EXECUTIVE SUMMARY

Significant change has occurred in the world’s social and economic order over the past decade. Globalization, technological advances, financial restructuring, climate change, and resource limitations are only a few of the factors demanding new and creative approaches to advancing the quality of life for all people. This presents the Faculty of Engineering at McMaster University with the unique opportunity to play an increased leadership role in guiding the changes that will shape the future. The following strategic plan was developed to guide the Faculty in this direction over the next five years and in keeping with the University’s primary strategic document, Refining Directions. Following is a summary of the key goals to be achieved by 2014.

Our Mission

The Faculty of Engineering at McMaster University is committed to the pursuit of excellence in teaching, research and service, and to fostering the quality of academic life.

Our Vision

The Faculty of Engineering at McMaster University will be known internationally as a leader in research and education supporting the development of engineering practices for a sustainable world.

The term “sustainability” is used widely and in a variety of contexts. Here we use this term rather broadly to mean the application of engineering in a socially responsible manner. The most obvious application of this relates to environmental sustainability and the development of eco-effective designs, processes and products. However, the term can be interpreted more broadly to include sustainable practices that provide greater access to goods and services (for example, in health care or communications technologies), more effectively and to more people. It also encompasses our desire to develop engineering methodologies that can sustain societies anywhere, leading to the concept of a Global Engineer.

STRATEGIC PLAN: 2009 – 2014

The Faculty’s existing and new competencies will provide the toolkit through which we will achieve the goals and objectives outlined in more detail in this plan. The plan itself is organized along five themes, three of which represent the pillars of undergraduate and graduate education along with research. The other two represent our commitment to greater external engagement – locally, nationally and internationally.

1. Enhancing Undergraduate Education

Our vision for undergraduate education is to offer a world-leading integrated, interdisciplinary undergraduate education and to be recognized as “the place to study” for students interested in an educational experience that balances technical excellence with a deep understanding of the role of an engineer in addressing sustainability and related key issues affecting our World.

2. Enriching Graduate Education

Our vision for graduate education is to provide, and be recognized for, an outstanding graduate education program that links the research intensity of the Faculty (and the excellent facilities and projects that this provides) with superb mentorship and skills training to produce the best cohort of advanced research engineers of any university in Canada.

3. Excellence in Research

Our vision for research is to be recognized internationally for research intensity, as measured by research innovation, the quality of scholarly output, research funding, and commercial impact; to become the destination of choice for top level faculty, graduate students, and post-doctoral fellows, both domestic and international; and, pride ourselves in engaging undergraduate students in the research enterprise.

4. Internationalization and the Global Engineer

Our vision is to create a Faculty that is recognized internationally for providing an educational experience that enables students to understand the role of engineers on an international level and that helps them to develop into active global citizens.

5. Outreach: Beyond McMaster

Our vision is to be viewed as outward looking and highly engaged with the wider community at the local, national and international level.
The Faculty of Engineering celebrated its 50th anniversary in 2008. This provided an opportunity to reflect on the past, to re-examine the Faculty’s core values and to look into the future. This plan is the culmination of that process. It will guide the Faculty over the next five years.

The planning process commenced with a one day retreat in June 2008. This was attended by many faculty and staff members from within the Faculty, members of the Dean’s Advisory Board and several members of the broader community. This group of about 120 individuals engaged in a lively discussion regarding the mission and core values of the Faculty (past, present and future) and shaped an ambitious list of future goals and endeavours.

Following the retreat, five task forces were struck to draft a set of goals and objectives around the theme areas of:

1. Undergraduate studies
2. Graduate studies
3. Research
4. Internationalization
5. Outreach

The outcome from these task forces was then distilled by the Dean into a draft strategic plan. Initial feedback and validation was provided by the Faculty Strategic Planning Committee and Dean’s Council. The plan was then circulated to the Faculty as a whole and to specific groups within the Faculty for feedback. The plan was also discussed by the Dean’s Advisory Board and presented for discussion in a Town Hall meeting open to all faculty and staff. Following this consultation process, the plan was revised and presented to the Faculty as a whole for final approval in May 2009.

A plan such as this is necessarily broad and far-reaching. It is more focused on where we want to go rather than on how we are going to get there and what obstacles will need to be overcome. Once the plan is approved, Dean’s Council will develop a process for implementation and accountability. In addition, departments and schools are encouraged to develop their own plans that provide greater detail on how the plan will be used to guide their own development.
McMaster University’s Faculty of Engineering does not exist in isolation. We are part of and respond to a wide variety of constituencies including, but not restricted to, the university as a whole, our province and country, the student body (past, current and future), our academic, governmental and industrial partners, the engineering profession, and the worldwide community. We must imagine our own future in terms of this context. As a forward-looking academic community, we strive both to respond to and to help shape trends and directions in our society. In developing a plan with at least a 5 year horizon we must recognize and incorporate both short term conditions and long term needs and opportunities.

