are key contributors to mitigate damage already done.

The courses under this umbrella include ecology, geology, and other sciences, with a strong focus on conservation and innovation. Science accounted for 25 percent of all identified sustainability programs.

Sample Programs in order of prevalence

- Geography and Geographic Information Systems Analysis
- Conservation and Ecology
- Environmental Technician
- Physical Sciences
- Ocean and Fisheries
- Sustainability
- Forestry
- Energy and Resource Management



Photo: archbould.com

Yukon University *Whitehorse, YK*

Renewable Resources Management

The two-year program trains graduates in the management and conservation of natural resources, including wildlife, botany, aquatics and fisheries, as well as air and water and other non-living components that are vital for future generations. The program focuses on hands-on practical skills in lab, field, and classroom settings, and on topics relevant to northern ecosystems, current political and employment realities, and unique management and conservation processes. The graduates gain exposure in areas such as data collection, mapping/ GIS techniques and resource management practices of local First Nations among others.

Next Steps

1 Track

"You can't manage what you don't measure."

Work with CIGan to implement a tracking system to capture college and institute progress towards integration of climate and sustainability lens in all program offerings.

2 Do

Use the opportunity of the curriculum planning and auditing process to consider the inclusion of the six sustainability themes.

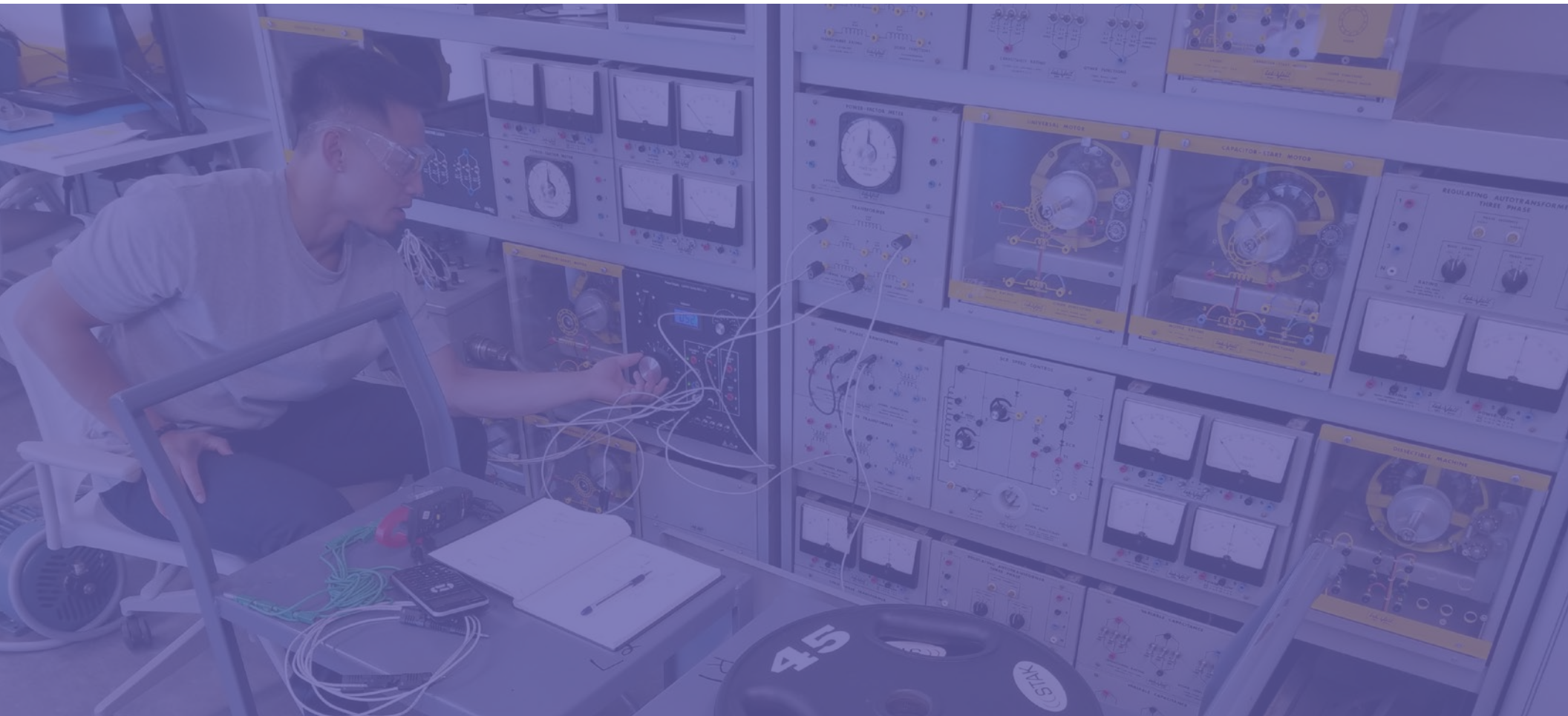
3 Collaborate

Contribute to and utilize CIGan resources that include Faculty Training Modules for greening the building and landscape trades based on a collaborative and holistic approach.

4 Advocate

Encourage governments to support the creation, expansion and adoption of programs and initiatives that provide learners with green skills.





Overview

The innovation ecosystem will be critical to Canada's global competitiveness, especially in the face of climate change and the needed societal response.

To achieve a prosperous and socially just future, we need a symbiotic, collaborative, and productive relationship between industry, educational institutions, and the communities they operate within. Applied research and community engagement initiatives led by colleges and post-secondary institutions are an important part of this relationship; these initiatives allow us to find innovative solutions to real-world challenges and support knowledge mobilization and economic development. Successful research initiatives sprouting from these relationships can allow us to quickly adapt and scale the response to the greatest challenge of our time.

This study reviewed applied research and community engagement initiatives across colleges and institutes using a lens based on specific aspects of sustainability. The initiatives were categorized into five predetermined themes. A sixth bioeconomy theme was created based on the common nature of the remaining initiatives. The applied research and community engagement initiatives captured within these six themes represent cutting-edge partnerships between colleges and institutes, governments, Indigenous Nations, industry, and other stakeholders. These partnerships touch many program areas, regions, sizes and types of colleges and institutes. The partnerships also represent many critical aspects of sustainability and climate action such as clean technology, transportation and mobility, climate adaptation and resilience, Indigenous-led initiatives, green buildings, food systems, and circular economy.

