SUSTAINABLE PRACTICES ACROSS LEADING CANADIAN UNIVERSITIES

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Abstract: Educational institutions are the learning grounds both for current students and for generations to come. These establishments often play a significant role in shaping human behavior as values and practices adopted by students influence their actions and their future communities. Universities - being the premier knowledge producers in society - should therefore be the leaders in bringing and promoting sustainable practices and behaviour. Sustainable development, sometimes referred as "meeting the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development, 1987), has become an increasingly important consideration as evidence mounts that ecosystem degradation, natural resource depletion and global climate change threaten our ability to support society into the future. In this situation, the ability to foster sustainable behavior among all academic disciplines could be the single greatest contribution that universities can make towards a sustainable future. This is in addition to any facilities management-related activities that any large organisation can claim expertise over. Recognizing this, universities have increasingly focused on campus sustainability and mandated the creation of associated action plans. "It's Greener Here" by University of Toronto, University of Waterloo Sustainability Project (UWSP), Social Ecological Economic Development Studies (SEEDS) by University of British Columbia are a few Canadian examples. However, due to the variety of approaches and scope of interventions, there is a great need to assess current sustainability practices. Hence, this paper reviews and analyzes Campus Sustainability Assessment Frameworks (CSAF) by leading Canadian universities with the objective of identifying current best practices.

Based on this analysis, a campus sustainability assessment tool has been developed using multi-criteria decision making (MCDM) technique. The tool is then implemented for the purpose of drawing comparisons across the large volume of divergent campus sustainability indicators. These indicators are broadly classified into five thematic groups: research, education, infrastructure, campus operation, administration & community engagement. The implicit nature of MCDM makes it particularly suitable for this analysis as it permits the integration of the three well-known pillars of sustainability: economic, environmental and social and thus, provides a unified overall outcome. According to the analysis, all the universities under consideration have shown superior performance in infrastructure operation and community engagement while overall campus operation and designing sustainability focused curricula have got the least attention.

By emphasizing the critical role of universities, this paper encourages the advancement of the sustainability agenda by moving closer to a "culture of continuous improvement".

1 BACKGROUND

Sustainability generally refers to the endurance of systems and processes. Since its first significant popularization in 1978, this concept has evolved to represent an holistic approach that considers environmental, social and economic dimensions for enduring prosperity. With the realization that climate change is an impending global challenge with long-term implications, the need for sustainable development is strong. At present, it has become essential to move towards a long-term strategy with strong social, economic and environmental dimensions and a comprehensive response plan that promotes sustainable growth. Universities, both as stewards and as public institutions, and both as the creators of future leaders and the incubators of technological development, have a central role to play in advancing the sustainability agenda. Recognizing the intrinsic relationship between sustainability and the core function of educating future generations, Canadian universities are in the process of committing to sustainable development philosophies, the results of which should be the creation of a generation of sustainability-conscious graduates able to impact their world while the institutions responsible for their education demonstrate sustainability within their own operations.

2 REVIEWING SUSTAINABILITY FRAMEWORK OF LEADING CANADIAN UNIVERSITIES

This section briefly reviews campus sustainability frameworks associated with several Canadian universities. Though this analysis can be significantly enriched by encompassing a larger set of educational institutes, time and resource constraints limited this preliminary coverage to quite large and nationally well-known universities. This study does not attempt to imply the superiority of these universities in advancing the sustainability agenda, but rather wishes to identify unique features, distinctive measures, and the motivation behind such initiatives etc. – which are rarely addressed while performing sustainability assessments individually at the institutional level. The universities covered in these section are University of Toronto (St George Campus of UofT), University of British Columbia (UBC), McGill University, York University, Queen's University (Queen's), and University of Alberta (UofA).

2.1 Defining Sustainability

There is a wide variation regarding how sustainability is defined among different universities. While Queen's and UofT have adopted the well-known Brundtland Commission form, a few have defined it in line with their own terms and objectives. One example is McGill which has defined sustainability as "working together towards a shared vision for a flourishing future in a manner that integrates social, economic, and environmental dimensions" (McGill University, 2012b). Some institutes have sustainability themed around optimal resource utilization. York defines sustainable university as "the one that combines the ecological functioning of its campuses with the core function as educators through an integrated framework of economic and environmental accounting" (York University, 2015). According to the UofA, "sustainability is the process of living within the limits of available physical, natural and social resources that allow the systems to thrive in perpetuity" (University of Alberta, 2015).