Amongst the most important trends that will help define the future of the Faculty, we identified the following:

- Challenges in developing secure and sustainable forms of resources, including energy and water
- The need to develop more sustainable practices in all branches of engineering
- Increased opportunities for technology to improve human health
- Globalization and its impact on industrial supply chains, education, research and the human condition
- The challenge of demographics that will see an unprecedented wave of retirements in the western industrial world over the next decade

All of these trends provide both challenges and opportunities. For example, short term fluctuations in energy markets will not abate the need to develop long term solutions for more efficient use and new forms of energy for transportation, nor the drive towards forms of energy procurement, utilization and conservation that minimize green house gas emissions. The continued emergence of countries such as India and China will put a strain on all resource sectors. These trends, combined with the impact of climate change, will lead to increased concern for the security of systems related to water, food, energy, communication and transportation. The challenges represented by these issues call for a wide range of engineering solutions that are context-specific. The Faculty of Engineering is well poised to play a leadership role in the development of intelligent technological innovations for a sustainable world.

An additional issue facing all Engineering Faculties in North America and Europe is the need to attract sufficient numbers of young men and women to the profession. Within Canada and elsewhere the university undergraduate population is increasingly female, while Engineering as a profession has remained a male-dominated profession. The need for Engineering to increasingly address pressing societal issues related, for example, to sustainability and human health, may offer a new opportunity to realign Engineering in the minds of young people as a caring profession. The current generation of students is much more attuned to global issues and the need for new approaches than their predecessors. By focusing on the critical role of engineering in solving our most complex global issues, we have the opportunity to make the profession more attractive to both male and female students, but perhaps especially the latter. This would help address a longstanding demographic issue where engineering has lagged behind the other professions such as medicine and law in participation amongst women. As a Faculty we therefore need to look at how our own programs and procedures can position us as leaders in developing the profession as a calling based primarily on a sense of socially responsible.

Demographic trends provide additional challenges and opportunities. Hamilton is expected to experience a 30 per cent increase in population and employment growth over the next 25 years. Canada as a whole will see 10 million “baby boomers” retire in the next 10 years. Sectors such as energy, which saw tremendous growth in employment during the 70s, will be especially hard hit as this wave of employees reaches retirement age together. At the same time, the emergence of high quality,
world class education in emerging countries is reducing the supply of foreign trained graduate students. There has never been a greater need for Canada to focus its resources on higher education. At the same time we must incorporate a more flexible approach to learning which recognizes the effect for example of digital media and networking on the way people interact with the world around them.

These broadly based challenges have shaped and influenced our thinking throughout the development of this plan.

Guiding Principles

Our Mission: The Faculty of Engineering at McMaster University is committed to the pursuit of excellence in teaching, research and service, and to fostering the quality of academic life.

As committed members of the McMaster community, the Faculty of Engineering strives to advance the future of McMaster University as outlined in Refining Directions, the university’s primary strategy document. Refining Directions lists three primary goals for the institution to achieve:

- To provide an innovative and stimulating learning environment where students can prepare themselves to excel in life
- To achieve the next level in research results and reputation by building on existing and emerging areas of excellence
- To build an inclusive community with a shared purpose

The Faculty of Engineering holds these overall goals to be of prime importance and to serve as guideposts by which we judge how our own activities contribute to McMaster.

In keeping with McMaster values and as a community of scholars we have identified a number of core values for the Faculty. These are essential and enduring tenets that serve as guiding principles, not to be compromised for financial gain or short-term expediency. They are:

- To be honest, mutually respectful, fair and inclusive
- To foster a collegial, interdisciplinary and innovative work environment
- To respect and reflect diversity in our opinions, our recruitment and the community we build
- To conduct ourselves according to the highest standards of professionalism, acting ethically and with integrity; and to expect no less of our students
- To instill in our students a love of learning
- To inspire our students to see themselves as global engineers
- To be stewards of the environment and exercise social responsibility in our research and education
Moving forward means both re-using and re-positioning what the Faculty is good at, developing new capabilities to meet new needs and unlearning practices that do not add value.

The Faculty of Engineering has identified four core competencies that it now holds and which are important to maintain and strengthen over the next five years:

- A high level of research intensity
- An innovative educational culture
- Strong industrial partnerships
- Excellent, world class research facilities

In the next five years we will add five new core competencies to support and enhance the Faculty’s effectiveness. These are:

- A focus on engineering for a sustainable world
- A high level of student engagement
- Superior organizational agility
- A clear and recognizable brand
- Education and research integrated with partners in industry, government and NGOs

Put more succinctly we identify the following as our overarching vision for the next five years.

**Our Vision:** The Faculty of Engineering at McMaster will be known internationally as a leader in research and education supporting the development of engineering practices for a sustainable world.

Because the term “sustainability” is used widely and in a variety of contexts it is important to indicate how the term is to be interpreted in this document. We will in fact use the term as a placeholder for a variety of issues related to the application of engineering in a socially responsible manner. The most obvious application of this relates to environmental sustainability and the development of eco-effective designs, processes and products. However, the term can be interpreted more broadly to include sustainable practices that provide greater access to goods and services, for example in health care or communications technologies, more effectively and to more people. It also encompasses our desire, as expressed through Engineers without Borders for example, to develop engineering methodologies that can sustain societies anywhere in the globe, leading to the concept of a Global Engineer.

**Goal 1**

Double the number of female faculty members in the Faculty of Engineering

While this may seem a relatively modest goal we do not anticipate that the next five years will see a large expansion in terms of total Faculty complement. Achieving this goal will mean that going forward we will need to attract roughly equal numbers of male and female faculty members. Moreover, achieving this goal will bring the Faculty close to the national average. This is clearly just the first step in a generational plan to raise the number of female faculty so that we reflect the demographic balance within the profession as a whole.