This study considers green applied research and community engagement initiatives across the following six themes:

- 1 Sustainable Food and Agriculture
- 2 Green Construction and Landscape
- 3 Waste and Remediation
- 4 Clean Transportation
- 5 Indigenous Initiatives
- 6 Bioeconomy and Bioproducts

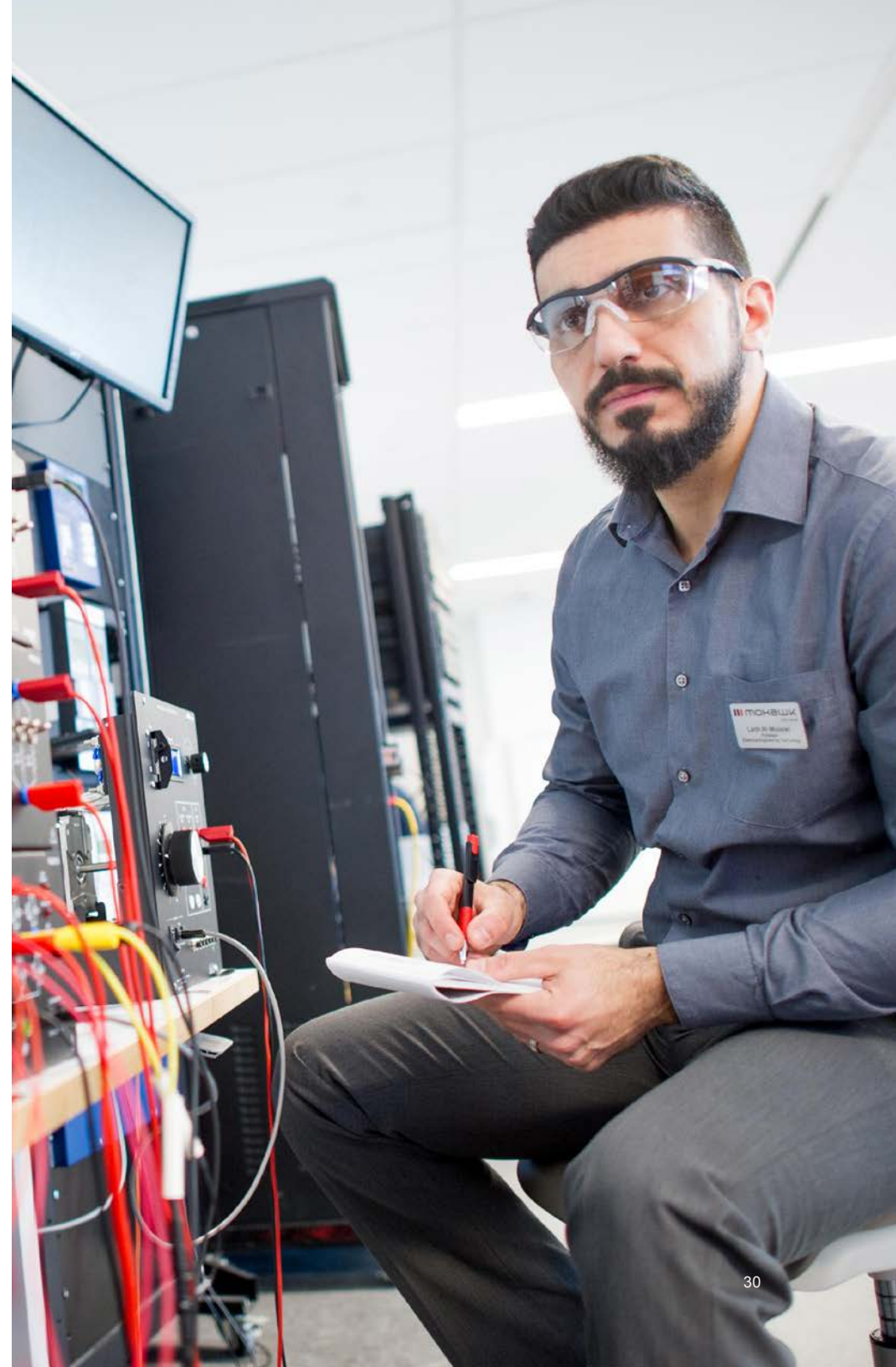
Summary of Findings

The scan of green applied research and community engagement initiatives showcased the innovative ways that colleges and institutes are helping lower our environmental footprint, adapt to a changing climate, and incorporate 21st century technologies.





Common applied research initiatives across colleges and institutes include those related to sustainable agriculture and forestry, such as new technologies and processes that reduce the energy, GHG emissions, and resource consumption of these activities, as well as finding new high-value uses for by-products and waste.

Another common theme revolved around clean communities; this includes environmental monitoring, remediation, and adapting our buildings and infrastructure to a changing climate.

Many initiatives found in the scan highlighted the fourth industrial revolution – incorporating the use of digital technologies in combination with mechanical and biological processes. Tangible examples include the use of sensors, drones, machine learning, artificial intelligence, robotics, and additive manufacturing.



Sustainable Food and Agriculture

Themes	Trends	Examples of Applied Research
 <p>Farming and food production technologies</p>	Horticulture, urban farming, hydroponics	Developing a hydroponic technology to increase local food production capacity in northern British Columbia
 <p>Marine and aquatic conservation</p>	Eco friendly fishing techniques, aquaculture	Using fishery dependent landings data to examine fish distributions, environmental influences and bycatch avoidance; aquaculture of Lake Whitefish for Commercial Purposes in Northern Ontario
 <p>Food and beverage processing</p>	Food quality assessment, food innovation	Innovative food product by a biotechnological transformation process
 <p>Agtech and sustainable farming technologies</p>	Smart irrigation, precision agtech digital sensors, drones, biotechnology related to food	Social innovation contribution to the robotization of an agricultural vehicle; Multispectral imagery as a tool for analysis and diagnosis of soil productivity in precision agriculture

Sustainable Food and Agriculture

Kwantlen Polytechnic University (KPU)
Surrey, BC





The Institute for Sustainable Food Systems (ISFS), an applied research and extension unit at KPU, analyses, supports, and promotes regional and sustainable food systems as critical components of sustainable communities.

The ISFS conducts collaborative, multidisciplinary applied research projects to help communities accomplish their food sovereignty aspirations by nurturing sustainable regional food systems. Working with the community, First Nations, government, and industry, the research covers policy, economics, and community health. One of these projects is exploring the need for a province-wide extension service that would integrate applied research, dissemination methods, and programming to enhance awareness of organic production practices and the sector's long-term sustainability.

While the ISFS conducts agricultural and food-related technical and policy research, the KPU Department of Sustainable Agriculture provides a research and teaching opportunity on its departmental farm. The farm explores various low-carbon farming practices, such as a novel way of sequestering soil carbon, a solar greenhouse, and organic farming practices that avoid dependence on GHG-producing fertilizers and pesticides. The produce grown on the farm is sold into local markets and on campus to further reduce food waste- and transportation-related GHG emissions.



