

# UTQAP Cyclical Review: Final Assessment Report and Implementation Plan

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## 1. Review Summary

<b>Programs Reviewed:</b>	Chemical Engineering, BAsC Chemical Engineering and Applied Chemistry, MEng, MASc, PhD
<b>Unit Reviewed:</b>	Department of Chemical Engineering & Applied Chemistry
<b>Commissioning Officer:</b>	Dean, Faculty of Applied Science and Engineering
<b>Reviewers (Name, Affiliation):</b>	<ul style="list-style-type: none"><li>• Peter Englezos, Professor and former Chair, Chemical &amp; Biological Engineering, University of British Columbia</li><li>• P. James McLellan, Professor and former Chair, Chemical Engineering, Queen's University</li><li>• Christopher K. Ober, Professor and former interim Dean, Materials Science &amp; Engineering, Cornell University</li><li>• Viviane Yargeau, Professor and Chair, Chemical Engineering McGill University</li></ul>
<b>Date of Review Visit:</b>	June 8-14, 2021 (conducted remotely)
<b>Date Reported to AP&amp;P:</b>	April 12, 2022

## Previous UTQAP Review

Date: March 3-4, 2016

### Summary of Findings and Recommendations

#### 1. Undergraduate Programs

The reviewers observed the following **strengths**:

- Strong reputation and diverse student population
- Department does excellent job of developing students' skills and attitudes for effective leadership, group work, and communication
- Faculty are actively engaged and committed to modernizing the curriculum
- Graduates enter a wide array of careers

The reviewers made the following **recommendations**:

- Undergraduates have a great deal of experiential and lab work, but may have less time for research activity

#### 2. Graduate Programs

The reviewers observed the following **strengths**:

- Impressive caliber of research and educational programs
- Collegial atmosphere creates a safe and productive environment
- Concerted effort to provide opportunities for students to engage in professional development activities
- Department is proactive in monitoring student progress

The reviewers made the following **recommendations**:

- Track Ph.D. student outcomes and continue to prepare students for diverse career pathways
- Develop specific achievement indicators for research-based graduate degrees

#### 3. Faculty/Research

The reviewers observed the following **strengths**:

- Bold, ambitious research vision and research directions relevant to society
- Remarkable levels of funding and success in landing competitive grants
- Encouragement and reward for collaborative research with other academic units within the Faculty and University promotes interdisciplinary efforts

#### 4. Administration

The reviewers observed the following **strengths**:

- Very high morale, fostered by positive leadership
- Very good facilities, with excellent scientific equipment and well-run labs
- Ambitious and visionary five-year plan draft that clearly aligns with the Faculty

and University planning documents

- Department compares very well with the top 30 or 40 chemical engineering departments in the world

The reviewers made the following **recommendations**:

- Continue successful work in diversifying the student population
- Prioritize the departments' strategic goals
- Create stronger relationships with alumni and encourage department's Board of Advisors to assist with integrating professional development into Ph.D. program, as well as with further advancement activities

**Last OCGS review(s) date(s):**

## Current Review: Documentation and Consultation

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### Documentation Provided to Reviewers

Terms of reference; self-study; previous review report including the administrative response; access to all course descriptions; access to the curricula vitae of faculty; PPTs of Faculty and ChemE overviews; FASE Academic Plan, 2017-2022; FASE Annual Impact Report, 2020-2021. Views of the Canadian Engineering Accreditation Board regarding the 2018 accreditation review of the chemical engineering program are appended to the self-study.

### Consultation Process

The review team met with the FASE Dean and academic leadership team; ChemE Chair and academic leadership team; ChemE faculty; undergraduate and graduate students; administrative staff and senior program administrators; as well as heads of relevant FASE cognate units as determined by the commissioning officer.

## Current Review: Findings and Recommendations

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### 1. Undergraduate Program

*Unless otherwise noted, all bulleted comments apply to all programs reviewed.*

The reviewers observed the following **strengths**:

- Overall quality
  - ▶ Strong evidence of department's commitment to providing an excellent education to the nearly 500 undergraduate students
  - ▶ Undergraduate program re-accredited by CEAB in 2019 for maximum six-year term (extended to 2026, due to pandemic)

- Objectives
  - ▶ Undergraduate program expectations are well thought out
  - ▶ Degree level expectations have been judiciously mapped to CEAB graduate attributes
- Admissions requirements
  - ▶ Undergraduate program attracts excellent students
  - ▶ First year class size is in line with targets
- Curriculum and program delivery
  - ▶ Program offers a modern curriculum rich in hands-on learning opportunities, and develops design, teamwork and communications skills
  - ▶ Recent curriculum updates offer students opportunity to prepare well for traditional and new industries and services
  - ▶ Teaching-stream faculty have made tangible positive contributions to learning environment, in particular supporting substantial second and third year lab courses
  - ▶ Laboratory component of program is very strong
  - ▶ “In addition to a set of well prescribed wet and dry labs, the integration of an industrial biodiesel process within the curriculum is a highlight of recent developments”
  - ▶ Capstone design course has been revised to ensure that workload is reasonable
- Innovation
  - ▶ Availability of minors and certificates is unique relative to similar programs at other Canadian and international universities
- Accessibility and diversity
  - ▶ Over 30% of students are international, and the percentage of women in the program has reached 50%; next focus area is to increase intake of Black and Indigenous students
- Student engagement, experience and program support services
  - ▶ PEY Co-op program is popular and has high participation
  - ▶ Students appreciate flexibility that minors and certificates provide in tailoring their education
  - ▶ Students value opportunities to gain work experience, and networking connections and insights that CONNECT provides
  - ▶ Students appreciate faculty efforts to adapt and teach effectively during pandemic
- Quality indicators – alumni
  - ▶ Graduates find employment in a wide array of traditional and emerging industries, or continue on to graduate education or professional programs