2.2 Sustainability drivers

Other than their intrinsic conviction that this is the right thing to do, educational institutes may be motivated to take on sustainability projects for a number of reasons, some of which include: to improve their image, build trust and reputation, monetary benefits, in response to community pressures, risk management, regulatory considerations, or to respond to educational opportunities. According to Lambrechts and Liedekerke, 2014, identifying the underlying drivers of sustainability provides resources, strategies, and implementation ideas for planning the organization's sustainability roadmap. Primary drivers for UBC's sustainability endeavours include its efforts to move towards 'carbon neutrality' and be a 'net positive energy' and 'zero-waste' campus (Armitage et al., 2007). McGill stated motivation is to achieve the highest possible standards of sustainability on its campuses and in its day-to-day activities through its academic practices, in its facilities and operations, and by its outreach to the broader community. (McGill University, 2012b). McGill further aspires to connect its core function as an educator with professional development pertaining to sustainability, while York strives for a "net environmental

gain" protecting its natural heritage features (York University, 2015). Queens' sustainability mission is committed to a GHG reduction plan that will set strategies and target dates in order to contribute to global reductions (Queen's University, 2015a). Such definitions therefore range from a narrow operations perspective to one also encompassing a broader educational mandate.

2.3 Sustainability focus

All the universities have placed their strategies under the three well-known pillars sustainability: economic, ecological and social. UofA has adopted an institution-wide approach for managing campus resources focusing largely on buildings, energy, food, recycling, and student initiatives among others. Unlike other universities, UBC lays down the goals with specific targets and proposed action plans under each of the three sustainability pillars. Interestingly, its social objectives are set to include employee health and wellness program, disability and safety management etc., which are not explicitly articulated by other universities. While UBC has set specific goals for its sustainability measures, some universities have kept it rather ambiguous or infused it with its core functions of education.

McGill's sustainability strategy, aimed at fulfilling its Sustainability Policy (2010) directive, presents goals and actions across five categories: research, education, connectivity, operations and governance & administration (McGill University, 2012a). What separates McGill's framework from the rest is its prioritization of sustainability as well as specific guidelines regarding advancing solutions to sustainability challenges through collaborative research within disciplines and across disciplinary boundaries.

2.4 Strategy development

Effective and successful implementation of sustainability frameworks requires participation from all stakeholders (Karol, 2006; Muller-Christ et al., 2014). Development of a sustainability strategy through stakeholder (the departments, faculties and all major student organizations) consultation at UBC has permitted participation as well as sharing responsibilities in moving forwards (University of British Columbia, 2010). McGill's sustainability strategies were also guided by a multi-stakeholder steering committee through numerous public events, presentations, and online surveys. It began with benchmarking its sustainability performance relative to its peers using the AASHE STARS framework and thus clearly identified key areas of focus: energy efficiency and green buildings for McGill (McGill University, 2012b).

By contrast, Queen's developed a series of indicators, measured in specific units, for monitoring its progress towards sustainable operation. Its sustainability office is committed to providing a progress report summarizing these activities and the resulting changes to these indicators. However, the university's priority lies with its core functions of education and research and expects to align its sustainability endeavors with such goals (Queen's University, 2015a).

2.5 Sustainability related programs

To the current authors, the document "Inspirations and Aspirations 2006-2012", as a comprehensive guideline for campus sustainability by UBC with its clear objectives, goals and timeline – sets the standard among Canadian universities in terms of ambition and clarity. Many universities are attempting to serve as "living labs" that foster learning through close and mutually beneficial integration with education and research. Apart from research on energy management, Queen's' sustainability initiatives include student driven programs such as "Recyclemania", "Freecycle" which encourages the culture of recycling (Queen's University, 2015b). York also has similar student driven programs such as "Res Race to Zero", an annual competition that encourages residences across campus to reduce their carbon footprint. A noteworthy step by UofT has been introducing Green Courses Program. Since its inception, ninety one courses have been officially designated to be green, often leading the students to their first step towards sustainability by reducing paper use. A few of these universities have extended their sustainability initiatives to build renewable generation capacity on campus.