Green Construction and Landscape

Themes	Trends	Examples of Applied Research
 <p>Energy efficient technologies and systems</p>	Heat recovery, solar thermal hot water, HVAC, building envelope	Development of air multiplier to improve HVAC/cooling tower efficiency
 <p>Advanced control and automation</p>	Energy management, AI for asset management, smart homes	Smart building monitoring and performance measurement; design, fabrication and optimization of a novel, modular sun-shade system powered with a robust, cost-effective hybrid solar energy system
 <p>Advanced materials and manufacturing</p>	Embodied carbon, additive manufacturing / 3D printing, modular construction	Development of composite materials suitable for repairing the wind turbines in northern environments
 <p>Landscape design and architecture</p>	Green roofs, water management	Green roof test plots for water dispersion control and building energy monitoring

Green Construction and Landscape

Southern Alberta Institute of Technology (SAIT)
Green Building Technology (GBT) Lab and
Demonstration Centre
Calgary, AB

As an applied research facility, the Green Building Technology (GBT) Lab and Demonstration Centre provides hands-on training and industry-based experience through a living lab setting. Working with builders, government, regulatory bodies, and numerous rightsholders, the GBT engages students and researchers from multiple disciplines and across different contexts and projects, bringing new products and processes to the residential and commercial green building marketplace.

The GBT research area offers a broad range of service lines, technical consultation, and “R&D” resources, including building-integrated solar and water technologies, green materials fabrication, prototyping, and product testing.



The GBT Lab and Demonstration Centre is a 6,350 square foot living and breathing example of energy efficiency, building-integrated green technologies, and renewable energy solutions. With additional square footage dedicated to specialized workshops, testing bays, storage, and a large construction staging area, the entire facility totals over 16,800 square feet of research infrastructure.

Highlights include:

- Green roof test plots for water dispersion control and building energy monitoring
- Structural testing jigs for new building product performance measurement
- Guarded hot box for wall and roof system performance testing
- Lifecycle testing for wall, roof, cladding and building components
- Electrical, plumbing and carpentry workshops
- 5,800 square foot pre-manufactured construction and staging area
- Integrated Solar Lab, Solar carport and electric vehicle charging bays
- Smart building monitoring and performance measurement
- Solar aquatic and constructed wetland bio-filtration
- Living wall comparative test plots
- Rainwater harvesting lab
- Energy storage battery solutions lab



Waste and Remediation

Themes	Trends	Examples of Applied Research
 <p>Circular economy related initiatives</p>	<p>Recycling services, Waste collection, smart packaging</p>	<p>Recycling lithium-ion batteries from electric cars; deployment of the agricultural plastics recovery service in the MRC of Arthabaska</p>
 <p>Water and wastewater utilities management, remediation services</p>	<p>UV water purification systems, water filtration,</p>	<p>Validation of third generation UV water purification systems for enhanced treatment of drinking water, reuse and wastewater</p>

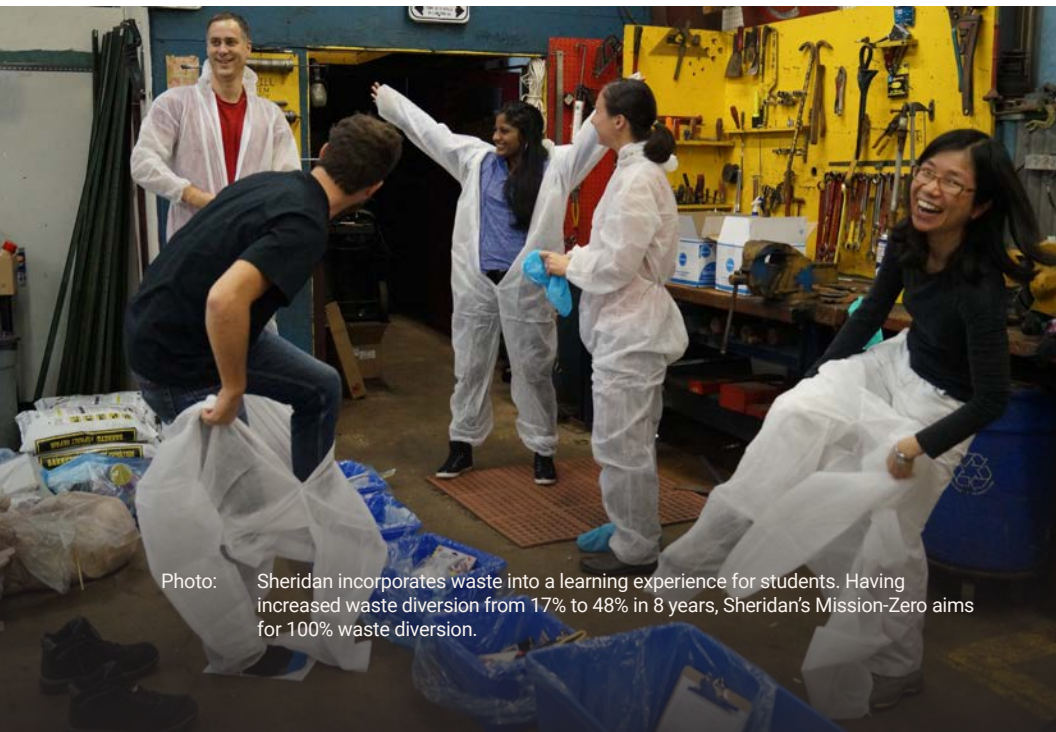


Photo: Sheridan incorporates waste into a learning experience for students. Having increased waste diversion from 17% to 48% in 8 years, Sheridan's Mission-Zero aims for 100% waste diversion.



Waste and Remediation Case Study

Cégep Saint-Hyacinthe
Groupe CTT
Saint-Hyacinthe, QC

Groupe CTT is one of the two college centers for technology transfer of Cégep de Saint-Hyacinthe. It was established in 1983 and currently has 40,000 square feet of laboratories on its premises. Groupe CTT specializes in applied research, development, and analysis of technical textiles, geosynthetics, and advanced textile-based materials.