The reviewers identified the following **areas of concern**:

- Curriculum and program delivery
  - ▶ Number and timing of courses in program’s core structure can make it challenging to pursue minors and certificates without taking extra time in the program
- Assessment of learning
  - ▶ Larger numbers of projects associated with many courses can exacerbate workload challenges

- Student engagement, experience and program support services
  - ▶ Students express desire for more international exchanges, however, note challenges with scheduling around major lab courses in second and third year
  - ▶ Some concerns expressed about workload in second and third years of program, which have been further exacerbated by COVID
- Student funding
  - ▶ Students expressed concerns around recent PEY fee increase

## 2. Graduate Program

*Unless otherwise noted, all bulleted comments apply to all programs reviewed.*

The reviewers observed the following **strengths**:

- Overall quality
  - ▶ Graduate program attracts excellent students and offers opportunities to engage in world class research with award winning faculty
  - ▶ Department is at forefront of research in life science, energy and the environment
- Objectives
  - ▶ Department has articulated broad objectives and takes into consideration technical and scientific knowledge complemented by critical thinking, communication and leadership skills, so that graduates have a wide spectrum of career opportunities
  - ▶ Specific degree level expectations consist of five common outcomes for the three graduate degrees (PhD, MAsc, MEng), with sixth expectations around research and scholarship for research students, and methodologies for MEng students
- Admissions requirements
  - ▶ Department engages in targeted campaigns to recruit excellent graduate students
  - ▶ Number of MEng students has increased in recent years
  - ▶ Department aims to have 40% of student population comprised of graduate students
- Curriculum and program delivery
  - ▶ Course offerings are broad and include a course on chemical engineering fundamentals for nonchemical engineers, and a suite of fundamental courses and courses in emerging fields like data science, sustainable processing, biomanufacturing and soft materials
- Accessibility and diversity
  - ▶ Excellent, diverse student population
  - ▶ Clear departmental commitment to further improve diversity, with focus on enhanced Black and Indigenous representation, and aims to increase percentage of women beyond current level of 30%
- Assessment of learning
  - ▶ Department has the administrative structure and support in place to monitor student progress
  - ▶ Newly introduced individual development plans offer opportunities to systematically monitor student learning, well-being and job skills development

- Student engagement, experience and program support services
  - ▶ Recent introduction of 'individual development plan' is expected to benefit graduate students in a number of ways
  - ▶ Strong start-up community provides opportunities for graduate students to develop entrepreneurial skills
- Student funding
  - ▶ Recent reduction in international fees has removed a barrier to attract excellent international students

The reviewers identified the following **areas of concern**:

- Admissions requirements
  - ▶ Number of PhD students remained constant in recent years, and that of MASc students has declined
- Quality indicators – graduate students
  - ▶ Reduction of average time to completion is an ongoing objective, and remains a continuing concern
- Student funding
  - ▶ Graduate student funding relative to cost of living in Toronto identified as significant concern, along with a desire for more clarity in funding support for each student
  - ▶ Some concerns expressed about finding minimum guaranteed TA support hours

The reviewers made the following **recommendations**:

- Objectives
  - ▶ Given that graduate degree level expectations were adopted Faculty-wide in 2011, reviewers encourage reflection on their success and/or need for updates
- Admissions requirements
  - ▶ With regard to plans for growth of graduate student population to 40% of students, department will need to consider optimal balance of research/MEng students, and remain mindful of EDI objectives
- Curriculum and program delivery
  - ▶ Students express desire for statistics/design of experiments/data analysis course tailored to chemical engineering needs, which reviewers note would complement existing or planned machine learning and AI courses
- Quality indicators – graduate students
  - ▶ Reviewers recommend examining and regularly monitoring student progress data in greater detail to identify any specific reasons why some theses take longer to complete
- Student funding
  - ▶ Would be helpful to clarify at start of Fall term how support will be paid out throughout the year, to help with student budgeting
  - ▶ Reducing time to completion may help alleviate challenges in graduate student support by freeing up research funds to support new, incoming students

- ▶ Any steps the department can take to help clarify understanding around graduate funding and to facilitate planning for graduate students “will be very much appreciated, and will reduce associated stresses of making ends meet”

### 3. Faculty/Research

The reviewers observed the following **strengths**:

- Overall quality
  - ▶ “a number of key university leadership positions at the FASE and university level are led by faculty from Chemical Engineering & Applied Chemistry, which is testament to the strong leadership potential in the department”
  - ▶ “The culture of collaboration and presence of shared facilities are enabling and attractive characteristics and facilitate the recruitment, integration and fast onboarding of new hires”
  - ▶ Quality and extent of research output places department amongst best in the world
- Research
  - ▶ Several faculty lead interdisciplinary initiatives of Faculty- and institute-wide importance (SOCAAR, OCCAM, BioZone, CRAFT and others), showing strong leadership in research
  - ▶ Reviewers commend faculty for “being willing to think big in pursuit of the programs of research”, noting high levels of funding per PI relative to Faculty-wide average
  - ▶ Multidisciplinarity of research is prominent and offers stimulating training environment for graduate students
  - ▶ Researchers in department (and FASE more broadly) perform well in NSERC Discovery Grant competitions
- Faculty
  - ▶ Department has been able to hire outstanding new faculty in recent years
  - ▶ Upcoming retirements viewed as opportunity to bring in expertise in AI, Biomanufacturing and Sustainability