2.6 Recognition

Almost all the universities reviewed here have shown firm commitments in advancing the sustainability agenda and have been awarded in recognition to their endeavours. In 2014, University of Alberta was chosen as one of Canada's greenest employer for the sixth time in a row followed by York University which made the list in 2013 (Mediacorp Canada, 2015). UofT's waste minimization program is recognized as far back as 1991 when the university received Waste Minimization awards from the Recycling Council of Ontario (University of Toronto, 2015a).

UBC's sustainability endeavors have been honoured with 14 provincial, national, and international sustainability awards (University of British Columbia, 2013). The university received Canada's first Gold rating in AASHE STARS (Sustainability Tracking, Assessment & Rating System), a comprehensive university sustainability rating system in 2011. Following in those footsteps, UofA has achieved Gold AASHE STARS in 2014 preceded by a Silver rating in 2012. McGill University currently holds a mid-range silver AASHE STARS (2012) for its sustainability reporting (Association for the Advancement of Sustainability in Higher Education, 2015). UofT is not rated.

3 DEVELOPING A CAMPUS SUSTAINABILITY ASSESSMENT TOOL

Recent years have seen a wider participation in the development of campus sustainability assessment tools (Roorda, 2001; Cole, 2003; Alshuwaikhat and Abubakar, 2008, Gómez, 2014; Olszak, 2012, Tan et al., 2014). However, many of these studies are either qualitative or lack implementation at the institutional level. Inspired by a similar study on European universities (The Alliance for Global Sustainability, 2008), this research is motivated to develop a cross-institutional campus sustainability assessment tool for the purpose of measuring the relative performance of Canadian higher education institutes.

Recognising the wide potential range of sustainability matrices adopted by these universities, the authors attempt to aggregate the diverse sustainability indicators and present them in a systematic manner. Accordingly, indicators are grouped into five different themes: sustainability focused curricula, research on sustainability, infrastructure, campus operation and community engagement. At the initial stage, the study came up with numerous indicators under the proposed themes. Considering the scope as well as data availability, the initial list was cut down to a reasonable number. A brief description of these indicators are provided here.

Sustainability focused curricula are measured using two indicators: the number of sustainability-related courses, and the distribution of these courses among different disciplines. The second theme explores the intensity of sustainability focused research programs, presence and operation of related research centers and many more. Though the themes of infrastructure and campus operations have considerable overlap, the importance of energy efficient operation of a university's sprawling infrastructure is the motivation behind the separation of these two. While the former discusses energy and water consumption as well as renewable generation, the latter includes other considerations such as transportation (use of alternative modes such bikes, public transit), food, waste diversion, carbon footprint, etc. The last category explores training and seminars: opportunities to engage staff and students in advancing the sustainability agenda. A complete list of indicators under each of these categories is provided in Table 1.

Information on these indicators is then collected and aggregated from available literature, university websites as well as personal communications. The authors have not individually verified the data but rather relied on the universities' own interpretation of the themes and reported values in ASHEE and other public documents. For example, the ambiguous nature of the term "sustainability related course" may lead to different reporting standards for different universities. However, the data is not corrected for such biases. Data processing involves converting the numbers to either percentages (waste diversion, commute model split, recycled paper use etc.) or per person basis (per capital water consumption, emission etc.) whenever possible in order to standardize for comparison purposes. Based on the information collected, universities are evaluated in terms of their relative performance on each of these indicators on a scale of 1 to 5 where 1 represents a poor performance while 5 stands for the best practice among the institutes analyzed. The quantitate analysis then includes Similarity to an Ideal Solution

(TOPSIS), a widely accepted Multi-Criteria Decision Making (MCDM) technique, based on the concept that the ideal alternative has the best level for all considered attributes while the negative ideal is the one with all worst attribute values. Solutions are defined as points that are farthest from the negative ideal point and closest to the ideal point simultaneously (Dong et al, 2014). The five sustainability themes are also weighted in terms of their relative importance through a method named Analytical Hierarchy Process (AHP) (Saaty and Shang, 2011).