The Groupe CTT's research and development focuses on the following research areas:



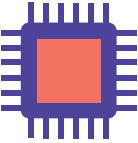
- **Smart textiles** - textiles with electrical components that perform active functions.
- **Textile chemistry** - chemical treatment of textile fibers that add value to the product.
- **Technical textiles** - bringing together a range of advanced textile products
- **Geosynthetics** - alternative materials to conventional construction materials
- **Ecotextiles and processes** - developing bio-based alternatives, recovering textile waste, and improving natural fiber processing
- **Arctic Climate** - Developing and evaluating textile materials designed for extreme cold

Building on the historical strength of the textiles industry in the region, Groupe CTT supports industry groups through prototyping, chemical analysis, and ecotextile processing. Current projects include a collaboration with Cintech Agroalimentaire to develop biodegradable textiles and materials to be used in food and agriculture applications.

Current projects include a collaboration with Cintech Agroalimentaire to develop biodegradable textiles and materials to be used in food and agriculture applications.



Clean Transportation

Themes	Trends	Examples of Applied Research
 Vehicle Electrification	Charging infrastructure, energy storage, electric motors, batteries, smart grids, renewable power interfaces	Electric conversion of bus fleets; battery and charging technology
 Alternative Fuels	Low-carbon fuels from renewable feedstocks, hydrogen, fuel cells	Biofuels for maritime applications; treatment of sulphur emissions
 Digital Technology	Sensors, smart mobility, remote sensing, software interfaces	Alternative mobility solutions; transportation logistics; diagnostic and predictive analysis of equipment

Energy and Environment Applied Research

Mohawk College - Energy and Power
Innovation Centre (EPIC)
Hamilton, ON



Mohawk College's EPIC is part of IDEAWORKS, their active hub of applied research and innovation. As a Technology Access Centre, EPIC partners with companies to test and de-risk upcoming technology; support system data integration and analysis; and provide capacity building for students and industry partners.

EPIC works closely with Mohawk College's Centre for Climate Change Management (CCCM), to offer industry partners comprehensive solutions to identify and assess environmental opportunities. One example of clean transportation-related applied research at EPIC is the development of a data acquisition hardware and software platform to monitor and troubleshoot hydrogen units installed on trucks.

Other examples of EPIC's research initiatives include:

- Cloud-based data systems integration.
- Customer and electric grid impact of higher participation of electric vehicle and renewable energy systems.
- Test-bed for operational technology cybersecurity threats.
- Industrial carbon footprint environmental and economic impacts – CCCM collaboration.



Peace Garden



Dawson College
Montreal, QC

Dawson College is getting creative with their approach to greening transportation and are currently exploring ways to reduce their transportation GHGs through offsetting carbon with tree planting. Dawson has a number of partnerships with landowners where trees can be planted on marginalized land. Recently, Dawson has begun a wetland construction project on campus as one of CICan's ImpAct-Climate Campus Living Labs Demonstration Projects.

Nurse trees, such as the one planted in Dawson's Peace Garden (right), are an important part of tree planting projects, providing invaluable supports and nutrients to young saplings.



Indigenous Initiatives

Themes	Trends	Examples of Applied Research
 <p>Indigenous traditional knowledge and practices</p>	<p>Language revitalization, food security</p>	<p>Creating language speakers and documenting oral legacy</p>
 <p>Community Engagement</p>	<p>Enabling businesses, community education, access to technology</p>	<p>Enabling the development of plant and seed delivery businesses within Indigenous and Métis communities</p>

Indigenous Initiatives

Yukon University
Whitehorse, YT

Yukon University has been conducting, mobilizing, and sharing research on northern topics for over three decades. YukonU partners with industry, communities, post-secondary institutions, and all levels of government, including Indigenous governments, to conduct applied research across Canada's North.

YukonU engages in research that combines western and Indigenous worldviews rooted in relationships, collaboration, reconciliation and trust, and their partnerships deepen their relationships with the people and the land. This work is grounded in respect, listening, trust, and with an acknowledgement of past harms caused by colonial practices. YukonU works to create space for discourse and difficult conversations, with opportunities to link to broader reconciliation efforts.

Creating space may include working with visiting researchers from other institutions to incorporate employment opportunities for local youth into their projects, attending and participating in community events with a focus on relationship-building over research, hosting events and Indigenous speakers to share their knowledge and challenge assumptions. YukonU researchers, in turn, share their knowledge and follow suggestions from their First Nation partners on how and where to work.




Other examples of YukonU Research Center's research programs include:

- Climate change and adaptation
- The impacts of thawing permafrost
- Sustainable energy production
- Mine remediation
- Strategic for patient-oriented research
- Indigenous knowledge
- Biodiversity monitoring
- Climate policy and decision-making support



Image credit: [archbould.com](https://www.archbould.com)

Bioeconomy and Bioproducts

Themes	Trends	Examples of Applied Research
 <p>Forest-based products and services</p>	Mass timber, CLT, biomass	Utilization and enhancement of urban forest biomass for energy and value-added wood products
 <p>Clean energy production from biomass</p>	Biomass management	Optimization of the biomass drying process by recycling residual energy
 <p>Alternative sustainable materials</p>	Biochemical, bioplastics, biomaterials	Development of biobased products and materials derived from different biomasses (forest, agricultural, algals, residuals)

Bioeconomy and Bioproducts

Cégep de Trois-Rivière - Innofibre
Trois-Rivières, Québec

Innofibre is one of the three College Centres for Technology Transfer (CCTTs) affiliated with Cégep de Trois-Rivière. Innofibre's primary objective is to accelerate the technological advancement of bioproducts and bioprocesses. Innofibre's research is driven by collaboration with the private sector, which seeks Innofibre's expertise and technology to help them develop innovative products. This represents nearly 90 percent of their partnerships.

Innofibre has established itself as a market leader in the creation of bioproducts and bioprocesses derived from cellulosic fibres. Currently, Innofibre leases a 17,000-square-foot industrial space to conduct research in conjunction with businesses and other research institutions.

With its diverse fields of expertise in bioproducts and biorefinery, Innofibre is better positioned than ever to become a vital partner for businesses and institutions pursuing a sustainable economic transition. Currently, a partnership with UQTR and ULaval is underway to valorize digestate, a solid by-product of biomethanation.

Examples of Innofibre's areas of expertise are:

- Papermaking
- De-inking
- High-performance pulps
- Bioactive papers
- Thermomoulded pulps
- Modified fibers
- Biomass conditioning processes
- Thermochemical conversions
- Bioenergy
- Forest extractives
- Microalgae and bio-sourced products derived from organic residual materials



Image credit: innofibre.ca

Community Engagement and Action

It has never been more important to think globally and act locally.

The ability to develop networks of relationships across communities is what fosters collaboration and overcomes complex challenges that affect our well-being, like climate change. These bonds improve our ability to work together to create a better future for ourselves and the planet. When research and academic teams join forces with those with the knowledge and expertise of understanding and interpreting their communities, difficulties are addressed, and the potential for innovation and adaptation can be uncovered.

