Request for Approval of the
A New Option in the Existing Master of Engineering Degree
Major in Sustainable Systems Engineering

College of Engineering
Engineering Professional Development
March 21, 2012

Dear Members of the Graduate Faculty Executive Committee:

Engineering Professional Development (EPD) has worked with faculty across campus to develop a new online graduate degree program focused on sustainability applications in engineering. As a result of this work, we are submitting the attached proposal for a new option in the existing Master of Engineering degree in Sustainable Systems Engineering (SSE) for your approval.

This online sustainability masters degree option provides the University of Wisconsin with an opportunity to demonstrate its leadership in engineering education while helping address one of society’s challenges. Our analysis of potential students has determined there is strong interest for an online masters of engineering degree focusing on technical issues associated with sustainability.

We also view this program as an opportunity to fund the development of several new courses that would expand the University’s capabilities in sustainability; as faculty who teach in this program will be free to use any educational assets prepared for this new program in their campus courses. The proposed program is structured to provide faculty an opportunity to deliver current on-campus courses to a new off-campus audience with faculty and their associated departments while sharing in this new revenue source.

We expect enrollment of early and mid-career engineers who are currently in sustainability related professional positions. The program’s structure will allow students to complete the degree program in 2-3 years while continuing to pursue their professional careers.

The College’s online graduate programs have maintained strong enrollment even during a time when other means of continuing professional education has been significantly impacted by the weak economy. Utilizing our past experience with online programs as a guide, we are scaling-up our capabilities for faculty and student support. For this effort, start-up funding has been committed from the Division of Continuing Studies, the Office of Sustainability, the College’s existing Credit Courses at a Distance Program, and EPD internal funds. Our business plan anticipates this program will be financially self-supporting in the third year of operation.

Recognized nationally as the leader in providing students with high quality online education, the University will gain an important advantage in establishing this proposed program now. Other higher education institutions are aggressively expanding online offerings and prospective students will soon have many more choices available to them. Consequently, we are seeking to enable those potential students to begin their studies with us in the fall of 2012. Based on preliminary inquires we expect to have about 20 students in the first set of classes planned for fall 2012.

Please note, the COE’s Master of Engineering Oversight Committee approved this proposal February 28, 2012, and the COE’s Academic Planning Council will have its second reading for approval on April 11, 2012.

I am available to provide more information.

Thank you for your consideration,

Philip R. O’Leary, PhD, PE
Professor and Chair
REQUEST FOR APPROVAL OF A NEW OPTION IN THE EXISTING MASTER OF ENGINEERING DEGREE MAJOR

1.0 Summary and Requested Action  Page 1
2.0 Background and Rationale  Page 2
3.0 Program Design  Page 3
4.0 Administrative Structure  Page 5
5.0 Admissions and Degree Requirements  Page 6
6.0 Curriculum  Page 7
7.0 Collaborations and Partnerships  Page 11
8.0 Enrollment Projections  Page 11
9.0 Faculty  Page 12
10.0 Financial Support  Page 12

1.0 SUMMARY AND REQUESTED ACTION

The Graduate Faculty Executive Committee’s approval is requested for a new option to be offered under the existing Master of Engineering major degree. The proposed option is a Master of Engineering in Sustainable Systems Engineering designed for online learning. This option was approved by the College of Engineering’s Master of Engineering Oversight Committee on February 28, 2012 and is scheduled for a second reading with the College of Engineering’s Academic Planning Council on April 11, 2012. The flexibility of the College to create and retire options within the M.E. degree was granted as part of the UW System Regents’ 1998 authorization of the M.E. degree.

This proposed new option offers several important strategic advantages to the University of Wisconsin, the College of Engineering, and its students:

- Supports the University’s strategy of using educational innovation to reach new student populations and thereby promote the Wisconsin Idea;
- Resonates with the interdisciplinary, university-wide emphasis on Sustainability as one of two major campus initiatives;
- Helps the College of Engineering meet its strategic planning objective to: “Develop and deliver three new online masters degree opportunities by 2015.”
- Fills an unmet demand for engineers prepared to meet the technical and business challenges of maximizing sustainable performance in their workplace.

