Regenerative Revolution: How Canadian Polytechnics are Leading the Charge

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***Innovation Spotlights** extremely brief contributions that highlight an innovative teaching practice, approach, or tool, and provide accompanying evidence that speaks to the effectiveness of the innovation.

Abstract
Canada's polytechnics have long been at the forefront of innovations in sustainability and combatting climate change. These institutions have the capacity to play a critical role in driving the adoption of climate-conscious practices throughout industry and the wider community. As the need to move past sustainability and propel the adoption of regenerative practices is better understood, polytechnics are uniquely positioned to drive this shift. This paper explores the concept of regenerative design and how Canada's polytechnics have employed on-campus initiatives and infrastructure projects in three broad categories: production of excess energy, recycling and reusing waste or runoff, and ecological (re)integration. Through these endeavours, the institutions are positioning themselves as role models and intermediaries able to introduce and help stakeholders adopt regenerative practices. Maximizing this capacity is an important way the Government of Canada can achieve its climate-related objectives as laid out in the 2022 Federal Sustainable Development Strategy. By harnessing polytechnic regenerative expertise and their deep ties to both industry and their surrounding communities, Canada will be better positioned to meet its ambitious climate targets.

Introduction

A sustainability-focused approach to combatting environmental degradation and resource scarcity is now critical. It is no longer viable to consume the world's natural resources or develop our natural landscape in the manner of the last century. At current rates of fossil fuel consumption, climate models predict that Earth's global average temperature will rise an additional 4°C (7.2°F) during the 21st Century, threatening coastal cities, increasing the frequency of natural disasters and heightening the risk of extinction among numerous plant and animal species (UCAR, 2022).

Achieving the net-zero targets outlined in the 2016 Paris Climate Accords stands to slow the pace of environmental degradation and extend livability on the planet. That said, arguably the most important outcome of the Accords was not emissions targets, but acknowledgement by the leadership of 193 countries that

immediate action must be taken to mitigate the degradation of the natural environment (United Nations, 2021). Where current climate agreements and policies fall short is in the failure to recognize that the planet needs more. Rather than just minimizing damage, the environment requires efforts to actively renew, revitalize and repair. This is where regenerative design principles come into play.

Regenerative design is an approach intended to produce net-positive benefits to the health of ecosystems, communities and the broader environment. While not yet a part of mainstream policy or discourse, Polytechnics Canada has identified leadership in this area among its member institutions. Sometimes unintentionally, Canada's polytechnics are propelling regenerative design with pragmatic approaches that are broadly replicable, drawing on faculty and student expertise, world-class research facilities and close ties to industry. This paper provides just a few examples of how Canada's polytechnics are leading the way.

From Sustainability to Regeneration: Recognizing the Need to do More

As mentioned above, regenerative design can be simply defined as an approach intended to produce net-positive benefits to the health of ecosystems, communities and the broader environment. The concept, however, is more complex, and is representative of a paradigm shift within the field of sustainability. Examining how polytechnic institutions stand to serve as catalysts for a wider movement towards regenerative design therefore requires an understanding of the relationship between regeneration and sustainability.

The most widely quoted definition for sustainability and sustainable development comes from the UN World Commission on Environment and Development. The Commission defines sustainable development as meeting the needs of the present without compromising the ability of future generations to meet their own needs (Thomsen, 2013). This definition forms the ethos of the United Nations Sustainable Development Goals (UNSDGs), the framework for improving the lives of people around the world and mitigating the effects of climate change.

In Canada's Federal Sustainable Development Act (June 2008), the government adopted this definition of sustainability and committed to the pursuit of the 17 UNSDGs, a commitment reaffirmed in the 2016 Paris Climate Accords (Environment and Climate Change Canada, 2021).

The UN has defined sustainability as the mitigation and reduction of harmful practices, a relationship that requires humankind to limit its consumption of the earth's resources and curtail the degradation of ecological health. For example, the Canadian government's promise to act on climate change focuses on reducing greenhouse gas emissions and developing strategies related to mitigation, adaptation and impact reduction (Environment and Climate Change Canada, 2021). This approach to sustainability – reduction and mitigation – has dominated political discourse and related public policy.

Other concepts of sustainability go further, advocating for a symbiotic relationship between humans and the environment and requiring a more active role in revitalizing natural systems. For example, in the charter for the UCLA Sustainability Committee (University of California Los Angeles, 2021), sustainability is defined as "the integration of environmental health, social equity and economic vitality in order to create thriving, healthy, diverse and resilient communities for this generation and generations to come." The United States Environmental Protection Agency (2021) subscribes to this approach, asserting that everything we need for survival and well-being depends, directly or indirectly, on the natural environment, requiring humans and nature to exist in productive harmony.