Community engagement initiatives among colleges and institutes involve partnerships between local governments, First Nations, non-profit organizations, businesses, and the public. This engagement takes the form of social innovation to provide community benefits such as better access to technology, employment opportunities, and community food security.

Examples of community initiatives among colleges and institutes include:

Sanyakola Project: Being Creative Together-Indigenous Language Revitalization

This project aims to support the revitalization of Kwak'wala: the language of the Kwakwaka'wakw Nations. The initiative focuses on the critical link between Indigenous holistic wellness and language revival. It relies on active community engagement, youth capacity building, and an action-based, braided strategy that has the potential to serve as a model for the recovery of endangered Indigenous languages in general, with international consequences.

Social innovation contribution to the robotization of an agricultural vehicle: towards new farmer/technology relationships

The goal of this project is to create a navigation system for an agricultural off-road self-driving vehicle. Once created, this vehicle will be utilized to automate binding duties such as weeding. Knowing that this new technology will represent a substantial paradigm shift for agricultural employees, the applied research focused on engaging with farmers to gain a deeper understanding of the relationship between farmers and the introduction of robotization into their profession. Several workshops, interviews, and farm visits were held to engage with the farmer's community.

A pilot project to improve the capacities of communities to manage coastal zones and adapt to climate change

The goal of the project is to create an integrated coastal management plan that can be utilized as a tool for climate change adaptation in the coastal area. Citizens, organizations, businesses, municipal employees, and decision-makers were all involved in this initiative, which utilized a participatory approach. This plan includes factsheets on information and awareness, recommendations for sector-specific interventions, an action plan, and guidance for citizens, employees, and elected leaders.



Photo: Ambassadors of the Wendat Nation at CICan's 2018 Indigenous Education Symposium in Wendake, QC, held at Hotel-Musee Premieres Nations

Next Steps

1 Track

Identify and monitor the employment opportunities generated by green applied research and development projects, including those for local youth and underemployed populations.

2 Do

Sustainability offices should promote college applied research as solutions-builder for community partners looking for green solutions.

3 Collaborate

Contribute to and utilize CIGan Net-Zero communities of practice, including our Living Labs which explore GHG emissions reductions research opportunities and communication around these initiatives.

4 Advocate

Encourage applied research partners to reach out to government to promote the results and impact of sustainable applied research projects.





Overview

For Canada to achieve its 2030 and 2050 climate targets, building owners and operators will need to upgrade, retrofit, and ultimately decarbonize hundreds of millions of square metres of space.

They will also need to commit to net-zero new construction by 2030 at the latest. It is estimated that large building retrofits can reduce building-sector emissions by up to 51 percent (21.2 million tonnes) by 2030. Colleges and institutes in Canada are large landowners and have a significant role to play in contributing to these targets. Today, many are leading the way through campus sustainability and decarbonization plans.

This study undertook a review of CICan infrastructure survey and STARS data which was then expanded through secondary research. Early findings were further complemented through focus groups and interviews with a diverse range of members that included schools representing a cross section of Canadian urban and rural institutes. Historically, higher education campuses have been early adopters of climate mitigation strategies and have a track record of leveraging industry standards to champion green building. The last several years has demonstrated increased attention and commitments to campus-wide decarbonization policies. Land-use planning has prioritized emission reductions and sustainability objectives through infrastructure improvements. Further, as campus administration put in place accountability frameworks to monitor and manage progress, performance tracking and public disclosure has increased.



Sustainability Plans and Public Disclosure

A sustainability plan establishes a series of goals that set emission reduction targets alongside other priority environmental issues such as waste and water use.

These plans may also include health outcomes and objectives related to resilience. The plans also outline goals and key objectives typically aligned with international commitments (e.g., Canada has committed to reducing its emissions by 40 to 45 percent below 2005 levels by 2030, and to achieving net-zero by 2050). A sustainability plan establishes the platform and pathway to achieve emission and environmental targets by identifying the critical actions – along with resources – needed to achieve the established goals.

A pathway to strengthen accountability for campus sustainability targets are public dashboards. These rely on schools tracking and reporting performance data to dynamically share with the public. This acts as a visible display of sustainability goal progress and as an education tool – equipping students and faculty with insights into sustainability metrics.



Some colleges with public dashboards include:

- Bow Valley College
- Fanshawe College
- Kwantlen Polytechnic University
- Okanagan College

Sustainability Plans

Fanshawe College Campus
London, Ontario

In 2020, Fanshawe developed a campus-wide Greenhouse Gas Roadmap and Reduction Action Plan that set emission reduction targets by 30% below baseline levels by 2030 and 80 percent by 2050. The plan prioritizes improvements to buildings, waste, and transportation.

Four strategies to generate sustainable outcomes:

1. Energy Efficiency and Management
2. Infrastructure and Building Management
3. Waste Management
4. Faculty and staff Research with a focus on sustainability.

GHG Reduction strategies include Conservation & Demand Management, Net-zero Buildings, Fleet and Facility Electrification, and Renewable on-site Energy Generation.

The framework leverages industry standards to validate their program including through a Gold-rating under the Sustainability Tracking, Assessment & Rating System (STARS) and the use of LEED® certification and Zero Carbon Building™ standards.

Through their efforts, they have achieved over \$15 million in energy savings and GHG emissions by 17000 tons (tCO_{2e}), which is equivalent to removing 3200 cars from the roads for one year.



Gold Rating

For sustainability under the Sustainability Tracking, Assessment & Rating System (STARS) by the Association for the advancement of Sustainability in Higher Education (AASHE)

Energy use per square foot **reduced by**
15%
since 2013

93
academic courses
dedicated to
sustainability being
offered

CO₂ GHG emissions
per square foot since
2013
-29%

91%
faculty and staff
engages in
sustainability
research

22%
reduction in waste
generated per person
since 2013

67%
of total waste
diverted from landfill
in 2018

Public Dashboard

Bow Valley College
Calgary, Alberta

Bow Valley College has initiated an Energy Dashboard online and on-campus to capture active consumption and provide an overview of daily, monthly and yearly data. This data allows Bow Valley College to identify trends and strategize for the future. The efforts towards decarbonization are validated through adoption of LEED rating systems for both the North and South campuses.

Sustainability as a core idea is encouraged through initiatives including mapping electricity, water, and natural gas consumption, innovating ways to achieve greater energy efficiency, encouraging mass public transit, walking and bicycling, and waste diversion on campus.