EPD’s market analyses has revealed that accelerated start-up of this degree will enable the CoE and UW to capture visibility and satisfy market demand. Accordingly we have developed and are prepared to implement a rapid start-up plan that will enable an inaugural class of SSE students to begin studies in September 2012. We respectfully request the GFEC’s review and approval to enable UW-Madison to establish a visible leadership position in sustainable systems engineering and allow the first class of SSE students to begin studies with the 2012 fall semester.
2.0 BACKGROUND AND RATIONALE

3.1 Background

Applications of “Sustainability” concepts have gained momentum in popular and technical communities. Though the term lacks precision in its definition, most approaches attempt to balance and optimize a “triple bottom line” economic model. Looking forward, six of the fourteen “Grand Challenges in Engineering” published by the National Science Foundation also have sustainable goals for technology innovations.

The University of Wisconsin has a long history and a well-respected reputation for research, teaching, and service in sustainability. As the demand for sustainable performance increases, so does the demand for engineers prepared to meet the technical and business challenges of this new milieu.

The Department of Engineering Professional Development, in cooperation with the Office of Sustainability (OS), the Division of Continuing Studies (DCS) and the Graduate School, is seeking to offer an online Master of Engineering in Sustainable Systems Engineering (SSE) degree program. This new, online program will be available to off-campus graduate students as a new option under the College of Engineering’s existing Master of Engineering degree. The program’s purpose is to fill an unmet demand for a graduate degree aimed at practicing engineering professionals in a topical area of intense interest across broad segments of the industry. The market research we have conducted indicates that practicing mid-career engineers are not likely to interrupt their careers to study on campus in pursuit of this or similar graduate degrees. The SSE program will therefore complement, rather than compete with, existing degrees and certificates.

3.2 Rationale

To determine the feasibility of a Sustainable Systems Engineering degree program, EPD performed a market assessment in 2010-2011. The purpose of the assessment was to determine the level of interest, level of employer support, funding sources, and program design requirements for those in the target market.

From our analysis we found a sufficient pool of professional engineering degree candidates in the near and long-term, a sufficient level of employer support, a high degree of recognition and value assigned to the UW brand, and a positive valuation and willingness to hire program graduates. However, research indicated that to be successful the program will need to be offered entirely in an on-line instructional environment, and provide for degree completion within three years, preferably two.

Risks to program success are primarily in the area of student funding. Most students will be required to fund their graduate studies all or in part. The market analysis also found that direct competition for sustainable engineering programs is small, but rapidly growing.
3.0 PROGRAM DESIGN

3.1 Master of Engineering Degree

The existing Master of Engineering Degree was approved in 1998 as a way to serve both students and employers by providing specific programs focused on practice-oriented Master’s degrees that would allow students to keep up with the latest technology and maintain their competitiveness. The Master of Engineering degrees are terminal degrees, following a Bachelor’s degree in one of the College of Engineering’s traditional majors. The topics emphasized by these programs are expected to shift fairly rapidly as the relevant industrial practices evolve.

The College of Engineering and Department of Engineering Professional Development currently offer four Master of Engineering options.

<table>
<thead>
<tr>
<th>Degree</th>
<th>Major</th>
<th>Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>Master of Engineering</td>
<td>Engineering</td>
<td>Professional Practice (Engineering Management) (MEPP)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Engine Systems (MEES)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Polymer Engineering and Science</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Technical Japanese</td>
</tr>
</tbody>
</table>

These online programs were named #1 in January 2012 by U.S. News and World Report in its survey of online graduate engineering programs in the categories of “Teaching Practices and Student Engagement” and “Student Services and Technology.” 62 institutions responded to the U.S. News and World Report survey, and UW–Madison is one of only three universities that made U.S. News and World Report’s “Honor Roll” for top-quality online engineering degree programs. This important distinction was announced as U.S. News and World Report released its first ranking of online master’s of engineering programs, which required eligible programs to pass rigorous standards for quality education.

• In the “Teaching Practices and Student Engagement” category, UW–Madison’s programs were judged on factors such as a high level of student collaboration and participation, the availability of instructors to answer student questions, small class size, and the inclusion of an instructional designer dedicated to developing courses to meet online learner needs

• In the “Student Services and Technology” category, UW-Madison’s programs were ranked highly based on such factors as the ability of students to conveniently receive classes through both audio and visual methods, and the use of a centralized student information system

UW–Madison’s online engineering graduate programs also ranked among the top five in the “Faculty Credentials and Training” category.
3.2 New Option for Master of Engineering: Sustainable Systems Engineering

Using the experience gained through the existing Master of Engineering options, EPD is requesting a fifth option be added to the Master of Engineering degree in Sustainable Systems Engineering. The SSE program is being designed for mid-career engineers who wish to build technical and leadership skills to:

- **Lead sustainability initiatives through their organization**
- **Apply sustainability concepts and practices to engineering design**
- **Engage stakeholders in sustainability issues**
- **Apply engineering tools to perform needs assessments, environmental modeling, life-cycle cost and benefits design and analyses, optimization, and impact statements on affected populations**

Another key program design requirement desired by the target industries and students in preliminary market studies was the option for students to select a specialization, similar to the structure used in Civil and Environmental Engineering’s B.S. specialization options. The initial areas selected for the degree launch based on student interest from our market survey are: facilities and the built environment, energy production and distribution, and public infrastructure. These specializations are also well supported by the expertise of existing faculty.

