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Developing an interdisciplinary Master's program in sustainability in engineering and design

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Panel Discussion

Developing an interdisciplinary Master's program in sustainability in engineering and design

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The Trottier Institute for Sustainability in Engineering and Design (TISED) of McGill University is a unit in the Faculty of Engineering. Historically, degree programs at the undergraduate and graduate levels in the Faculty have been offered through six engineering departments plus two schools focused on the design professions of architecture and urban planning. However, more recently, in 2023, TISED recently launched a cross-disciplinary Master's program on sustainability that encompassing all areas of engineering and design from strengths reflected across the Faculty.

About a decade ago, the community of the Faculty of Engineering came together to express an urgent need to launch an interdisciplinary initiative for research and teaching in sustainability, as it related to engineering and design, with strong connections to many other disciplines and stakeholders. Ultimately, with the support of key benefactors, this led to the creation of TISED in 2012, whose mission is to produce innovative engineering and design solutions for sustainability and to nurture the intellectual capacity necessary to do so. TISED is engaged in research, education and outreach with particular focus on four themes: (1) sustainable industrial processes and manufacturing, (2) renewable energy and energy efficiency; (3) sustainable infrastructure and urban development; and (4) climate change adaptation and resilience. TISED's membership currently consists of approximately 60 professors, whose research and teaching relate to these themes and beyond.

In direct alignment with its mandate to educate students in sustainability, planning for a Master's program was initiated in 2017 through a committee of TISED members struck for this purpose. The process for the conception of the program was interactive and consultative, with input sought from faculty members across the Faculty of Engineering and the broader McGill community plus diverse groups of students, industry practitioners and others, on their views of what would

constitute effective educational goals for this program. Surveys and consultations of industry leaders in Québec and Canada were conducted to assess the employment demand for engineering, architecture and urban planning students with particular strengths with regard to sustainability. In addition, polling of our graduating and recently graduated undergraduate students confirmed that while social awareness of sustainability is high among engineering students, there was a strong demand for more in terms of depth and breadth in sustainability education and training. Analysis of leading programs across the world showed that this type of proposed program, combining a generalised core and specialized streams, is not common in engineering schools. Many existing programs typically offer courses that cater to specific types of engineers, or sub-disciplines in engineering, but not to all, let alone involve active engagement with those from the fields of architecture and urban planning.

The program was conceived as an innovative offering that delivers sustainability training and education in an interdisciplinary environment. The training offered in this program is both broad and in-depth, and incorporates systems thinking, collaborative design, and exposure to economic and social perspectives in the context of roles that engineers, architects and urban planners must inevitably play in the coming decades in building a better world. Importantly, as part of the planning process for this program, it was important to draw from the expertise of professors from across the Faculty and the university at large, to bring in outside expertise of practitioners, and to create added value to all partnering departments and schools. An essential part of this was a detailed business planning exercise in which it was essential that the program be financially sound, effective in using all available resources (e.g., personnel, space, facilities) and would reap important benefits (financial and otherwise) for the University, the Faculty, all partnering units, and, of course, TISED.

The Master's program structure (Figure 1) reflects our belief that engineering and design can be an important part of the solutions for climate change and many other sustainability challenges, but will only be effective when social, environmental, and economic ramifications are collectively assessed and accounted for. The 45-credit program (nominally, 15 credits would be completed in a single semester) has a core of eight required sustainability courses (27 credits) that provides a solid background in sustainability and systems thinking and trains students on important analytical skills. Existing expertise for teaching of the core content was mapped across the Faculty of Engineering, and tenure-track professors were hired to meet the needs for areas where there was insufficient availability or expertise. The broad learning of sustainability through the core courses is reinforced through six complementary courses (18 credits) centred around the four sustainability issues/domains, namely, renewable energy and energy efficiency, sustainable industrial processes, sustainable infrastructure; and sustainable urban development. The four complementary course streams are built from courses from multiple departments and schools of the Faculty of Engineering and relevant courses outside the Faculty may also be taken. Students can opt to complete six credits of research under supervision of TISED professors towards meeting the complementary course requirements. The first cohort of 20 students are expected to graduate at the end of 2025, with a second cohort being admitted in Fall 2025. At steady-state, the goal is to have 60 students admitted to the program each year.

The program's graduates will be able to analyse problems with systems-based frameworks using formulated sustainability metrics (e.g., life cycle assessments), work collaboratively in an interdisciplinary setting to understand the multiple paradigms of complex problems, and learn to integrate non-engineering disciplines into their sustainable engineering and design solutions. These skills will make them valuable contributors in their future organizations and in society.

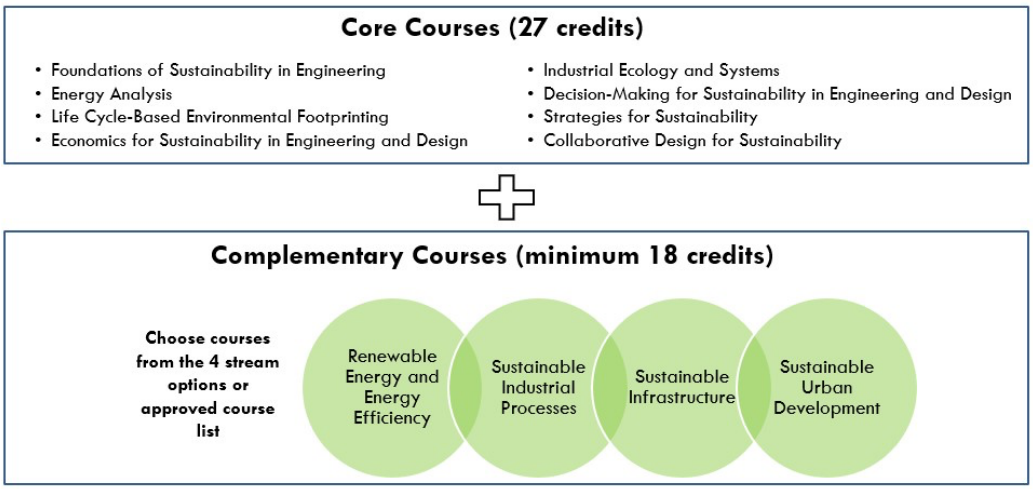

Figure 1. Program structure for the 45-credit M.Eng. in Sustainability in Engineering and Design at McGill University.