4 RESULT AND ANALYSIS

The results are presented in two separate sections. The first section evaluates performance of the universities in each of the five categories. The second section ranks categories as well as the universities based on the performance evaluation. It should be noted that the highest score in the analysis is not representative of the best practices in campus sustainability, but rather a proof of the university's outstanding performance among its peers. The task of comparing these universities with respect to a universally accepted benchmarks falls outside the scope of this research and is generally performed for accreditation purposes.

Table 1: List of indicators under five broad categories

Sustainability focused curriculum	Sustainability research	Infrastructure	Campus operations	Community engagement
Sustainability related courses	Student research opportunity	Energy intensity	Local/fair trade food	Student outreach program
How well courses are distributed	Faculties involved in sustainability research	Per capita water consumption	Office paper policy	Employee sustainability training
	Research centers within universities	Renewable energy generation	Campus fleet or transportation	Health and wellness program
		Energy management plan	Commute model split	Community activities
		Adoption of building standard	Waste diversion rate	Presence in the social media
			Carbon footprint	
			Sustainability office operation	

4.1 Performance evaluation on sustainability themes

4.1.1 Sustainability focused curriculum

Based on the information available, McGill has the best sustainability focused curriculum in comparison to the universities analyzed. McGill leads with an impressive six hundred and ninety sustainability related courses spread among seventy seven different departments (Association for the Advancement of Sustainability in Higher Education, 2015). Universities such as UBC, UofA and York, though offer close to five hundred sustainability related courses, only a few shows such a large dispersion.

4.1.2 Sustainability research

The analysis identifies UofA as the leaders in this category with nine hundred faculty members from seventy three departments engaged in sustainability research. The university is closely followed by UBC

and UofT. While UBC's SEEDS Program has been successful in addressing sustainability challenges, UofT has a strong reputation in the field of sustainable infrastructure. That being said, performance evaluation in this theme deals with the largest percentage of missing information, mostly from Queen's and York University. Moreover, the basic statistics are extracted from self-reporting and little distinction for shade of commitment is currently available.

4.1.3 Building and energy infrastructure

The long-term Energy Management Plan (EMP) adopted by all six universities demonstrates their commitment towards improving infrastructure operation. However, apart from a few Leadership in Energy & Environmental Design (LEED) certified buildings, these institutes (exceptions are UBC and UofA) have apparently not yet formalized any building standard. Energy intensity typically varies between 1.45-2 GJ/m^2 (Environment Canada 2015; University of British Columbia 2013; Association for the Advancement of Sustainability in Higher Education 2015; York University 2015; McGill University 2013; University of Toronto 2015b) with lowest at Queen's. UBC, UofA, UofT and Queen's all score above 3.5 in this category. One notable performance is half the conventional per capita water consumption by UofT (personal communication) but similar comparisons were not readily available at other locations. It should be noted that energy intensity depends on many factors including climate conditions, however, the results here are not corrected for such considerations.