**Goal 2**

Develop strategies for increasing the participation of females in the Faculty at all levels

This goal sits well with the Faculty vision to focus on stewardship and social responsibility within the practice of engineering. This is not something new to the profession but too often engineers are viewed as toolmakers and technological problem solvers rather than professionals addressing societal needs using technological means. Our five year programs along with the more broadly based graduate programs within the School for Engineering Practice set us apart and we need to take advantage of that. The Women in Engineering Committee will develop a long term plan based on best practices elsewhere and consistent with the rest of the strategic plan to increase the attractiveness of McMaster for female students, staff and faculty.
Our vision for undergraduate education is
to offer a world-leading integrated,
interdisciplinary undergraduate education,
and
to be recognized as “the place to study” for students interested in an educational experience that balances technical excellence in Engineering disciplines with a deep understanding of the role of an engineer in addressing sustainability and related key issues affecting our World.

ENHANCING UNDERGRADUATE EDUCATION

BACKGROUND
The Faculty offers a strong technical education in a range of disciplines. The Faculty has also distinguished itself in a number of ways including the development of some unique undergraduate programs. Thus, in addition to our widely recognized programs in traditional areas of mechanical, civil, chemical and electrical engineering, we offer niche programs such as materials engineering, chemical engineering and bioengineering, engineering physics, biomedical engineering, software engineering and game design, plus numerous others. Of particular note is the Faculty’s wide range of 5-year programs that offer students the opportunity to combine the discipline-based engineering program of their choice with in-depth studies in the liberal arts through our programs in Engineering and Management, Engineering and Society and the recently added Engineering and International Studies. Up to a third of our undergraduate students take one of these options. However, the extra dimension that these students develop flavours the experience of all of our undergraduate students and affects the culture of McMaster Engineering in a very positive way. To give just one example, McMaster has one of the most vibrant chapters of Engineers without Borders (EWB) in Canada. Another innovation of note is the Bachelor of Technology (BTech) program which involves a partnership with Mohawk College. This program represents a new approach in that it allows a student to obtain both a college diploma and a university degree in four years. This program is designed to educate students who want advanced knowledge with a very practical focus.

As a Faculty we will continue to adapt our educational offerings to address emerging areas of student interest and societal need. Thus we anticipate increasing our offerings in areas related to energy and water resources as well as broadening our concern for environmental engineering. Another likely area for expansion involves increased offerings in biomedical engineering with linkages to the Faculty of Health Sciences.

In addition to introducing new programs we must continually strive to improve the educational experience of our students. Two areas of particular concern are student retention rates, especially in first year, and the quality of the student’s laboratory/practical experience. We also wish to do a better job of engaging our students, of evaluating the effectiveness of our teaching and of leveraging our research strength to enhance undergraduate learning.
GOAL 1

Develop a vertically and horizontally integrated design course on a Faculty wide basis.

Objective 1: Develop an interdisciplinary capstone design course to be offered as an alternative to the equivalent courses offered by departments [first offering Sept 2010].

We will evaluate the success of this course both by the number of students who choose this over the department equivalent and through exit interviews with students. The latter will be part of an outcomes based assessment of the effectiveness of our programs. The target is 20% of students taking this course by year 3 increasing to 50% within five years.

Objective 2: Develop similar design courses in levels 2 and/or 3, to be offered on an elective basis [first offering Sept 2011].

Success will similarly be measured over a five year period.

GOAL 2

Offer high level practical experience in all disciplines

Objective 1: Enhance the laboratory experience by making labs more exploratory in nature and less focused simply on a demonstration of principles related to lectures.

Objective 2: Upgrade undergraduate laboratory facilities across the Faculty.

Departments will be asked to prepare a prioritized plan and a budget by the end of the 2009/10 academic year. The goal is to offer a substantially upgraded lab experience to all undergraduate students within five years. Some of the planning required to change the way in which we approach labs is currently being used to develop the lab experience for the BTech program. This experience should be used to guide innovations for the BEng lab program.

GOAL 3

While maintaining or improving academic standards, reduce student attrition rates by 20% within 2 years and 50% within 5 years.

The university recruitment and admission process is inevitably imperfect, and thus there will always be students admitted to programs who should not be there or who have chosen the wrong path for themselves. There are however, students who could become first-rate Engineers who nonetheless do not succeed in our programs currently. We should therefore strive to provide the kind of assistance and guidance to students that will optimize their chance of success in a demanding program such as Engineering. We currently offer the M program to Level I BEng students who are found to be in academic difficulty partway through their first year. However, we recognize that more needs to be done to enhance the success rates of students, in both the BEng and BTech programs. While it is of paramount importance to maintain or improve academic standards, we must recognize that student success depends critically on providing the best possible learning environment and support system.

Objective 1: Develop intervention programs based on an analysis of best practice for such programs operated at other institutions [January 2010].

Objective 2: Develop a suite of support and intervention strategies to reduce attrition rates. Success will be measured based on a combination of improved retention rates along with improved educational outcomes. [Start Jan 2009 complete Sept 2014].

As we move towards outcomes based assessment under the new CEAB standards we will develop measures that can be used directly to ensure that quality is not sacrificed to retention.
GOAL 4
Establish McMaster as the leading institution in Canada for the education of socially responsible engineering practices, including a focus on social, environmental and economic sustainability.