Energy efficiency innovation in South Campus is achieved through a closed loop district heating system, which is more efficient than many traditional heating methods.

The Sustainability Committee motivates students and employees to take steps towards a sustainable campus.







Industry Standards for Buildings

Green building standards are used to support building owners' sustainability goals for both new construction and renovations. While LEED is the most widely adopted standard across the country, other tools are available to support a range of sustainability objectives.

What is a net-zero carbon building?

A net-zero-carbon building is a highly energy efficient building that either produces on-site or procures non-emitting renewable energy or high-quality carbon offsets to counterbalance the annual carbon emissions from its materials and operations.

Industry Standard	Trends	Examples of Applied Research
Zero Carbon Building Standards 	Framework to help buildings achieve zero carbon in design and in annual operations.	Design and refurbishment of existing buildings
LEED (Leadership in Energy and Environmental Design) 	Supports sustainability in 6 areas: water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, sustainable sites, and regional priority.	Design, construction, operation, and maintenance
BOMA BEST 	Recognizes excellence in energy and environmental management.	Operations and maintenance
Passive House and EnerPHit 	Focused on highly energy efficient construction and renovations.	Design, construction, and refurbishment of existing buildings

Building Performance Improvement Pathways

Any building owner, manager, or professional striving to reduce building related emissions and improve energy efficiency, must evaluate viable retrofit pathways and develop a holistic transition plan.

Irrespective of a building's size and type, a deep retrofit – aiming to reduce energy consumption by more than 40 percent – requires a “building as a system” approach.

There are three main technical strategies that can serve as a starting point for most large building types in Canada as they begin zero carbon transition planning and retrofit project development :

1. Reduce/replace fossil fuel use for space heating, mainly through electrification;
2. Implement energy demand-reduction measures and;
3. Incorporate and/or install on-site renewable energy systems.

What is a Zero Carbon Transition Plan?

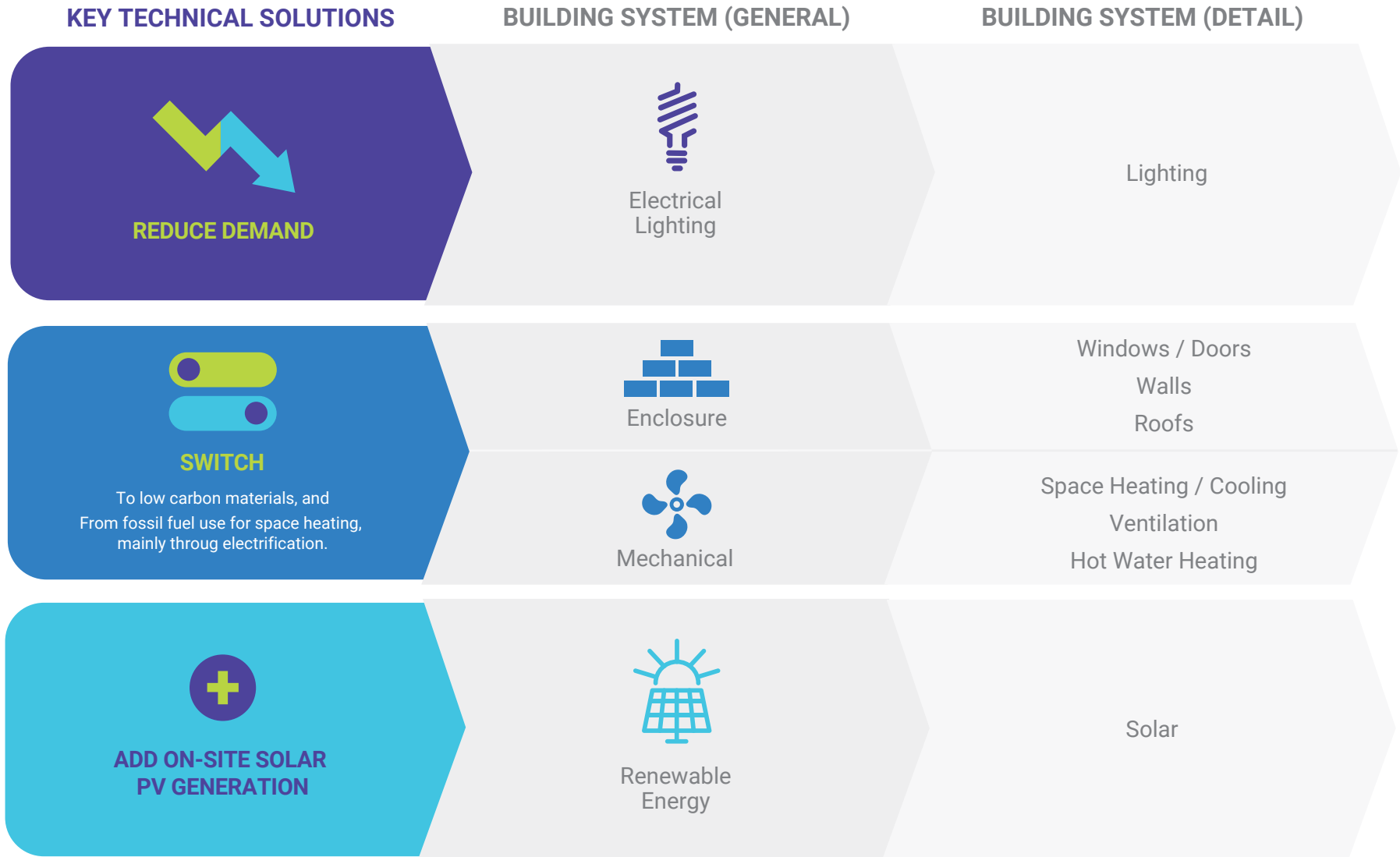
A costed plan that outlines how a building will leverage natural intervention points and adapt over time to remove combustion from building operations. The plan should identify any necessary peak electrical demand reduction measures that are necessary to ensure that the transition does not put unnecessary strain on the electrical grid. This typically includes enclosure upgrades to reduce the need for space heating and cooling, potentially reducing both operating and capital costs.

A transition plan is best implemented over time by incorporating the steps into the building capital plan and leveraging existing equipment replacement cycles. Having a transition plan provides a clear plan of action, and helps ensure that future building improvements, planned or otherwise, work towards the goal of zero carbon.



Photo: FNTI is in the planning phase of building a student-centric 50,000-square-foot, net-zero facility on their homeland in Tyendinaga Mohawk Territory in Ontario. The building will be mass timber construction, powered by solar panels and will integrate other elements of long-term sustainability, adaptability and reciprocity with the natural world.