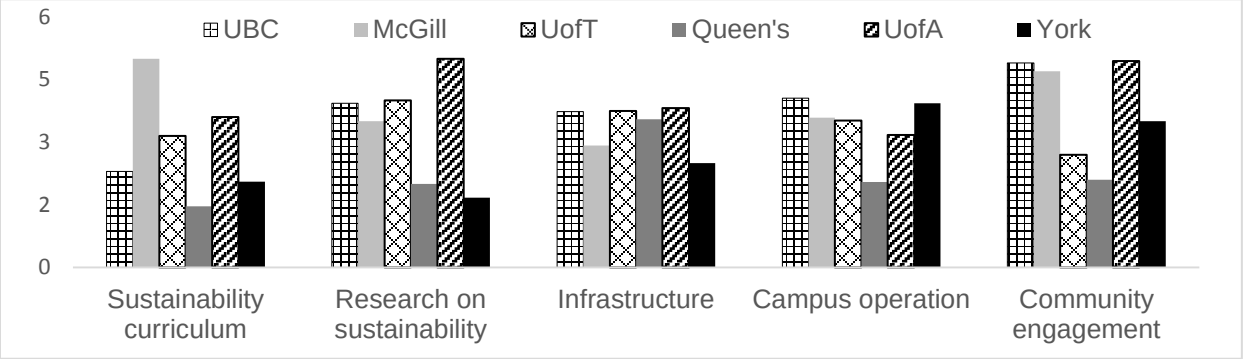

Figure 1: Performance evaluation on sustainability categories using MCDM

4.1.4 Campus operation

All the universities have adopted fair trade and official paper policies. However these guidelines are often limited to individual departments with few reported results. Waste diversion is the category where all the universities have made significant progress with UofT leading the way with 72.1% diversion rate. The same for other universities ranges between 30 to 67%. The least reported success is in the campus fleet; a few electric cars, bike-run security services at York and hybrid mail trucks and solar powered carts at UofA are the notable ones. Another important indicator in this category is the carbon footprint, where York is leading the way with a reported 0.36 tonnes of CO_2e per capita. Based on reported overall performance, the leaders in this category are UBC and York.

4.1.5 Community engagement

The universities with outstanding achievements in community engagement are UBC and UofA, closely followed by McGill. What separates them from the others is the strong presence of employee-targeted sustainability training programs and the incorporation of health and wellness within the sustainability matrix. Figure 1 shows performance of the universities with respect to the proposed sustainability matrix.

4.2 Overall ranking

In this section, TOPSIS is used to rank the five categories for the purpose of identifying the ones where these universities have excelled followed by the ones requiring further attention. According to the

analysis, universities have shown superior performance in the category of improving infrastructure condition and community engagement. Extending sustainability to overall campus operation and designing sustainability focused curriculum have got the least attention from these universities in addressing sustainable challenges until now (Table 2).

The analysis also attempts to rank the universities in order to identify and recognize the ground-breaking performances in the field of campus sustainability. This ranking does not, in anyway, represent the absence of sustainability measures or inferior performance by these universities and may very well be influenced by the lack of data as well as the priority values assigned through AHP. Based on the indicators proposed in this analysis, UofA is leading the way, followed by UofT, UBC and McGill University.

Table 2: Ranking of the sustainability categories

Categories	d+	d-	Ri	Rank
Sustainability focused programs	0.343	0.141	0.34	5
sustainability research	0.284	0.196	0.408	3
Infrastructure	0.210	0.261	0.55	2
Campus operation	0.226	0.153	0.404	4
Community engagement	0.188	0.242	0.56	1

5 LIMITATION OF THIS STUDY

This study has several crucial limitations. First, it handpicks only a few from the vast array of potential sustainability indicators that lack clear standards for their eventual quantification. Secondly, data is mostly collected from publicly available documents and websites. In case of lack of data and email responses from respective universities, a reasonable estimation is made based on the information at hand. Therefore, the universities may be unfairly penalized for not mentioning any measures undertaken. Thirdly, measuring performance indicators such as community engagement in terms of numeric value can often prove challenging. Ranking of the university is sensitive to the priority values assigned to the various categories through the AHP process and may completely change based on individual preferences. Moreover, this is a highly dynamic field and the quest for rapidly improving sustainability is both evident and tangible. Thus significant issues is not really the quantitative comparisons but the broad and growing spectrum of sustainability related initiatives being undertaken.

6 CONCLUSION

The idea of campus sustainability is not to transform a corner of a city into a green oasis. Rather, it aims to inculcate a culture of sustainability by promoting sustainability education through research, curricular and co-curricular activities and practices, while supporting sustainable land, habitat, and watershed management practices. The incorporation of campus sustainability into universities' plans and visions is a relatively new phenomenon in Canada. The initiatives taken by these universities can be considered as founding pillars and of course much work remains in engaging wider participation and deeper commitments from other existing universities, as well as in communities surrounding each university.

This particular study is aimed at benchmarking UofT's performance with respect to its peers. The process is expected to assist the university to identify potential areas for improvement as well as guide its future sustainability endeavours. Realizing the benefits of participatory action in this regard, the authors expect to share the proposed assessment tool as well as the outcome with its peer universities. The particular formation of the model allows continuous update once new data and information are available. The model can also be extended to handle an extensive list of potential indicators. The authors hope that this article will be particularly helpful to researchers and educators formulating a broader framework to measure

campus sustainability as well as to university authorities taking the first step towards establishing a sustainable campus.