The reviewers made the following **recommendations**:

- Faculty
  - ▶ It will be important to develop clear career paths (assessment/support/resourcing and expectations) for teaching stream faculty, in order to support impactful and rewarding careers
  - ▶ “Hiring faculty with AI expertise will provide new, potentially game changing capabilities to the department”

## 4. Administration

The reviewers observed the following **strengths**:

- Relationships
  - ▶ Department functions in cohesive manner, and is viewed by other units as very collegial, with engaged professoriate and committed faculty and staff
  - ▶ Department has functioned well under current leadership; widespread recognition of chair's supportive, proactive, transparent and effective approach
  - ▶ Students are proud to be part of department and feel part of a strong community
  - ▶ Students expressed appreciation for instructor and staff support during COVID
  - ▶ Staff feel their work is appreciated by department leadership and faculty
  - ▶ Collegial environment provides ample opportunities for faculty collaboration in pursuit of research opportunities
  - ▶ Strong support for collaborative initiatives such as BioZone, SOCAAR, and OCCAM
  - ▶ Clear commitment to increasing collaboration with industry, and impressive ongoing start-up community
  - ▶ New partnerships with National Research Council (CRAFT and CC-GEM) offer interesting possibilities
  - ▶ Department has active board of advisors that recognizes fundraising as a key activity
  - ▶ Alumni appreciate connections and insights that 'Department Dinners' offer, and stay in touch with department through U of T Engineering CONNECT
  - ▶ Through service contributions of faculty, department has contributed significantly to development of chemical engineering profession in Canada
- Organizational and financial structure
  - ▶ Department appears well-financed and operations run well
  - ▶ New Director of Facilities position identified as a welcome addition
  - ▶ Presence of an Associate Chair, Research sends a strong message about the importance of research in the department
  - ▶ Sustainability lab a welcome addition; expected to catalyze further collaborations and student engagement in sustainability research
  - ▶ "Access to space [for faculty] does not seem problematic and is facilitated through the collaborative environment"
  - ▶ Reviewers commend Dean's Strategic Fund initiative, which is key source of funding for several departmental initiatives
- Long-range planning and overall assessment
  - ▶ Department continues to be a national and global leader in chemical engineering research and academic programs at the undergraduate and graduate levels
  - ▶ Department noted for being proactive in assessing opportunities to enhance teaching based on COVID experience, and adapting courses (notably including labs) quickly for online delivery
  - ▶ Proposed combined BAsC+MASc program is expected to enhance research opportunities for UG students, and to recruit talented graduate students



- ▶ Department continues to look for new revenue streams and resource generation, including growth of graduate student body, partnerships with industry and government, and creation of new research capabilities in the form of shared facilities
- ▶ Department has been reflecting on future directions in practice of chemical engineering in Canada and globally, as field undergoes major transitions
- International comparators
  - ▶ Quality and extent of research output department places department amongst world's best
  - ▶ Department's profile compares very favourably to those of top-rated state schools in the United States with strong engineering programs

The reviewers identified the following **areas of concern**:

- Relationships
  - ▶ Work-life balance in the post-COVID era identified as a particular concern for staff
- Organizational and financial structure
  - ▶ "Network cybersecurity remains a concern, posing challenges between providing connectivity while maintaining security"
  - ▶ Concerns expressed about ventilation in the pilot plant [Unit Operations Lab]: "ventilation/electrical issues in the old building are an ongoing challenge that limits the extent of experiments in the undergraduate labs and is not at par with the excellence in research that is carried out by the department's faculty in general"

The reviewers made the following **recommendations**:

- Organizational and financial structure
  - ▶ Maintaining and building on current strong collegial structure will be an important consideration in selecting a new Chair
  - ▶ "The pilot plant facilities contribute significantly to the undergraduate program, and have potential to contribute to research and research integration in undergraduate programming, but the facility will require adequate ventilation to ensure it can be used to maximum impact"
  - ▶ Appropriate resolution to ventilation/electrical concerns may require effort at all levels of the University, given capital likely required to retrofit an older building
- Long-range planning and overall assessment
  - ▶ "The expansion to biomanufacturing is perhaps a generational opportunity for the department's science excellence and world leading research"
  - ▶ Reviewers recommend that department include development of a graduate student stipend support fund as an advancement goal

## 2. Administrative Response & Implementation Plan



UNIVERSITY OF TORONTO  
FACULTY OF APPLIED SCIENCE & ENGINEERING

January 24, 2023

Professor Susan McCahan  
Vice-Provost, Academic Programs  
University of Toronto  
27 King's College Circle

Dear Professor McCahan,

I write in response to your letter of March 15, 2022 regarding the June 2021 external review of the Department of Chemical Engineering & Applied Chemistry (ChemE) and its undergraduate and graduate programs.

The external review process is a valuable exercise that affords us the opportunity to take stock of the state of our academic units and of the Faculty as a whole. We are extremely pleased with the reviewers' description of the department as a "national and global leader in chemical engineering research and academic programs," with an excellent and diverse population of students and supportive, proactive, transparent and effective leadership.