For example, engineers must learn to become “eco-effective” designers, which means expanding the “vision from the primary purpose for a product or system to consider the whole. … What is the entire system – cultural, commercial, ecological – of which this made thing, or way of making things, will be a part”? McMaster Engineering already emphasizes sustainable practices, but we must go further in helping students to take a more holistic approach. We do well in this regard through the Engineering and Society program. The goal is to extend the breadth and depth of such offerings and to do this in a systematic way across the Faculty.

Objective 1: Develop courses with an environmental or sustainability focus within each undergraduate discipline [Fall 2011]

Objective 2: Develop sustainability-related content for Eng 1P03 [Fall 2009-Fall 2011]

Objective 3: Encourage departments to introduce approaches such as eco-effectiveness, social responsibility and sustainability into curriculum content wherever appropriate in all engineering courses [2009/10]

These objectives will be monitored by a periodic curriculum and delivery assessment starting from a baseline assessment in 2009/10. The primary vehicle to develop this program and monitor its success will be the Undergraduate Curriculum and Policy Committee of the Faculty, which may opt to establish a sustainability sub-committee.

GOAL 5
Increase the level of student engagement in all engineering programs

It is important to engage students in their education beyond a focus on passing courses and earning a degree. Most of our students are anxious to find ways to apply their new knowledge and to think about the broader societal context of engineering, long before they graduate. It is expected that the previous goals will improve student engagement in this regard, but this will be further enhanced by the specific objectives listed below.

Objective 1: Develop improved methodologies of student engagement, based on an assessment of best practices at other institutions [2010]

Objective 2: Develop a set of tools to assess student engagement at all levels [2011].

Success will be evaluated continuously. Moreover, such measures will become part of the outcomes based assessment process being implemented by the Canadian Engineering Accreditation Board.

Objective 3: Create better linkages between “course material” and extracurricular activities involving regional, national and international competitions and where possible facilitate participation in competitions “for credit” [2010-ongoing]

Students benefit tremendously from participation in design and outreach activities, from advanced vehicle clubs to Engineers without Borders. Wherever possible course projects should be structured to align with such activities. The Faculty-wide capstone design course described above should be specifically designed with this in mind.
Objective 4: Establish a stable funding mechanism to support approved Engineering Clubs engaged in programs with direct educational benefits [2010-2014]

Objective 5: Develop a long range plan to engage undergraduate student from McMaster and elsewhere through a summer research internship program [2009-ongoing]

As a research intensive Faculty we are well placed to provide students with opportunities to learn about and engage in cutting edge research. While we already do this to a significant extent a purposeful program along these lines will increase the number of students involved and provide networking opportunities. Incorporating non-McMaster students increases the diversity of interactions for our own students but also serves to develop ambassadors for McMaster elsewhere. This program is motivated both by our student engagement goal as well as by our goals for graduate growth noted in the next section.

GOAL 6

Develop clear and achievable learning objectives and student outcomes for each undergraduate program

Objective 1: Develop appropriate methodologies to be used by departments to define clear learning objectives [July 2009-June 2010]

The aim will be to align these, to the greatest extent possible, with the new “graduate attributes” on which we are now expected to report through the engineering accreditation process.

GOAL 7

Develop a new undergraduate program in Engineering and Health Science

Objective 1: Explore the development of a 5-year program in Engineering and Health Sciences, to be offered jointly with the Faculty of Health Sciences.

This program would link to the successful Bachelor of Health Sciences Program. It would be a fully accredited engineering program. The issues for consideration around this objective must include how to relate this program with existing programs in biomedical engineering and in chemical engineering and bioengineering. [Aim for first class to enter in September 2011]

GOAL 8

Increase Faculty involvement in educational research, including the development of evidence-based methodologies for curriculum development and program delivery

Objective 1: Encourage greater faculty engagement in education-based research, particularly amongst, but by no means only amongst, the cohort of Teaching Stream faculty.

As the cohort of teaching-stream professors and teaching-oriented CLAs increases, complementing a number of tenure-stream faculty with a particular interest in this area, we will achieve a critical mass to develop a community of scholars with a particular interest in research focused on pedagogy. The Faculty will value activity in this area as equivalent to technical and scientific research.

Objective 2: Develop greater use of evidence-based approaches for assessing best practices in learning methodologies, curriculum content and delivery.

The Faculty of Health Sciences is a leader in the effective use of evidence-based curriculum development and pedagogy. We should tap into that expertise to develop a stronger engineering program.
ENRICHING GRADUATE EDUCATION

BACKGROUND

The Faculty of Engineering has seen significant growth in graduate studies, with about a 60% increase in student numbers over the past 6 years. During this same period the faculty complement increased by about 30%. Thus growth has been driven both through faculty hiring as well as through an increase in the Faculty’s level of research intensity. One of the main factors driving this growth has been the development of new programs that complement and extend the traditional slate of research-based MASc and PhD degrees. The School for Engineering Practice now offers 4 MEng programs in the areas of Design, Entrepreneurship and Innovation, Public Policy, and Manufacturing. These are all unique programs that address specific needs for engineers with advanced training suited to specialized careers not linked to any particular Engineering discipline. We have also, in collaboration with other Faculties, developed several interdisciplinary graduate schools - in Biomedical Engineering, in Computational Engineering and Science, and in e-Health. There are still administrative barriers to the successful implementation of such interdisciplinary programs that need to be removed. We are therefore encouraged by the existence of a university task force on interdisciplinary programs that is now at work under the direction of the Associate Vice-President and Dean of Graduate Studies.