Building Performance Improvement Pathways



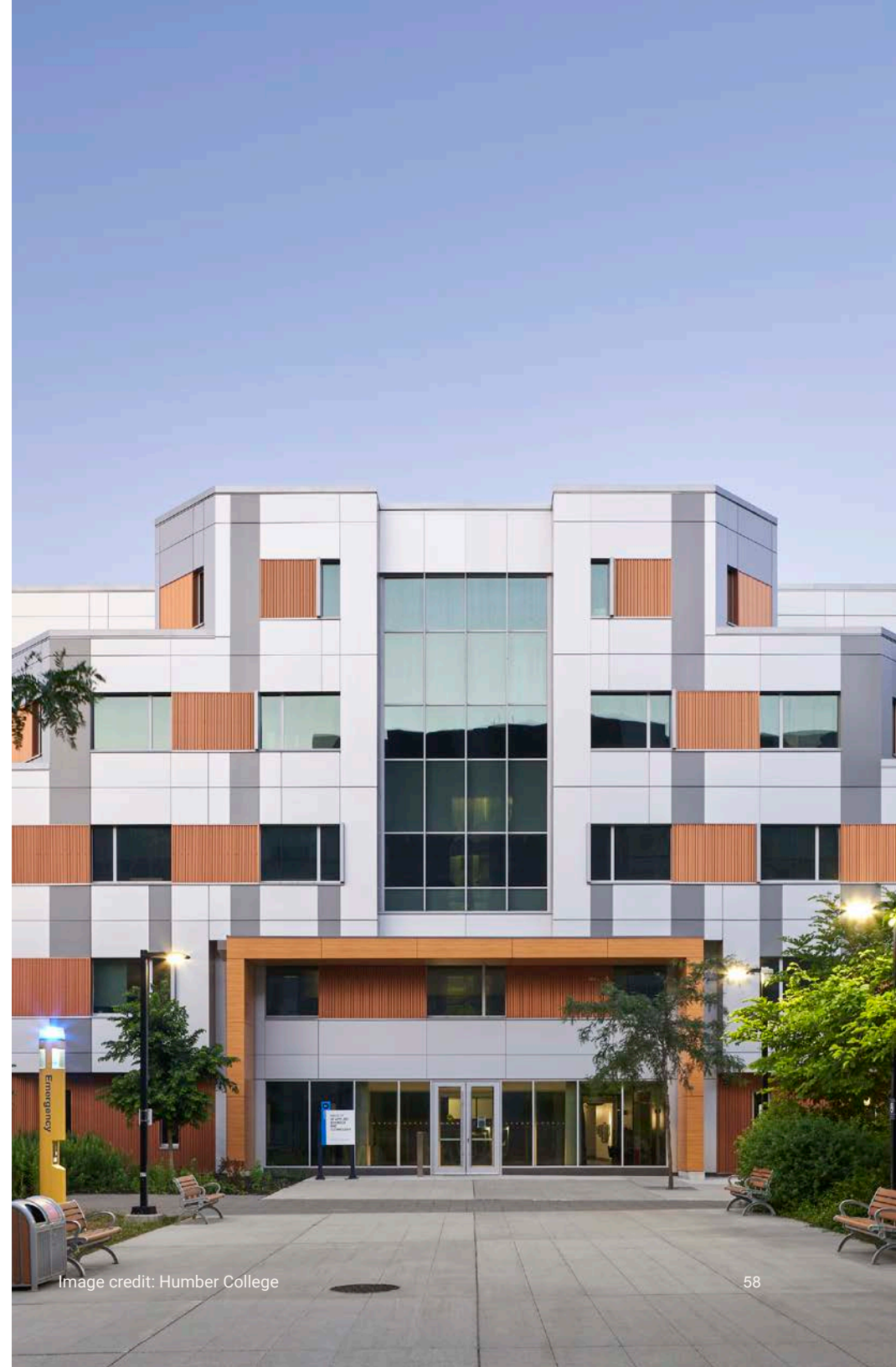
Deep Energy Retrofit

Humber College
Toronto, Ontario

Built in 1989, NX Building was infamous for being freezing cold in the winter and extremely hot in the summer. Faced with a building that was near its end-of-life, Humber's energy team decided to embark on the ambitious journey of performing a deep energy retrofit on an aging building that would remain occupied throughout construction.

Humber's NX Building is the largest non-residential Passive House certified building in Canada and was one of the first 10 buildings in Canada to receive the Zero Carbon Building (ZCB) - Design certification from the Canada Green Building Council (CAGBC). This foundational project has informed all of Humber's current and future sustainability projects as we build towards net-zero carbon emissions.

Completed in 2019, the building uses 70 percent less energy than it did before and has a 90 percent reduction in GHG emissions. Humber College has a 20-year Integrated Energy Master Plan (IEMP) in place to strategically address the institution's energy and water consumption with the goal of reducing energy, water, and GHG emissions.



New Addition

Centennial College Block A *Toronto, Ontario*

Centennial College Block A Expansion Project would be the first mass timber, zero carbon, post-secondary education facility in the country when it opens in 2023. Drawing from Indigenous principles and references from nature and designs, the low carbon, highly energy-efficient master building is built with locally-sourced Canadian timber.

Notable features of the development will include:

1. Mass timber structure, providing carbon sequestration abilities.
2. No emissions produced from the operations of the building from space-heating, ventilation, hot water and lighting; due to on-site renewable energy generation.
3. Flexible learning spaces, to allow for the reorientation of physical elements to be conducive to Indigenous models of teaching and learning.
4. Spaces for gathering with Traditionalists, Elders, citizens of Indigenous Nations, and members of Indigenous communities, equipped with indoor and outdoor learning spaces, office space, and common areas.

A life cycle assessment was undertaken to evaluate the embodied carbon footprint contributed to the project's overarching low-carbon sustainability goals. An integrated approach involving the owner, engineers, and architects has been fundamental to ensuring sustainability goals are accomplished through design. Already, the building has secured Canada Green Building Council's Zero Carbon Building – Design Standard certification and is also seeking LEED Gold v4 and WELL v2.



New Construction

Okanagan College, Jim Pattison Centre of Excellence
Penticton, BC

The Jim Pattison Centre of Excellence for sustainable building technologies and renewable energy conservation is a 'living-learning' facility. There, students can leverage the building operations to enhance their understanding of building performance.