The quality of this program notwithstanding, the review report raises a number of issues and challenges. These have been addressed in the attached table, which was developed in consultation with the chair of the Department of Chemical Engineering & Applied Chemistry. For each area addressed, I have provided an implementation plan that identifies actions to be accomplished in the short (six months), medium (one to two years) and longer (three to five years) terms, and who (department, Dean) will take the lead in each area. I have also identified any necessary changes in organization, policy or governance where appropriate; any resources, financial and otherwise, that will be provided, and who will provide them.

My office provided comments on the draft *Final Assessment Report and Implementation Plan* on January 19, 2023.

I anticipate the next review of the Department of Chemical Engineering & Applied Chemistry will be in 2025-2026 to coincide with end of the chair's term. Chairs and directors in FASE are expected to report on progress made toward their external review goals at least annually at a meeting of the chairs and directors, which I chair.

I acknowledge that you will request a brief report midway between the 2020-2021 review and the year of the next site visit.

I also confirm that I will attend the February 16, 2023 meeting of the Committee on Academic Policy & Programs to answer any questions that may arise regarding this review.

Thank you very much for the opportunity to respond to the report of the external review team. Their comments and recommendations will help inform the vision and future priorities for the Department of Chemical Engineering & Applied Chemistry.

Sincerely,

A handwritten signature in black ink, appearing to read "Chris Yip".

Chris Yip  
Dean

cc:

Ramin Farnood, Chair, Department of Chemical Engineering & Applied Chemistry  
Craig Steeves, Acting Vice-Dean, Graduate Studies, Faculty of Applied Science & Engineering  
Tom Coyle, Vice-Dean, Undergraduate, Faculty of Applied Science & Engineering  
Caroline Ziegler, Faculty Governance and Programs Officer, Faculty of Applied Science & Engineering  
Daniella Mallinick, Director, Academic Programs, Planning and Quality Assurance  
David Lock, Coordinator, Academic Planning and Reviews  
Emma del Junco, Acting Coordinator, Academic Planning and Reviews  
Alexandra Varela, Assistant Coordinator, Academic Planning and Reviews

## 2020-21 UTQAP Review of FASE Department of Chemical Engineering & Applied Chemistry – Administrative Response

Appended to January 24, 2023 letter from FASE Dean Chris Yip to Vice-Provost, Academic Policy & Programs, Susan McCahan

Request Prompt	Rec. #	Program Response	Dean's Response
<p>The reviewers commented on undergraduate student concerns regarding workload, noting in particular the “substantial laboratory courses in the second and third years of the program” and the large number of projects; students also commented that the number and timing of their courses makes it challenging to pursue minors/certificates and international exchanges.</p>	1	<p><i>Immediate action (6 months)</i></p> <ul style="list-style-type: none"> <li>• ChemEng created a new leadership position in ChemEng: “Associate Chair Undergraduate Curriculum Development” with the mandate to address these curriculum issues and to modernize our curriculum (a strategic academic priority for the Department). Professor Will Cluett has been appointed the inaugural Associate chair.</li> </ul> <p><i>Medium term action (1-2 years)</i></p> <ul style="list-style-type: none"> <li>• We will begin the process of consultation on curriculum in the 2022-23 academic year.</li> <li>• By engaging the Office of Vice-Provost Academic Programs, the Office of Vice-Dean Undergraduate Studies, and the Institute for Studies in Transdisciplinary Engineering Education &amp; Practice, we aim to complete our curriculum planning in 2023-24.</li> <li>• The Departmental Curriculum Committee will review laboratory contact hours in the 2<sup>nd</sup> and 3<sup>rd</sup> year with the goal of reducing contact time.</li> </ul> <p><i>Longer term action (3-5 years)</i></p> <ul style="list-style-type: none"> <li>• We will roll out the new curriculum following the CEAB accreditation process.</li> </ul>	<p>The approaches that Chemical Engineering has implemented with respect to these points are quite strategic and timely. The appointment of a senior faculty member with significant academic leadership and curriculum development experience as Associate Chair is excellent.</p>
<p>The reviewers noted undergraduate student concerns regarding the recent PEY fee increase. <i>(Note: In your response, you may wish to comment on potential issues of equity/access, and how the Faculty may provide support for students interested in PEY for whom the fee is a barrier.)</i></p>	2	<p><i>Immediate action (6 months)</i></p> <ul style="list-style-type: none"> <li>• ChemE created a new leadership position: “Associate Chair Undergraduate Student Experience” with the mandate to continuously improve the quality of student experience. Professor Jennifer Farmer has been appointed the inaugural associate chair.</li> <li>• With support from the Engineering Career Centre ( ECC), develop a communication plan to emphasize the value of additional services and benefits that are provided to improve student experience.</li> </ul>	<p>The Faculty has been working on strategies to help address the ECC fee increase, including philanthropy and other approaches. Many of these approaches are already in active development by the ECC and are being implemented in conjunction with the Tri-Campus Partnership.</p>