Our rapid growth in graduate education has created significant challenges. One of these, namely space, will be alleviated when the new Engineering Technology Building comes on-stream in late 2009. The Faculty aims to continue to grow the graduate population, in keeping with our aim to remain as one of the most research intensive Faculties of Engineering in Canada.

An additional structural innovation will also pay dividends for the development of graduate studies within the Faculty. This involves modifying the role of the Associate Dean for Graduate Studies (ADGS). There will now be an ADGS for each Faculty. This will enable the associate dean for Engineering to play a greater role in developing Faculty-wide initiatives to promote and implement the goals set out in this plan. A strong Associate Dean of Graduate Studies will be a unifying factor in the Faculty.
GOAL 1

Attract more and better graduate students

Objective 1: Increase the size of the total full-time equivalent graduate student population to an average of 5 students per tenure-stream faculty member [achievable by 2012]

The Faculty of Engineering already has the highest graduate student to faculty ratio in the university at just under 4 students per faculty member (counting only in-time students). There is however some room for growth, especially given that we have a large cohort of young faculty who have yet to hit their stride.

Objective 2: Increase the fraction of domestic students (Canadians and landed immigrants) to 60% by 2012

The current graduate student population is less than 50% domestic, the remainder being Visa students. The Faculty has always valued having a graduate student population that contains a diversity of culture, experience and gender. However, the fraction of domestic students has actually dropped over the past years. Given the trends outlined in the introduction it will become increasingly necessary to attract domestic students to fill our graduate programs. Additionally, it has been a longstanding policy of the Ontario government not to fund Visa students. Thus the only support generated by these students comes from tuition, which is not sufficient to sustain a strong graduate program. Therefore, so long as this remains government policy, achieving this objective is imperative to the long term financial viability of the graduate program.

The task force which developed the graduate studies plan has proposed a number of initiatives in order to achieve this objective. In particular graduate student recruitment requires a more coordinated message at the Faculty level. Graduate recruiting is now mostly the responsibility of individual departments. The Faculty should develop a more broadly based approach to publicizing research that will provide more generic information about our research quality and excellence and a generic template for Departmental research brochures would enhance our reputation. Particular initiatives should include the following:

- Addressing the “Hamilton” factor. The city has an undeserved reputation based on its steel town image. This is a major stumbling block to enticing more students to choose McMaster Engineering for graduate studies. Active recruiting is necessary to overcome this limitation. There are a number of ways of achieving this including:
  + Creation of a virtual online tool, highlighting the local area (waterfall tours, Coote’s paradise, rail trail for biking, etc.).
  + Engaging a social marketing firm for this purpose, in collaboration with other Faculties and the School of Graduate Studies.
  + Bringing students from other universities to McMaster for a few days to see both the city and research environment and culture. The students would be invited to McMaster for a series of demonstrations, workshops and tours of the local area. One on one interaction with faculty and graduate students is an essential component.
  - Attracting second and third year students from other universities for summer research experiences through dedicated USRAs or a modified version of the UROP program.
  - Generating research interest in our own students through targeting initiatives such as a Faculty dinner for the top stu-
dents in each program. This dinner would be attended by Department Chairs, Graduate Coordinators, the Dean, appropriate Associate Deans and graduate students.

- Developing a set of named graduate scholarships similar to those offered at McGill in order to attract the best students. Many departments have one-time awards, as well as top up awards for external award recipients, and naming these would enhance their level of prestige.

- Developing non-traditional approaches to graduate student recruitment. Specifically, contacts in industry, alumni and connections of PEO and OSPE are potential areas for promoting McMaster research and graduate studies. We should expand our work with the people at Engineering Dimensions, building on current initiatives in regard to Engineering and Public Policy, to publicize the new and exciting work at McMaster.

Objective 3: Increase the fraction of our graduate students holding externally funded scholarships such as NSERC and OGS awards.

We should provide support and encouragement for students to develop and submit NSERC and OGS applications. This could be a staff or a TA function. The person responsible would visit 4th and 5th year undergraduate classes, highlighting requirements, offering support, talking about the graduate experience and helping to connect students with potential supervisors. In addition, we need to more pro-actively recruit scholarship holders to McMaster.

Objective 4: Expand the mandate of the School for Engineering Practice to develop, in collaboration with departments, a range of MEng programs [2010 – ongoing].

SEP provides the Faculty with a vehicle for developing and offering a wide variety of professional master’s programs. Now that the original SEP programs have been established, the School should look for additional opportunities for course-based master’s programs that address specific industrial or societal needs for advanced training. This could include programs aimed at assisting engineers to retool their skills for growth sectors, for example in the energy and power sector.

Objective 5: Develop new combined BEng / MEng programs [2010-ongoing].

We have developed a combined BEng/MEng program in Manufacturing Engineering. Students enter into this program just before their final year of undergraduate studies in one of Mechanical, Chemical or Materials Engineering. This approach enables students to combine a discipline specific undergraduate degree with a cross-disciplinary graduate program. We will develop a similar program in Sustainable Energy Systems. Entry into this program could come from a variety of programs. The aim is to have this program in place for 2011.