**Table 2. Proposed Option to Structure of Master of Engineering Degree**

<table>
<thead>
<tr>
<th>Degree</th>
<th>Major</th>
<th>Option</th>
<th>Specialization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Master of Engineering</td>
<td>Engineering</td>
<td>Professional Practice (Engineering Management) (MEPP)</td>
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<td></td>
<td></td>
<td>Technical Japanese</td>
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<tr>
<td></td>
<td></td>
<td>Sustainable Systems Engineering (SSE)</td>
<td>- Facilities</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Energy</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Infrastructure</td>
</tr>
</tbody>
</table>

In addition to the above requirements, EPD established competency models that represent key knowledge, skills, and attributes that must be present in the core curriculum. The core competencies fall within these broad categories:

- Engineering science and technologies
- Principles, tools, and methods for engineering systems analysis
- Engineering management and planning
- Implementing technical ideas and innovations
- Business practice and economics
- Working across boundaries and disciplines with a global perspective
The structure of the SSE program was also tested to ensure it met or exceeded the College of Engineering requirements for a Master of Engineering degree:

<table>
<thead>
<tr>
<th>Master of Engineering Degree Requirement</th>
<th>Sustainable Systems Engineering Program Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>CoE Admissions Standards</td>
<td>B.S. in Engineering from an ABET accredited program, &gt; 3.0 GPA</td>
</tr>
<tr>
<td>Minimum of 24 credits (programs currently vary from 26-30 credits)</td>
<td>27 credits (provides opportunities for 1 and 2 credit courses to meet financial aid eligibility)</td>
</tr>
<tr>
<td>Minimum of 9 credits at the 600 level or above</td>
<td>14 credits of courses in the proposed core curriculum are at the 600 level</td>
</tr>
<tr>
<td>Minimum of 12 credits from the College of Engineering</td>
<td>14 credits of courses in the proposed core curriculum are from EPD, with many electives from the CoE</td>
</tr>
<tr>
<td>If students do not come into the program with relevant work experience, the program must provide 6 credits of engineering professional practice</td>
<td>For the few students without experience, the 3 credit capstone project and EPD 660 and 661 projects will provide professional practice, working in coordination with projects from the Office of Sustainability</td>
</tr>
</tbody>
</table>

### 4.0 ADMINISTRATIVE STRUCTURE AND GOVERNANCE

#### 4.1 Administrative Structure

The Graduate School and the Department of Engineering Professional Development will confer the Master of Engineering in Sustainable Systems Engineering degree. The supporting operations for this degree will be managed by EPD. The degree will be coordinated by the Program Director (Marty Gustafson) under the supervision of EPD’s Director of Distance Degree Programs. Supporting staff from EPD have already been assigned to assist in technology management, marketing, admissions, instructional design and program assistance.

Two committees provide review and direction for this program. A program committee oversees the day-to-day operation of the degree, and consists of Phil O’Leary, Wayne Pferdehirt, Carl Vieth, Patrick Eagan, and Marty Gustafson from Engineering Professional Development.

An advisory committee consisting of leaders from industry, government, and other University Departments will be formed prior to degree launch. This work is currently underway.

#### 4.2 Assessment and Continuous Improvement

The SSE program is committed to an assessment strategy that will ensure high impact to students and their employers, and high quality of services to students, faculty, and
alumni. The program will build upon and adapt evaluation methods currently employed in the MEPP degree program, which have been selected as a model best program for distance programs by the Sloan Consortium.

Elements of the program will include:

- Mid-course surveys for all new course to enable early detection and corrective action to ensure course content and logistics are responsive to students’ needs and interests
- An end-of-semester evaluation of each course by students and the instructor
- A detailed programmatic evaluation by students at graduation
- A program impact survey conducted 9-12 months after graduation that includes graduates, and workplace supervisors and/or professional peers.