		<ul style="list-style-type: none"> <li>• With support from the Registrar’s Office, develop a process to monitor the percentage of students who may not be able to access ECC services due to financial barriers.</li> </ul> <p><i>Medium term action (1-2 years)</i></p> <ul style="list-style-type: none"> <li>• With ECC support, develop a service quality survey for students who completed their PEY.</li> <li>• With Dean’s support, create financial support mechanisms for students who are in need.</li> <li>• With support from ECC &amp; MITACS, create additional paid summer internship opportunities for 2nd year students.</li> </ul> <p><i>Longer term action (3-5 years)</i></p> <ul style="list-style-type: none"> <li>• With ECC support, increase the percentage of PEY students who choose international destinations.</li> <li>• Examine the feasibility of ChemE academic advisor for PEY students.</li> </ul>	
The reviewers noted graduate students’ desire for additional courses on statistics, data analysis, and design of experiments, and commented that this material would complement existing or planned courses in machine learning and artificial intelligence.	3	<p><i>Immediate action (6 months)</i></p> <ul style="list-style-type: none"> <li>• We offer a relevant Research Methods course that is required for all graduate students and teaches design of experiments.</li> <li>• A list of data science courses available to our graduate students is available.</li> </ul> <p><i>Medium term action (1-2 years)</i></p> <ul style="list-style-type: none"> <li>• A technical elective currently offered to our 4th year students on Data Analytics will be expanded to a 1000-level course to allow graduate students to benefit.</li> <li>• We have recruited two new faculty members in the areas of AI/ML that will enhance our ability to provide additional course in data science.</li> </ul>	These are excellent strategies for Chemical Engineering. It would be important to ensure that complementarity with course offerings by other departments in FASE or across the institution is clear.
The reviewers commented that reduction of graduate students’ time-to-completion is an ongoing objective and a continuing concern; they recommended monitoring graduate student progress to identify possible reasons for longer time-to-completion rates.	4	<p><i>Immediate action (6 months)</i></p> <ul style="list-style-type: none"> <li>• The Individual Development Plan (IDP) is now introduced to all research-stream graduate students in the Research Methods course. We encourage students and faculty to use this to improve the professional relationship between student and supervisor.</li> <li>• We reduced the number of required courses for PhD students by one.</li> </ul>	These are good strategies for helping reduce the time to completion. Enforcing the annual committee meeting and timely follow-up is important and one that is being addressed FASE-wide as this is a consistent challenge across all departments and institutes. The adoption of the IDP in alignment with the SGS Healthy Labs initiative guidelines is an important step forward.

		<ul style="list-style-type: none"> <li>• We eliminated the “Fundamental” description of some of our courses and the need to take one of these courses to provide PhD students with more flexibility in course selection.</li> </ul> <p><i>Medium term action (1-2 years)</i></p> <ul style="list-style-type: none"> <li>• We are changing our department culture such that going directly to the final oral exam (vs having a departmental exam first) is the norm. This should help in the time to completion.</li> <li>• Students often miss their annual PhD committee meetings, which leads to miscommunication. The annual PhD committee meeting will become a CR/NCR course in which all students need to enroll to help us keep track of those who are falling off track.</li> </ul>	
<p>Noting graduate student concerns regarding funding packages relative to the cost of living in Toronto, the reviewers recommended clearer and earlier communication regarding the structure, amount, and scheduling of student financial support for each academic year; they also recommended including the development of a graduate student stipend support fund as an advancement goal.</p> <p><i>(Note: in developing your response you may wish to consult with SGS or refer to the SGS Funding Principles for Graduate Units.)</i></p>	5	<p><i>Immediate action (6 months)</i></p> <ul style="list-style-type: none"> <li>• We’ve had a series of meetings with our graduate students and our professors addressing the graduate student stipend.</li> <li>• For 2022-2023, we have planned an increase in graduate student stipends of \$2,000, shared equally between the supervisor and the Department.</li> <li>• We are streamlining our communication with graduate students and professors with the goal of being more transparent and forthcoming in terms of graduate student financial support.</li> </ul> <p><i>Medium term action (1-2 years)</i></p> <ul style="list-style-type: none"> <li>• For 2023-2024 (and beyond), we will divide our Departmental Awards differently such that a large number of our PhD students in the funded cohort get approximately \$3,000 as a bonus to their stipend.</li> <li>• With the support of FASE Advancement, secure additional endowment to ensure all graduate students in the funded cohort will receive the above \$3,000 award.</li> <li>• The Graduate Studies Committee will develop a plan for additional base increases to MASc and PhD stipends for students in the funded cohort. This plan will be presented for discussion and ratification by our academic staff.</li> </ul>	<p>The need to increase graduate student stipends is acute and has been recognized across the Faculty. The Faculty is working proactively with all departments and institutes to develop a unified plan around increasing stipends. As a strategic priority, FASE Advancement is working to increase support for graduate student stipends and fellowships.</p>