GOAL 2

Enrich graduate student experience by providing more interdisciplinary opportunities

The graduate student experience can be enriched significantly by introducing a more interdisciplinary experience and focus. One of the most significant issues expressed by our graduate students is the lack of interaction they have outside of their own research groups and especially outside of their departments. We must take advantage of the interdisciplinary environment that we foster
at McMaster in order to provide graduate students with the best possible experience. This would have significant benefits to the programs as the graduate students would act as ambassadors for their programs, attracting new students. It will also help to foster a culture across the Faculty in which students are treated as colleagues and that this collegial relationship becomes seen as a normal expectation, established from the day the student joins the Faculty.

Objective 1: Provide a central meeting place for graduate students [2010]
Establishing a graduate student “lounge” would facilitate interactions amongst students. Organized discussions on a variety of topics would be a good way to initiate a culture of using such a facility.

Objective 2: Faculty wide seminars in social, economic, environmental and life related topics [starting 2010]
The Women in Science and Engineering (WISE) group does engage in such discussions. For example the WISE annual conference has included such topics as work-life balance, grant writing skills, resume writing as well as seminars from industry speakers on how they got to where they were. While this conference is open to all students, participants are mainly female. Such discussions would be useful to all of the students in the various programs. Therefore we should initiate a seminar / discussion series that focuses on issues other than research.

Objective 3: Develop a broader range of course offerings available to all students [2010 – ongoing]
There are many experts on these topics within the faculty and we have industrial connections in many other cases. The planning committee for this should be student run.

Objective 4: Develop an evidence based approach to the improvement of graduate programs [2010 – 2011]
The School of Graduate Studies performs exit interviews with students. We should analyze the data from these interviews as input into program modification.

Objective 5: Encourage graduate student participation in teams and clubs [2010 – ongoing]
The various teams and activities that have been developed primarily from an undergraduate perspective serve as excellent morale and community building activities for graduate students. They also provide graduate students with mentorship opportunities and graduate students should be encouraged to play a great role. These opportunities should be included in advertising.
EXCELLENCE IN RESEARCH

BACKGROUND
The Faculty has significant strength and recognized international standing in several research areas, among them, materials design, manufacturing, and characterization; automotive research; photonics and microsystems; nuclear engineering, including safety analysis; masonry and earthquake engineering; and information technology, including formal methods, scientific computation and signal processing. It will be critical to continue strong support for these areas of strength to maintain and enhance our national and international position.

We must also pay close attention to emerging areas of national and international interest. The federal government’s 2007 Science and Technology (S&T) Strategy document identifies four focus areas, the first two of which are also explicit foci of Ontario’s Research Excellence Strategy:

- Environmental science and technologies
- Natural resources and energy
- Health and related life sciences and technologies
- Information and communications technologies

The Faculty is well positioned to take advantage of these new opportunities. Building on key discriminating strengths, there are growing activities in the broad area of sustainable energy (in particular nuclear, solar, and wind) and infrastructure, water-related research, the application of nanotechnology in the health sector and in biomedical engineering. These are indications of how well many of the Faculty’s researchers are attuned to the demands and challenges of today’s society. We will need to provide them with the resources required to develop strong, fundable proposals and to support them during the building stages, once their research programs are funded. The Faculty’s many Canada and Industrial Research Chairs will be catalysts for success in these endeavours and we will continue to see investments, especially during the final stages of the university-wide Campaign for McMaster University, to enable additional Chair positions in strategically important areas.

We will need to involve our Research Chairs more strongly in the efforts to recruit top-level graduate students, by highlighting both newly established and traditionally strong areas of research and by marketing the international reputation of the Chair holders. In parallel, we need to develop a graduate student funding model that keeps us competitive with other Ontario and Canadian universities. Our research reputation both affects and is affected by the quality of our graduate students and thus, it is imperative that we be able to attract top students, both locally and internationally.

Our vision for research is that the Faculty will...

be recognized internationally for its research intensity,
as measured by research innovation, the quality of its scholarly output, research funding, and commercial impact;
be the destination of choice for top level faculty, graduate students, and post-doctoral fellows, both domestic and international;
and pride itself in engaging undergraduate students in the research enterprise.

Environmental science and technologies
Natural resources and energy
Health and related life sciences and technologies
Information and communications technologies
GOAL 1

Solidify and further enhance the Faculty’s international reputation in existing areas of strength

Objective 1: Assess critical mass/needs and develop a staffing plan [2009 - 2010].

Many of the most significant funding opportunities require the development of large, integrated proposals in areas related to government S&T policy. The Faculty’s recruitment plans should therefore be structured so as to provide the critical mass necessary to demonstrate leadership and breadth in areas of strategic importance to the Faculty.

Objective 2: Assess the many facets of existing industrial partnerships [immediate to 6 months] and aggressively pursue new industrial partnership opportunities [ongoing].

Objective 3: Broaden the international portfolio of academic and industrial partners [ongoing].

This objective is closely tied to several objectives listed under “Internationalization”.

Objective 4: Encourage and support the organization of international conferences at McMaster [immediate and continuing].

Objective 5: Assess the impact of existing IP policy, propose revisions as appropriate, and identify ways to increase the fraction of research results “leaving the lab” [target for completion: end of 2009].

In this objective liaison with MILO and the office of the Vice-President (Research and International Affairs) is critical. In particular, the Faculty will play a major role in helping to redefine the university’s role in commercialization.