Feedback from all sources will be reviewed with faculty, staff and the program advisory committee to identify opportunities and actions for continuous quality improvement.

5.0 ADMISSIONS AND DEGREE REQUIREMENTS

5.1 Admission Requirements

An admissions committee has been assembled for this degree, and each application will be individually reviewed by its members. The committee includes the Director of Engineering Distance Degree Programs (Wayne Pferdehirt), the program director for this degree (Marty Gustafson), Engineering Professional Development Professor Patrick Eagan, and the Director of Student Services for the Department of Engineering Professional Development (Gary Henderson).

The stated admission requirements include a Bachelor of Science degree in engineering or engineering technology from an ABET-accredited institution; a minimum grade point average equivalent to 3.0 on a 4.0 system; and three letters of recommendation.

Exceptions to any of these requirements could be made on an individual basis at the discretion of the admissions committee. Each student recommended for admission by the committee must then receive admission approval from the Graduate School.

Up to 6 transfer credits will be accepted, as we anticipate students working toward alternative degrees may be interested in applying to the program with specialization electives completed.

5.2 Graduation Requirements

In order to fulfill the degree requirements, each student must maintain at least a ‘B’ (3.0 on a scale of 0-4) average throughout the program. Any individual class in which the student receives a ‘D’ or lower must be repeated.

To meet the requirements for a Master of Engineering degree, each student must also complete at least nine credits at the 500-level or above. At least twelve credits must be
taken from the College of Engineering. Again, within the core curriculum 11 of the 14 credits are from CoE, along with two-thirds of the elective courses, allowing for this requirement to be reached.

Finally, should any students be accepted into the program lacking appropriate work experience in their chosen field, they must complete at least six credits of engineering professional practice. Three credits of this requirement will be met by a capstone project. The additional three credits can be met through the projects required in the core courses (EPD 660 and 661), with additional opportunities for professional practice in optional independent research, or through other elective courses with a project requirement. Students will be assigned an academic advisor to help them tailor course selection to meet degree and specialty requirements and to help students ensure they meet their learning goals.

6.0 CURRICULUM

6.1 Courses

The proposed SSE curriculum combines a fixed core curriculum with some flexibility of electives to give students the opportunity to tailor their learning to personal needs. The proposed 14-credit core curriculum for SSE includes:

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPD 641</td>
<td>Essential Skills for Engineering Productivity: On-line learning, group projects, technical communication Instructors: Tom Smith, Don Hanna, Mark Millard, Traci Nathans-Kelly, Christine Nicometo</td>
<td>2</td>
</tr>
<tr>
<td>EPD 660</td>
<td>Core Competencies of Sustainability: Foundational applications in sustainable competencies and tools Instructor: Patrick Eagan</td>
<td>3</td>
</tr>
<tr>
<td>EPD 661</td>
<td>Industrial Ecology Sustainability Tools: Systems analyses and optimization through contexts and tools Instructor: Patrick Eagan</td>
<td>3</td>
</tr>
<tr>
<td>EPD 662</td>
<td>Sustainable Improvements of Complex Systems: analytical techniques for improving operations and design processes Instructor: Mark P. Finster</td>
<td>3</td>
</tr>
<tr>
<td>EPD 669</td>
<td>Sustainability Initiative Capstone Instructor: Marty Gustafson</td>
<td>3</td>
</tr>
</tbody>
</table>

The core courses (with the exception of the capstone) will be offered in the first year of the program. After completion of the core courses, students can select 13 credits of elective courses that represent an area of specialization.

In order to integrate faculty from the College of Engineering into the SSE program,
existing courses are preferred as electives for the program. EPD will work with faculty to adapt relevant existing material into a model for online graduate learning. We anticipate that all electives will be offered as online sections for the SSE program, and will not mix on-campus with off-campus students.

The following existing courses have been identified as aligning well with the overall goals and objectives of the SSE program:

**General Electives in Policy, Impact and Sustainability Sciences (take 1-8 credits)**
- Geo 411: Energy Resources (3 credits)
- Envir St 575: Assessment of Environmental Impact (3 credits)
- Envir St 809: Energy Analysis and Policy (3 credits)
- EPD 664: Change Management (1 credit)
- EPD 665: Introduction to GIS Systems (1 credit)
- Envir St 707: Professional Skills for Global Systems Analysis (1 credit)
- Envir St 707: Professional Skills for Regional and Local Sustainability (1 credit)