References

Alshuwaikhat, H. M., and Abubakar, I. 2008. An Integrated Approach to Achieving Campus Sustainability: Assessment of the Current Campus Environmental Management Practices. *Journal of Cleaner Production*, **16**(16): 1777-1785.

Armitage, D., Berkes, F. and Doubleday, N. 2007. Adaptive Co-Management: Collaboration, Learning, and Multi-Level Governance. UBC Press.

Association for the Advancement of Sustainability in Higher Education 2015. https://stars.aashe.org/.

Dong, J., Chi, Y., Zou, D., Fu, C., Huang, Q. and Ni. M. (2014). Energy–Environment–Economy Assessment of Waste Management Systems from a Life Cycle Perspective: Model Development and Case Study. *Applied Energy*, 114: 400–408.

Environment Canada 2015. Canada's Greenhouse Gas Inventory.

Cole, L., and Wright, T. 2003. Assessing Sustainability on Canadian University Campuses: Development of a Campus Sustainability Assessment Framework. *Royal Roads University,* Canada.

Gómez, F. U., Sáez-Navarrete, C., Lioi, S. R., and Marzuca, V. I. 2014. Adaptable Model for Assessing Sustainability in Higher Education. *Journal of Cleaner Production*: 1-11.Karol, E. 2006. Using Campus Concerns about Sustainability as an Educational Opportunity: A Case Study in Architectural Design. *Journal of Cleaner Production*, **14**(9-11): 780-786.

Lambrechts, W. and Liedekerke, L. V. 2014. Using Ecological Footprint Analysis in Higher Education: Campus Operations, Policy Development and Educational Purposes. *Ecological Indicators*, 45: 402-406.

McGill University 2012a. Vision 2020 : Creating a Sustainable McGill.

McGill University 2012b. Vision 2020: A Sustainability Strategy for McGill University.

McGill University 2013. Five-Year Energy Management Plan.

Mediacorp Canada 2015. Canada's Greenest Employers.

Muller-Christ, G., Sterlig, S., Dam-Mieras, R.V., Aombent, M., Fischer, D. and Rieckman, M. 2014. The Role of Campus, Curriculum, and Community in Higher Education for Sustainable Development – A Conference Report. *Journal of Cleaner Production*, 62: 134–137.

Olszak, E. 2012. Composite Indicators for a Sustainable Campus—Design Rationale and Methodology: The Case of the Catholic Institute of Lille. *Ecological indicators*, 23: 573-577.

Queen's University 2015a. Sustainability Strategic Framework. Queen's University 2015b. Queen's University Guide to Sustainability : Initiatives and Issues.

Roorda, N. 2001. Auditing Instrument for Sustainability In Higher Education. *Dutch Committee on Sustainable Higher Education (DHO)*.

Saaty, T. L. and Jennifer S. S. 2011. An Innovative Orders-of-Magnitude Approach to AHP-Based Mutli-Criteria Decision Making: Prioritizing Divergent Intangible Humane Acts. European Journal of Operational Research **214** (3): 703–715.

Saaty, T. L. and Luis G. V. 2013. Decision Making with the Analytic Network Process: Economic, Political, Social and Technological Applications with Benefits, Opportunities, Costs and Risks. Springer.

Tan, H., Chen, S., Shi, Q., and Wang, L. 2014. Development of Green Campus in China. *Journal of Cleaner Production*, 64: 646-653.

The Alliance for Global sustainability (2008). The EESD Observatory.

University of Alberta 2015. Campus Sustainability Initiative. http://www.sustainability.ualberta.ca/.

University of British Columbia 2010. The Sustainability Strategy. University of British Columbia 2013. UBC Sustainability Annual Report 2013.

University of Toronto 2015a. Sustainability Timeline – University of Toronto Facilities & Services. University of Toronto 2015b. Environmental Footprint.

World Commission on Environment and Development 1987. Report of the World Commission on Environment and Development: Our Common Future.

York University 2015. Sustainability at York University.