GOAL 2

Establish the Faculty as a recognized hotbed of innovation in emerging areas

Objective 1: Establish a Technology Roadmap for the Faculty [target: Fall 2009] and devise a process to make the Roadmap a “living document” [continuing].

This objective is closely linked to the first objective in the previous section (critical mass). For a medium sized Faculty such as ours we can only aim to excel at a limited number of things. Thus the development of a roadmap will enable us to identify what those might be, linking our strengths with foreseeable opportunities.

Objective 2: Identify and nurture interdisciplinary initiatives by providing support for network and partnership formation [timing according to opportunities].

This follows naturally from the development of the roadmap.

Objective 3: Identify and aggressively pursue new opportunities at the provincial, national, and international levels and create a support system for such activities [see above].

Objective 4: Establish a Research Advisory Council under the leadership of the Associate Dean, Graduate Studies to advise the Faculty on long term research opportunities and trends.

Such a council could be composed of faculty with major distinctions (FRSC, FCAE, CRCs, etc.) as well as external consultants.
GOAL 3

Establish the Faculty as a destination of choice for HQP from Canada and abroad

Objective 1: Establish an annual Faculty Research Award to be announced at the Applause and Accolades event [immediate].

Objective 2: Celebrate research accomplishments and create an incentive system for nominations for prestigious award and prizes [2010].

Objective 3: Create a support structure for visiting researchers [2011].

Objective 4: Establish an annual Research Open House to engage the community and the undergraduate student population and to recognize student research accomplishments [2010]. The pursuit of this objective should be coordinated between the Associated Deans for Research and Graduate Studies.

Objective 5: Create a web portal for potential graduate students and researchers that conveys the exciting research opportunities that exist within the Faculty [2010].

The pursuit of this objective should be coordinated with the related objective under “Graduate Studies”. 
BACKGROUND

The Faculty currently offers a strong technical education in a range of disciplines. We have many examples of international collaboration but in general these are not integrated into the curriculum nor could they be considered to be pervasive. We have developed some more formal collaborations, for example the exchange with INPG in Grenoble, France, and are starting a similar venture with Trento, Italy. Until now accreditation rules have restricted the scope of any foreign educational experience, but there is evidence that the position of the CEAB is changing in this regard, recognizing the critical importance of having Canadian students involved in international experience opportunities. This is leading to increased flexibility on this issue. Wherever possible such partnerships should cover both undergraduate and graduate programs.

In terms of international content in our undergraduate curriculum, this is largely focused on the Engineering and International Studies Program. The motivation to develop this program comes from a desire to train engineering students on commercial aspects of globalization and does not involve a compulsory international experience component. Our activities in international development are currently restricted to a vibrant Engineers without Borders chapter which also contributes curriculum content to Level 1 and upper level programs.

There is considerable scope to expand our international collaboration, and to develop curricula focused on international development.
GOAL 1

Develop a formal international exchange option involving every department in the Faculty

Objective 1: Develop a model for undergraduate exchange programs that is compatible with CEAB guidelines [2010].

We need to fully investigate and make use of increased CEAB flexibility, particularly as regards exchange programs with countries that are party to the Washington Accord. In addition, we need to determine what kinds of exchange opportunities are of greatest interest to our students. There is a history amongst Canadian universities whereby “exchange” programs are really one-way, with many fewer students going abroad than coming to Canada. This is certainly the McMaster experience. Thus our development of exchange programs should also be consistent with demand from our students.

Objective 2: Expand the current collaboration with INPG to include the Department of Engineering Physics and the Biomedical Engineering Program. Target 9 students traveling in each direction every year [2011]

Objective 3: Develop a template based on the INPG experience to promote best practice in international collaborations. A key aspect of the INPG collaboration is the availability of financial support; therefore as part of this process the international funding opportunities will be examined. [Fall 2009]

Objective 4: Identify key institutions World-wide to target as collaborators, identify McMaster contacts with these institutions and develop a plan to develop these contacts. Target global coverage and Faculty-wide involvement. Collaborating institutions should have similar global rankings to McMaster [2012]

GOAL 2

Develop collaborative opportunities for graduate students and researchers at top institutions worldwide becoming the North American leader in international graduate programs

Objective 1: Develop a “2 plus 2” Dual PhD program with one or more foreign universities (initially, INPG Grenoble and University of Trento) [2010]

This is a model that is becoming common in Europe but has not taken hold yet in North America. Therefore we have a real opportunity to become a leader in this type of programming.

Objective 2: Identify key International Institutions to involve in additional dual degree programs [2010]

Objective 3: Develop dual degree programs involving each department in the Faculty [2014]

GOAL 3

Develop an international component throughout the curriculum and establish McMaster as a leader in Global Engineering

Objective 1: Develop a new program in Engineering and International Development [Fall 2010]

This program will be a modified version of the current Engineering and International Studies program and could be started simply as an elective package within that program. We should consider EWB Canada as an active partner for such a program.
Objective 2: Introduce an optional international experience component for students in the International Studies program and the new program in International Development [Fall 2010]

Objective 3: Establish a task force to examine the global engineer concept and how it can be best integrated into the undergraduate curriculum [2011]

The concept of a global engineer is gaining traction throughout the discipline and recognizes not only the global nature of engineering practice and the emergence of global engineering corporations, but also the obligation that engineers have to enable the development of prosperous and sustainable communities around the globe. We will embrace this concept by developing opportunities for engineering students to incorporate issues of global sustainability throughout their studies.