This systems-oriented approach is the basis of regenerative design. It goes further than mitigating the negative impacts of climate change by asking humankind to embrace, design and participate in net-positive approaches to our natural systems. There is broad consensus that regenerative design seeks to work as a positive force that restores, renews or revitalizes.

Mang and Reed (2012) suggest regenerative development[1] and design as a framework for creating, applying, adapting and integrating modern and ancient technologies to the design, management and continuing evolution of sustainable built environments. Regenerative approaches reverse the degradation of the planet's natural systems and design

1 Regenerative development relates to regenerative design in that the former determines the right phenomena to work on, or to give form to, in order to inform and provide direction for regenerative design solutions that can realize the greatest systemic potential.

human-driven systems that co-evolve to generate mutual benefits, improve life on the planet and create resilience for the future.

For Mang and Reed (2012), a regenerative approach is defined by the following characteristics:

- Place-sourced and place-specific;
- Evolutionary, embedding capacity to improve performance through time and variable environmental conditions;
- Bigger than functional performance goals;
- Addresses human aspiration and capacity to effect change in their immediate environment; and
- Focuses on processes and systems in physical structures.

Similarly, Colin Rohlfing (2021), director of sustainable development at HDR, an engineering, architecture, environmental and construction services firm, suggests the following regenerative development goals:

- Achieve net-positive impacts for ecology, health and society;
- Adapt its concepts for all project types (including existing buildings) and sizes;
- Generate decisions that are metric based and driven by unique site data;
- Produce projects that continuously evolve and renew;
- Incorporate and build upon existing paradigms, such as triple net-zero (energy, water and waste), carbon balancing (embodied and operational carbon) and social equity; and
- Engage and involve the community on a continuous basis.

Synthesizing these complementary approaches, this paper proposes three overarching goals for a regenerative design project: to implement solutions based on site-specific ecological characteristics and existing infrastructure; ensure that each project benefits and transforms the surrounding socioeconomic and ecological systems; and develop value-adding processes that indefinitely serve stakeholders and the environment beyond the project building and site.

Exemplars of Regenerative Design in Canadian Polytechnics

While regenerative design most commonly focuses on developing new or modifying existing infrastructure (i.e., buildings), a regenerative project can be any endeavour that is designed to restore, renew or revitalize. Though the concept of regenerative design has not yet been explicitly and fulsomely integrated into sustainability plans at Canada's polytechnics, these institutions have almost universally begun to adopt systems-oriented approaches to sustainability. The term regenerative design is not yet ubiquitous on campuses, but polytechnic sustainability ventures have begun to move past net zero and are more frequently seeking to generate future value to the environment and surrounding communities. In doing so, they have made strides towards the wholesale adoption of regeneration, integrating regenerative design into on-campus initiatives, research, partnerships, and infrastructure projects.

On polytechnic campuses, regenerative design is manifested in different ways, though there are some common threads. In highlighting some innovative regenerative design projects, we also see opportunities for polytechnics to facilitate the widespread adoption of regenerative design principles. This paper has grouped these projects into three categories representing divergent approaches to regeneration which represent only a snapshot of the potential positive impact of polytechnic regenerative design projects and partnerships.

Producing energy from renewable sources to power the campus and beyond

One area where polytechnics excel is in the development of buildings that produce excess energy without a detrimental ecological footprint. Whether solar, wind or geothermal, clean energy production is the cornerstone of these campus infrastructure projects. Buildings are not only self-sufficient in terms of energy use but produce sufficient excess energy to power adjacent buildings. These projects have further positive downstream impacts on surrounding ecology and the communities in which they are situated.

For example, the British Columbia Institute of Technology's Aerospace Campus features a geothermal heat pump that serves as the primary heating and chilled water system for the entire campus. The system uses a massive concrete slab in the campus's central hangar as a radiant heat source with air-to-air heat recovery that provides warmth to adjacent shops and classrooms (Olympic International, 2020).

The physical space and surrounding environment were both major factors in the decision about where and how to design the building. The campus is set well back from the Fraser River's shoreline and a greenbelt buffer of trees and bushes

was preserved to form a natural break between the river and the campus (British Columbia Institute of Technology, 2008).

A similar geothermal system can be found at neighbouring Kwantlen Polytechnic University's Surrey campus, where radiant floor technology is used to heat and cool the majority of the Arbutus building as well as parts of the Surrey Main building (Kwantlen Polytechnic University, 2016).