<p>Regarding plans for graduate program expansion, the reviewers encouraged careful consideration of the optimal balance of research and professional programs, the Department's equity and diversity objectives, and the feasibility of providing adequate student funding for additional students.</p>	<p>6</p>	<p><i>Immediate action (6 months)</i></p> <ul style="list-style-type: none"> <li>• Our professional MEng program is significantly smaller than comparable units within Engineering, so we are comfortable with our plans for expansion.</li> <li>• ChemE created a new leadership position: "Associate Chair Continuing Professional Development (CPD)." Professor Charles Jia has been appointed the inaugural associate chair.</li> <li>• The Office of Continuing Professional Development will focus on enhancing and expanding our professional development programs by building our Master of Engineering (MEng) curriculum and to better serve our MEng students and oversee the balanced expansion of our MEng program.</li> <li>• The IDP encourages communication with PIs and students and is now a requirement at the PhD committee meetings.</li> </ul> <p><i>Medium term action (1-2 years)</i></p> <ul style="list-style-type: none"> <li>• For EDI, we plan to conduct a survey to better understand the health and inclusivity of our research laboratories. This will set a baseline for future surveys.</li> <li>• The MEng Admissions Committee is tasked for setting the targets as well as developing new professional development programs</li> <li>• MEng Admissions Committee will develop a plan for MEng expansion as well as new continuing development courses for review by the leadership team and the department.</li> </ul>	<p>It will be important to carefully manage the MEng program expansion, including student expectations and opportunities. These can be quite strategic opportunities when managed well. The Department is encouraged to work closely with the other FASE units that have seen growth of their MEng programs. There are particularly strategic theme areas in Chemical Engineering for which an MEng program could be very well positioned, including biomanufacturing and sustainability.</p>
<p>The reviewers commented on the importance of establishing clear career paths for teaching stream faculty, noting in particular the need for clearly defined criteria for assessment of Renewal, Tenure and Promotion.</p> <p><i>(Note: in your response you may wish to confirm the defined criteria with the Office of the Vice-Provost, Faculty &amp; Academic Life.)</i></p>	<p>7</p>	<p><i>Immediate action (6 months)</i></p> <ul style="list-style-type: none"> <li>• All our faculty members, in particular our teaching stream faculty, were invited to participate in the consultation for preparing the <i>FASE Guidelines for the Assessment of Effectiveness of Teaching in Tenure, Continuing Status and Promotion Decisions</i>.</li> <li>• Copies of this guideline were distributed among teaching stream faculty members and discussed at one-on-one meetings between teaching stream faculty members and the Chair.</li> </ul> <p><i>Medium term action (1-2 years)</i></p> <ul style="list-style-type: none"> <li>• Use the above guideline in PTR review for assessing and providing feedback to our teaching stream faculty members</li> </ul>	<p>The <i>FASE Guidelines for the Assessment of Effectiveness of Teaching in Tenure, Continuing Status and Promotion Decisions</i> were ratified by the Faculty Council on April 27, 2022 and will be implemented for the promotion of CS faculty members.</p> <p>The Faculty will be considering <i>FASE Best Practices for Assessing Teaching Effectiveness in PTR Decisions</i> at its February 27, 2023 Council meeting for ratification.</p>

		<ul style="list-style-type: none"> <li>• Apply the above guidelines in mid-term review of our newly hired teaching stream faculty member</li> <li>• Examine and, if needed, refine our Workload Policy and Procedures to be consistent with the above guideline.</li> </ul> <p><i>Longer term action (3-5 years)</i></p> <ul style="list-style-type: none"> <li>• Apply the above guidelines in senior promotion review of teaching stream faculty members.</li> </ul>	
<p>The reviewers commended the Department's revised list of key research areas, and recommended that they be linked to faculty innovation clusters.</p>	8	<p><i>Immediate action (6 months)</i></p> <ul style="list-style-type: none"> <li>• Establish a ChemE-FASE research partnerships committee involving Faculty's research partnership staff. The committee meets monthly to better align department's and Faculty's efforts and to synergize modes of engagement with external partners (e.g., companies, municipalities, not-for-profits). (completed)</li> <li>• Highlight ChemE research centres within FASE research clusters (e.g., OCCAM in Advanced Manufacturing; BioZone in Sustainability, IWI in Water).</li> <li>• Ensure key research terms on ChemE webpage are included in "Find an Expert" word search from FASE.</li> <li>• Update "Find an Expert" for each FASE cluster to ensure inclusion of all relevant ChemE PIs.</li> </ul> <p><i>Medium term action (1-2 years)</i></p> <ul style="list-style-type: none"> <li>• Better integrate department's biomanufacturing initiative with Faculty's Advanced Manufacturing Innovation Cluster.</li> <li>• Create or reinforce pathways to share announcements/ communications and promote linkages between department's research themes and Faculty's Innovation Clusters (IC): <ol style="list-style-type: none"> <li>1. Environment/bio-based materials manufacturing (ChemE) with Advanced Manufacturing IC (FASE)</li> <li>2. Environment/remediation and water treatment (ChemE) with Water IC (FASE)</li> <li>3. Environment (ChemE) with Sustainability IC (FASE)</li> <li>4. Energy (ChemE) with Sustainability IC (FASE)</li> <li>5. Foundations (ChemE) with Data Analytics &amp; AI IC (FASE)</li> <li>6. Health (ChemE) with Human Health IC (FASE)</li> </ol> </li> </ul>	<p>These strategies are well aligned with the Faculty's restructuring and resourcing of the Partnerships team as well as the creation of the Vice-Dean, Strategic position, and revised mandate of the Vice-Dean, Research. Chemical Engineering has a terrific opportunity to rebrand and communicate more proactively its core research resources and the Faculty is supportive of these approaches.</p>