GOAL 4

Increase the fraction of Co-op Students taking an International Co-op to 10%

Objective 1: Develop international co-op placement opportunities and promote these within the Faculty [2010 - 2013]

The most likely industrial partners for such a program would be multinational corporations with strong Canadian operations.

Objective 2: Develop international co-op experiences within all exchange programs [2010 - 2013]

Objective 3: Set up reciprocal arrangements with international partners for co-op placement.

This is currently being piloted with the INPG exchange.

Objective 4: Conduct a survey of international experience students and employers. [Ongoing starting Fall of 2010]
BACKGROUND

We define “outreach” as a two-way communication process between the Faculty of Engineering and the wider community. The main objective of any outreach activity should be to increase the level of engagement between the Faculty and the community.

The Faculty engages in outreach using a wide range of vehicles, each one of which aims at a specific constituency. These include:

- **Engineering Career Services** which provides support for students and employers to make connections. ECS also supports and manages the Faculty’s co-op program as well as the UROP summer internship program.
- **Office of Alumni Affairs** which manages our contacts with alumni, including providing opportunities for alumni to interact socially.
- **Faculty Advancement Officer** who works with the Dean and other faculty to build and establish relationships including industrial partners, foundations, alumni and other interested individuals. This function is partly funded by and works closely with University Advancement.
- **Faculty Communications Officer** who coordinates the Faculty’s communication with the outside world including media coverage and publicity.

While all of these groups have well defined missions and target groups there is a need for greater interaction and coordination. At the moment all of these groups report separately to either the Dean or the Associate Dean for Research and External Relations.

Our vision is that the McMaster Faculty of Engineering be viewed as outward looking and highly engaged with the wider community at the local, national and international levels.
GOAL 1
Develop a coordinated approach to Outreach Activities

Objective 1: Establish an outreach team including the Dean, Associate Dean for Research and External Relations and the staff responsible for each of the four above-named outreach offices. This body will meet on a regular basis to ensure open lines of communication and coordination of activities.

Objective 2: Develop a more coordinated approach to external communications.

The outreach team members will each have as part of their mandate feeding stories and ideas to the communications officer for identification of publicity opportunities.

Objective 3: Ensure that external opportunities and emerging trends are communicated to all interested faculty members in a timely manner.

While most faculty members are engaged with technical societies and external research partners they often do not have the time to keep abreast of societal trends that will provide new opportunities. We should develop mechanisms that make this easier for faculty, and at the same time provide networking opportunities for everyone.

GOAL 2
Enhance Outreach Opportunities for Students

Objective 1: Increase the number of co-op placement opportunities for students

Along with continuously searching out new co-op partnerships we will investigate new strategic partnerships along the lines of the Hydro One Fellowship.

Objective 2: Improve the feedback we get from employers about their experience with our students, both through co-op and permanent placements.

GOAL 3
Establish New Outreach Activities and Programs

Develop new activities and programs that emphasize and strengthen our relationships by giving back to the Community

Objective 1: Develop programs for individuals who do not meet customary admission criteria, but with potential and strong motivation, for example foreign trained engineers.

Objective 2: Explore new ways of introducing engineering and McMaster.

We have for many years used the Fireball Show as a travelling exhibition to introduce students to the wonders of engineering. This mode of delivery however has become financially unsustainable and is no longer in tune with the ways in which high school students learn and interact. We will therefore explore alternative methodologies through the use of new social networking tools. We will also reach out to high school teach-
ers through programs that assist them in their role of explaining the world to their students. In this regard we will increase our engagement with Actua Canada.

**Objective 3: Explore new programs to bring engineering to a wide audience outside of the university community.**

The objective of this outreach activity is to acquaint the general public with the practice of engineering and to attract potential students into the discipline. For example, in many European countries “Long Night” events have become very successful. This approach could be adapted using an Engineering Open House aimed at the general public (but indirectly also targeting high school students).

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**GOAL 4**

Increase our engagement in public policy debates related to engineering and technology

The Faculty has established a Centre for Engineering and Public Policy which delivers a Master’s program with the same name. This has brought to McMaster some dedicated expertise and has also led to partnerships with PEO and OSPE. We need to build on this to involve more of our Faculty and students in thinking about how engineers can and should engage in public policy debates. This goal links directly to our objectives regarding engineering practice that emphasizes sustainability. While there are many technological issues to be addressed in creating a more sustainable world, probably the biggest challenges revolve around policy development, public perceptions and changing culture. Engineers must learn how to engage in these debates or else risk seeing promising technologies needlessly sidelined.

**Objective 1: Establish a working group, led by the Centre for Engineering and Public Policy, to broaden the degree of engagement in policy discussion within the Faculty [2009]**

**Objective 2: Encourage the incorporation of EPP components in all major research proposals [ongoing].**

Most major research initiatives need to provide justification in terms of their benefits to Canada at least and possibly globally as well. While in many cases this rationale can be easily developed, a much more forceful argument for funding can be made by including an in depth discussion of related policy issues in the project. Such studies could address, for example, societal barriers to implementation of the proposed technological solutions, the need for non-technological changes to make a new technology successful and so on.
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Theme task force members who drafted sections of this document, including:

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<td>Peter Mascher <em>(chair)</em></td>
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