These geothermal systems achieve the overarching goals of regenerative design. As a renewable source of energy, geothermal is both location- and site-specific. The nature of geothermal is such that these projects create a sustainable and long-term source of energy for the campus and its surrounding communities. Projects can be expanded to generate further energy to share among diverse stakeholders, further reducing overall reliance on non-renewable energy.

Repurposing waste and runoff for ecological rehabilitation

Another category of polytechnic regenerative projects involves systems that reappropriate waste and runoff. These projects promote the health of waterways on and near campuses, reduce strain on storm water systems and reduce overall water consumption. Waste and runoff are reused as fertilizer, helping to revitalize biodiversity on campus or used in ways that support student projects or commercial agriculture.

For example, at Fanshawe College's Simcoe Campus, a series of trenches have been dug to allow storm water to percolate into the soil. This helps replenish groundwater, decrease pollutants flowing into streams and reduce the burden on municipal storm water systems. On the same campus, rainwater hitting a green roof is collected in an underground storage tank. This water is recycled to flush toilets and water gardens (Fanshawe College, 2022).

Seneca College's King Campus has developed a similar system, where sludge created by sewage runoff is redirected to adjacent farm fields and serves as fertilizer (Prior et al, 2012). Like Fanshawe, Seneca's system mitigates the risk of pollutants permeating groundwater and polluting other water sources.

Both institutions have put regenerative design to use by reappropriating water which might otherwise have gone to waste. Projects were built around the unique geographical features of the campus and work to actively improve conditions in the surrounding ecology. Both institutions are committed to engaging with stakeholders who stand to be impacted by any given project, including students, faculty, municipal leaders and local farmers, adding value for both people and the environment (Seneca College, 2021; Whittingham, 2020).

Transforming campus spaces to introduce and promote biodiversity

Polytechnics also host projects that seek to explicitly create or bolster new and existing ecological features within human-built spaces. These projects promote ecosystem enrichment by creating spaces for native vegetation and animal species to flourish. By providing learning opportunities and promoting biodiversity on and near campus, these projects also incent stakeholders to actively maintain the ecological landscape, enabling benefits in perpetuity.

At Humber College, artificial beehives have been installed at the North and Lakeshore campuses as well as the Humber Arboretum. A pollinator garden was installed at the school's Centre for Urban Ecology. The Arboretum and hives at Humber allow the school to offer a Sustainable Beekeeping course, with topics ranging from equipment to growing native plants. The institution has also partnered with Bee City Canada to ensure the health of native bee species in the 250 acres of natural space surrounding the campuses. Honey is harvested and used by Humber's Culinary Management students (Humber College, 2021).

At Red River College Polytechnic (RRC Polytech), the Notre Dame Campus is also home to a pollinator garden, located on the east side of the arboretum. This garden is complemented by rooftop beehives that keep bees and other pollinators well-fed with nectar or pollen-producing plants. The installation has become the site of workshops on subjects such as honey extraction. Honey is also used by RRC Polytech's Paterson GlobalFoods Institute (Red River College Polytechnic, 2018).

Both polytechnics have fully embraced the principles of regenerative design in their pollinator projects, creating space for native bee species to thrive and ensuring a healthy population of pollinators for surrounding vegetation. Learning opportunities generated by these projects add value to the local community.

This section has highlighted the first way in which polytechnics can and are helping to propel regenerative design to the fore of the Canadian consciousness. By

engaging in projects similar to those listed above, the on-campus student population is being directly exposed to the importance and potential of regeneration. Such projects equally serve as exemplars for both government and industry as to the myriad ways in which regenerative design can be embedded into physical spaces.

Regenerative Design and the Circular Economy

In March 2022, the Government of Canada released its Federal Sustainable Development Strategy. The strategy includes a higher level of ambition for transparent and accountable sustainable development decision-making. Reflecting the 17 United Nations Sustainable Development Goals, the strategy primarily focuses on sustainability by advocating for shifts toward renewable energy sources and an overall decrease in the consumption of non-renewable energy (Environment and Climate Change Canada, 2021). In his foreword, the Honourable Steven Guilbeault, Minister of Environment and Climate Change, explains that the draft strategy reflects the principle of intergenerational equity (Government of Canada, 2021).

Though a sustainability-focused approach is a necessary starting point in the pursuit of intergenerational equity, proponents of regenerative design argue that sustainability alone is insufficient. To provide equitable opportunity for future generations, we must both limit human impact on the environment and actively work to repair and regenerate. The Government of Canada's draft strategy notionally recognizes the need for regeneration by referencing the circular economy. Specifically, it advocates for the widespread application of the three founding principles of the circular economy: designing pollution and waste out of the economy, keeping products and materials in use, and working with nature to regenerate and enhance ecosystems – principles which mirror those of regenerative design[2] (Environment and Climate Change Canada, 2021).