		<p><i>Longer term action (3-5 years)</i></p> <ul style="list-style-type: none"> <li>Address gaps between FASE Innovation Clusters and ChemE research themes (e.g., the Robotics clusters currently lacks representation from ChemE).</li> </ul>	
The reviewers noted staff concerns regarding work/life balance in the post-pandemic era.	9	<p><i>Immediate action (6 months)</i></p> <ul style="list-style-type: none"> <li>We are encouraging support staff to return to in-person while at the same time acknowledging personal needs.</li> <li>Our aim is to approach pre-pandemic in-person operation by September 2022 in order to better serve our students, and to provide opportunity for our newly hired staff to rekindle the engaged community in ChemE of which we are proud. (Staff hired during or shortly before the pandemic did not have an opportunity to work closely together in the workplace.)</li> <li>Monthly meetings will be organized for the support staff to meet the Chair.</li> <li>Support staff will be invited to participate in the departmental meetings to share their views and concerns.</li> </ul> <p><i>Medium term action (1-2 years)</i></p> <ul style="list-style-type: none"> <li>In collaboration with the Division of People Strategy, Equity and Culture, organize workshops for work-life balance for our support staff and faculty members.</li> </ul>	This is an area for which it will be important to maintain clear and open lines of communication around expectations and balance.
The reviewers observed that ventilation and electrical issues in the Unit Operations Lab constrain the pedagogical effectiveness of the facility, limiting the extent of experiments that can be carried out; they noted that the space is “not at par with the excellence in research that is carried out by the department’s faculty in general.”	10	<p><i>Immediate action (6 months)</i></p> <ul style="list-style-type: none"> <li>Departmental Space Committee and Department’s Unit Operation Laboratory Working Group are tasked with developing a plan and overseeing its implementation</li> <li>Meetings have been held with the University’s Facilities &amp; Services (F&amp;S) (Gord Robins and Jelena Vulovic-Basic) to develop the response outlined below.</li> <li>There was a feasibility study completed in 2021 for this space. In the next 6 months, confirm if the user requirements have significantly changed and if the feasibility study needs to be updated: <ol style="list-style-type: none"> <li>Review experimental plan with Teaching Laboratory Committee, identifying which chemicals (and quantities) and equipment (and their utility needs) would be used in the upgraded Unit Operations Lab.</li> <li>Review experimental plan with EHS to determine suitable design parameters (e.g., required ventilation rates).</li> </ol> </li> </ul>	The Faculty will identify similar facilities at other institutions and their contacts for determining design parameters.

		<p>3. Compare design parameters with similar laboratories at other institutions if data is obtainable.</p> <ul style="list-style-type: none"> <li>• Working with F&amp;S, update feasibility study if required.</li> <li>• Based on the feasibility study (existing or updated), F&amp;S and the Department to confirm scope, schedule and cost, and create the execution plan, cash flow requirements and funding sources.</li> <li>• Identify funding available for the design if not for construction.</li> <li>• Guidance and support from the highest levels of UofT F&amp;S needed for this complex project.</li> </ul> <p><i>Medium term action (1-2 years)</i></p> <ul style="list-style-type: none"> <li>• Submit Request for Project Services</li> <li>• Draft Project Planning Report</li> <li>• Obtain CaPS approval for design</li> <li>• Secure funding for construction</li> <li>• Begin design for both HVAC and electrical needs, including new transformers to serve the whole building as an alternate price item</li> <li>• Obtain CaPS approval for construction</li> <li>• Complete design, tender and award construction of project</li> <li>• Start procuring new laboratory equipment.</li> <li>• Complete construction: <ol style="list-style-type: none"> <li>1. Complete testing and commissioning.</li> </ol> </li> </ul> <p><i>Longer term action (3-5 years)</i></p> <p>Continue developing new experiments as the state of the art in industry evolves.</p>	
Improving TA administration processes.	11	<p>A survey of graduate students conducted in May 2022 by CEGSA identified issues related to TA administration that required attention.</p> <p><i>Immediate action (6 months)</i></p> <ul style="list-style-type: none"> <li>• A Task Force for TA administration was formed with the mandate to review our existing practices for TA administration, examine best practices, and provide recommendations to address the issues. Task Force membership included a graduate student representative.</li> </ul>	

		<ul style="list-style-type: none"> <li>• Task Force recommendations will be provided to the Chair by the end of July 2022. This plan will be reviewed by the department leadership and an implementation plan will be developed by August 2022.</li> <li>• The outcome of the Task Force for TA Administration may require hiring new staff or revising existing JDs</li> <li>• New TA administration process will be rolled out.</li> </ul>	
<p>Enhancing MEng students experience and our professional program.</p>	<p>12</p>	<p>In consultation with CEGSA and MEng students, there was a clear need to create a more streamlined MEng student support and program offerings. In addition, there are emerging opportunities to expand our professional program beyond MEng.</p> <p><i>Immediate action (6 months)</i></p> <ul style="list-style-type: none"> <li>• ChemE created a new leadership position: “Associate Chair Continuing Professional Development (CPD).” Professor Charles Jia has been appointed the inaugural associate chair and will focus on enhancing and expanding our professional development programs by building our Master of Engineering (MEng) curriculum.</li> <li>• Office of Continuing Professional Development (OCPD) has been established to improve our MEng students experience as well as support the expansion of the professional development program.</li> <li>• OCPD will support the VD-Graduate with the launch of micro-credential in biomanufacturing.</li> <li>• A Department Professional Development Programs and Admissions Committee has been created, which will be chaired by AC-CPD and supported by a Professional Programs Coordinator.</li> </ul> <p><i>Medium term action (1-2 years)</i></p> <ul style="list-style-type: none"> <li>• MEng Admissions Committee was formed to set admissions targets and develop recruitment plan for MEng students.</li> <li>• Populating MEng Lab/Research Assistant Job program (~\$3,000 per year value to each participating student).</li> <li>• Creating a dedicated activity room for MEng students in ChemE.</li> <li>• Creating paid internship opportunities for MEng students in coordination with the Engineering Career Centre.</li> </ul>	