Notable features of the development include:

1. Solar light tubes and sun central light tracking solar system for more daylight areas.
2. Green roof components, mimicking the regional flora.
3. Natural cross-ventilation using solar chimneys.
4. High-performance building envelope and displacement ventilation in closed mode.
5. Ground source heat pump with radiant floor heating and ground source cooling.
6. Localized thermal mass and radiant wall panels.
7. Radiant heating embedded in a concrete mixture poured on top of wood delivers further energy savings.
8. Innovative structural solutions avoiding extensive use of adhesives, preservatives and paints.

The building achieved LEED Platinum Certification in 2015.



Next Steps

1 Track

Collect, report and share sustainability data related to school goals publicly through a dashboard or other communication methods.

2 Do

Establish as a cross-departmental Sustainability Task Force to develop and implement a campus-wide plan that establishes firm commitments to sustainability objectives.

3 Collaborate

Share best data, practices, and lessons learned with other CICan members to strengthen the knowledge base of Canadian campuses.

4 Advocate

Engage the provincial and federal governments to ensure that college infrastructure development and maintenance is in alignment with Canada's goal to be Net Zero by 2050.



Conclusions

What now?

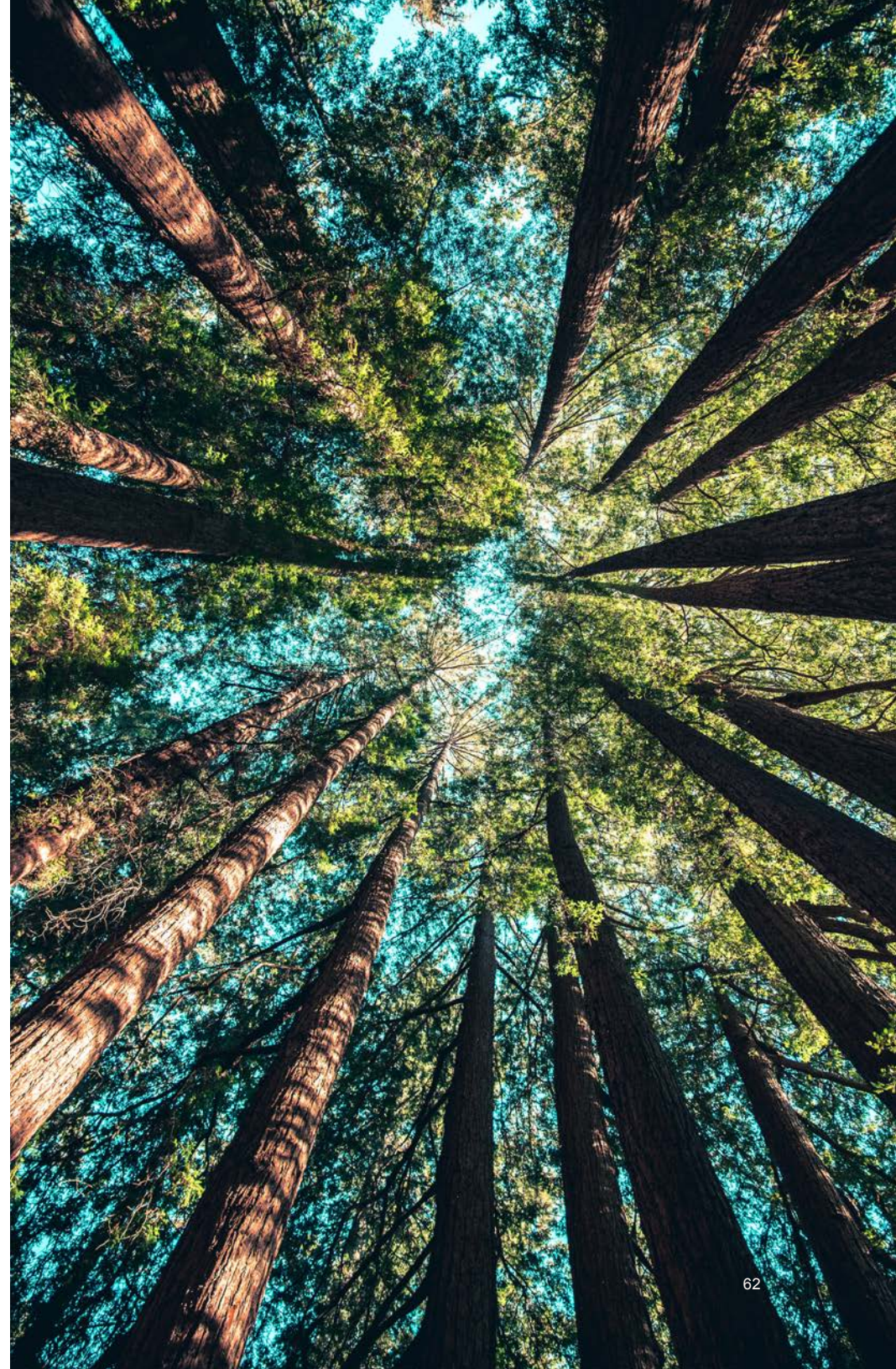
Net-zero emissions is an ambitious goal but not out of reach. We need to get serious about reducing emissions in a big way right now. Canada needs leadership, and colleges and institutes are stepping up.

Are We Ready?

If this study has one takeaway, it's the importance of collaboration. Canada's colleges, institutes, cégeps, and polytechnics make up the largest post-secondary network in the country. With more than 680 locations, their collective engagement goes a long way. By showcasing examples of sustainable design and initiatives across the post-secondary sector, we hope this report will inspire more leaders to work together to create positive change.

The decisions made now will define what future generations will inherit. Make bold commitments and hold each other accountable.

As a country, we are heading in the net-zero direction. As a sector, colleges and institutes are standing out. They are ensuring that industries, skills, learners, and the economy are better equipped to face the challenges of the future, and there is no future without net-zero.





Appendix A - Climate Change and Sustainability Curriculum

College and institute programs were scanned against a set of keywords, primarily by program title, but in many cases also course content and program descriptions. Please see page 14 for more details. Using this methodology, we found that the below colleges and institutes had the highest number of related programs.

- **British Columbia Institute of Technology (BCIT)**
- **Centennial College of Applied Arts and Technology**
- **Fleming College**
- **Algonquin College**
- **Conestoga College Institute of Technology and Advanced Learning**
- **Nova Scotia Community College (NSCC)**
- **Vancouver Island University**
- **Sault College**
- **Northern Alberta Institute of Technology (NAIT)**
- **George Brown College**

Smaller Schools that have a large number of programs (with percentage of all programs considered sustainable):

1. Sault College **14%**
2. Coast Mountain College **14%**
3. Cambrian College of Applied Arts **14%**
4. North Island College **10%**
5. Canadore College **8%**

Are We Ready?