Incorporating regenerative design into infrastructure and development projects would facilitate the transition toward a circular Canadian economy. Regenerative design inherently seeks to reduce pollution and waste, re-use and recycle materials and existing structures, and regenerate surrounding ecosystems. Industry-aligned polytechnic applied research facilitates the adoption of these principles.

Applied research refers to an exceptionally broad range of supports delivered in response to industry demand. Polytechnic institutions across Canada mobilize state-of-the-art facilities, equipment and expertise to deliver solutions for partners across industrial and social sectors, always in partnership and often with the help of student talent. As a result, institutions have a flexible and agile applied research infrastructure that adapts to the unique requirements of a partner and their project. This capacity positions polytechnics to export regenerative principles and ideas to industry, thus facilitating the transition to a circular economy.

One of the most notable examples is The Confluence, a "net-positive" home developed by Southern Alberta Institute of Technology (SAIT) Green Building Technologies in partnership with Woodpecker European Timber Framing. Contracted by a young family and working with a modest budget, SAIT and Woodpecker designed and constructed a home that was only one of three worldwide to comply with the standards of the Living Building Challenge (Cox, 2021).

The home's water and energy use are sustainable. The build used non-toxic, salvaged and natural materials. Highlights underscoring the regenerative principles include:

- The Materials Conservation Management Plan ensures 90-100 per cent of waste is diverted from landfills both during construction and operation;
- Both potable and non-potable water required by the homeowners is designed to be collected by harvesting rainwater and an onsite well;
- 105 per cent of the energy requirements is captured through 35 roof-mounted solar panels, with the potential to redirect energy back to the grid;
- Tours, open houses and a project website showcase the creative solutions employed, educating the public and encouraging others to use similar strategies (The Confluence, 2021).

This project demonstrates how polytechnic expertise and capacity can bring regenerative solutions into mainstream, industry use. The Confluence is just one example of a type of regenerative project to which a Canadian polytechnic

2 The Ellen MacArthur Foundation (2022) defines the circular economy as a systemic approach to economic development designed to benefit businesses, society, and the environment. In contrast to the 'take waste' linear model, a circular economy is regenerative by design and aims to gradually decouple growth from the consumption of finite resources.

could bring expertise. Significant potential exists for the Government of Canada to leverage this capacity in its pursuit of environment-related ambitions and the circular economy through the support of applied research partnerships centred on regenerative solutions. Achieving true intergenerational equity will require more than a net-zero approach, and Canada's polytechnics – with the right support – are ready to lead the charge in the regenerative revolution.

Given the necessary involvement of students, applied research projects at Canada's polytechnics can also serve as important learning opportunities with respect to regenerative design. Learners are exposed to the practical deployment of regeneration, gaining hands-on experience realizing regenerative solutions and learning how such principles can be employed by industry. By committing to pursue applied research projects centred on regeneration, polytechnics can play an important role in ensuring that the workforce of tomorrow is well-equipped to further embed regenerative practices across industries. Polytechnics have the capacity to further disseminate an understanding of regenerative design by embedding its principles across curricula, programs and workshops. In doing so, these institutions can help create a population that is more cognizant both of how human actions are causing our natural world to degrade and the actions and policies they can support to rectify this damage.

Conclusion

Reaching Canada's climate change and net-zero targets is simply insufficient – we need to reach beyond these objectives to leave the environment better than we found it. To capture the imagination and climate ambitions of this generation, a focus on regenerative design is key. The concept of intergenerational equity – ensuring the next generation has the resources and requirements needed to succeed to the same degree as past generations – is a powerful goal. Polytechnics are well-positioned to lead the charge.

With significant footprints in large urban centres and a stakeholder community that understands the need for climate change action, polytechnics sit at the intersection of talent and industry. Applied research expertise enables polytechnics to push new ideas and knowledge out to industry partners, municipalities and the general public. They equally serve as valuable educational opportunities, further exposing participating students to real-world applications of regeneration. By embedding regenerative design principles and pragmatic solutions in programs and workshops, institutions can impart an understanding of environmental degradation to their surrounding communities and ensure individuals have the skills to proactively address it. Finally, polytechnics are positioned to be community exemplars, using solar and geothermal energy on-campus, implementing green roofs and walls, and engaging in active initiatives to reduce, reuse and recycle.

While the work already underway is impressive, there is room for more. As governments seek to move on their net-zero ambitions, Canada's polytechnics are a natural destination for investments. Building on existing capacity and examples is a good start.

Note on Contributor

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