		<ul style="list-style-type: none"> <li>• Developing new courses and launching new MEng emphases, particularly those in partnership with the industry and other departments within FASE.</li> <li>• Increasing MEng enrolment.</li> </ul>	
Space renovation and expansion	13	<p>The department is expected to undergo a significant faculty renewal over the next five years, however, space limitations (mainly wet lab space) is expected to be a bottleneck. In addition, the Wallberg Building is an old building with significant deferred maintenance. In some cases (such as item 10, above), the deferred maintenance has limited our ability to provide the best educational experience for our students (undergraduate and graduate).</p> <p><i>Immediate term action (6 months)</i></p> <ul style="list-style-type: none"> <li>• Work with Facilities &amp; Services (F&amp;S) to develop a plan to resolve the electrical issues of the Wallberg Building.</li> <li>• Work with F&amp;S to resolve the noise issue related to our ventilation system that limits our ability to fully utilize the ventilation capacity installed during the SIF project.</li> <li>• Develop a plan for the creation of a Student Support Services Suite (S4 project), a physical space within Wallberg that brings together student support staff.</li> <li>• We need urgent support from the Centre to address deferred maintenance issues.</li> </ul> <p><i>Medium term action (1-2 years)</i></p> <ul style="list-style-type: none"> <li>• Implement the plan developed for Wallberg electrical and ventilation issues.</li> <li>• Develop a space plan that is linked with faculty renewal / hiring plan</li> <li>• Support the Faculty to develop an infrastructure plan (a new research tower for engineering)</li> <li>• Work with FASE Advancement to secure funding for the S4 project.</li> <li>• Financial support from UofT's deferred maintenance fund and from the Faculty will be necessary.</li> <li>• Advancement \$ is required for the S4 project.</li> </ul> <p><i>Longer term action (3-5 years)</i></p> <ul style="list-style-type: none"> <li>• Develop a plan to reorganize the research space within Wallberg.</li> </ul>	Support from the University to address deferred maintenance issues will be required, as will financial support from U of T's deferred maintenance fund and the Faculty.

### **3. Committee on Academic Policy & Programs (AP&P) Findings**

The spokesperson for the reading group reported that the review summary accurately described the full review and that overall, they had found the review to be positive. The reading group reported that the Dean's administrative response had adequately addressed issues identified by the review, however, asked the Department to further comment on the topic of curriculum consultation, a PEY fee increase, low funding for students, improving TA administration and space issues.

Professor Ramin Farnood, Chair, Dept. of Chemical Engineering & Applied Chemistry addressed the questions:

- The Curriculum consultation was ongoing and would include stakeholders outside the University, such as alumni and employers.
- Bursary supports were forthcoming to help students with the PEY fee increase and fees were staged over the course of four years in the program.
- As of this current academic year, students who had completed their qualifying exams were required to register annually in a credit/no credit course to support timely progress on their theses. Focused attention and communication to improve education and culture change to encourage attention to time to completion.
- Stipend increase of \$2000, with another increase scheduled (split equally between faculty and Department).
- Ongoing improvement regarding TA administration, in partnership with Faculty administration and labour relations.
- A space working group had been established, prioritizing key infrastructure challenges.

No follow-up report was requested.

### **4. Institutional Executive Summary**

The reviewers praised the department as a “national and global leader in chemical engineering research and academic programs,” highlighting the excellent and diverse population of students and the department's commitment to further improving diversity; they noted that the modern undergraduate curriculum prepares students for both traditional and new industries, and the graduate program offers students the opportunity to engage in world-class research with award-winning faculty; they praised the chair's widely recognized leadership and the smooth running of departmental operations, strong internal and external relationships, and very high morale; they commented on the impressive start-up community and clear commitment to collaborative initiatives both internally and with industry; they commended the department for continuing to seek new revenue streams, for the outstanding new faculty hired in recent years, and for its significant contributions to the development of the chemical engineering profession in Canada; finally, they noted the students' appreciation of faculty efforts to adapt and teach effectively during the COVID-19 pandemic.

The reviewers recommended that the following issues be addressed: addressing undergraduate student concerns regarding workload, and the number and timing of their courses; engaging with undergraduate student concerns regarding the recent PEY fee increase; addressing graduate student desire for additional courses on statistics, data analysis, and design of experiments; monitoring graduate student progress and reducing time-to-completion; providing clearer and earlier communication regarding the structure, amount, and scheduling of graduate student financial support and exploring the development of a graduate student stipend support fund. The Dean's Administrative Response describes the Faculty, unit and programs' responses to the reviewers' recommendations, including an implementation plan for any changes necessary as a result.

## **5. Monitoring and Date of Next Review**

Chairs and Directors in the Faculty of Applied Science and Engineering are expected to report on progress made toward their external review goals at least annually at a meeting of the Chairs and Directors, chaired by the Dean.

The Dean will provide an interim report to the Vice-Provost, Academic Programs no later than midway between the 2020-2021 review and the year of the next site visit on the status of the implementation plans.

The next review will be commissioned in 2024-2025 with a review visit expected in 2025-2026.

## **6. Distribution**

On June 29, 2022, the Final Assessment Report and Implementation Plan was posted to the Vice-Provost, Academic Programs website and the link provided by email to the Dean of the Faculty of Applied Science and Engineering, the Secretaries of AP&P, Academic Board and Governing Council, and the Ontario Universities Council on Quality Assurance. The Dean provided the link to the Chair of the Unit.