**Specialization Electives (take 6-12 credits)**
- Facilities and the Built Environment
  - BSE 367: Renewable Energy Systems (3 credits)
  - Envir St 506: Modeling and Analysis of Environmental Systems (3 credits)
  - Civ Engr 649: Sustainable Energy Building Design (1-3 credits)
  - Civ Engr 698: Lean Construction Principals and Practices (3 credits)

- Energy Production and Distribution
  - BSE 367: Renewable Energy Systems (3 credits)
  - ME 567: Solar Energy Technology (3 credits)
  - Civ Engr 639: Wind Energy Site Design (3 credits)
  - Civ Engr 649: Sustainable Energy Building Design (3 credits)
  - Envir St 809: Energy Analysis and Policy (3 credits)

- Public Infrastructure
  - ME 466: Air Pollution Effects, Measurement and Control (3 credits)
  - Envir St 506: Modeling and Analysis of Environmental Systems (3 credits)
  - Civ Engr 694: Management of Civil Infrastructure Systems (3 credits)
  - Civ Engr 698: Sustainability of Infrastructure Systems (3 credits)

EPD is currently working with the faculty members of these and other courses to identify, engage, and schedule faculty interested in teaching in the program. Support letters from a number of faculty are included in the Appendix. As we receive support, we are creating a schedule of electives. For example, based on the support of faculty, the following courses will be available as electives in the energy specialization for the first two years of the program:

- Geo 411: Energy Resources
- BSE 367: Renewable Energy Systems
• ECE 356: Electric Power Processing for Alternative Energy Systems
• ME 466: Air Pollution Effects, Measurement and Control

Our goal is to enroll 20 students for the fall 2012 inaugural enrollment, and up to 50 students (2 sections) each year thereafter. Two examples of a sample student tracks are given below:

<table>
<thead>
<tr>
<th>Infrastructure Specialization</th>
<th>Energy Specialization</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Course No.</strong></td>
<td><strong>Name</strong></td>
</tr>
<tr>
<td>EPD 641</td>
<td>Essential Skills for Engineering Productivity (Smith)</td>
</tr>
<tr>
<td>EPD 660</td>
<td>Core Competencies of Sustainability (Eagan)</td>
</tr>
<tr>
<td>EPD 661</td>
<td>Industrial Ecology Sustainability Tools (Eagan)</td>
</tr>
<tr>
<td>EPD 662</td>
<td>Sustainable Improvements of Complex Systems (Finster)</td>
</tr>
<tr>
<td>Geol 411</td>
<td>Energy Resources (Carroll)</td>
</tr>
<tr>
<td>Envir St 575</td>
<td>Assessment of Environmental Impact (Ventura)</td>
</tr>
<tr>
<td>CEE 423</td>
<td>Air Pollution Effects, Measurement and Control (Schauer)</td>
</tr>
<tr>
<td>CEE 698</td>
<td>Sustainability of Infrastructure Systems (TBD)</td>
</tr>
<tr>
<td>CEE 649</td>
<td>Sustainable Energy Building Design (TBD)</td>
</tr>
<tr>
<td>EPD 669</td>
<td>Sustainability Initiative Capstone (Gustafson)</td>
</tr>
</tbody>
</table>

### 6.2 Course Delivery

The SSE degree is to be offered as a distance-learning program, using the software and methods previously developed and tested for the award-winning Master of Engineering in Professional Practice (MEPP) and Master of Engineering in Engine Systems (MEES)
programs as a baseline. The primary delivery mechanism is via asynchronous Internet delivery, supplemented with weekly web conferences for each course.

For the initial semester (Fall 2012) students will be able to register for two courses from the core course list: EPD 641 and InterEngr 601 (course name change to EPD 660 submitted February 9). An additional two courses will be offered the following semester. The first year will provide students to develop as a learning community and build valuable peer support through their on-line learning interactions. Specialization electives will be offered in the second year, with course offerings matched to the specialization tracks declared by students upon admission. We expect that specialization electives will further enhance peer and faculty interactions within the learning community.

6.3 Faculty Support for Instruction

EPD offers a unique model for new instructors and online course development designed to provide an exceptional level of support. All faculty will receive funding from EPD for developing new courses used in the SSE program. In addition to financial support, faculty will be provided with instructional design and technical support. As an additional benefit, participating faculty will have unrestricted use of all online course materials, enabling their use for on-campus instruction. This model also provides a mechanism to provide funding for departments. These funds encourage the creation of new courses in areas of SSE specializations that can later be applied to other on-campus programs.

When participating faculty’s classes are offered, their departments will receive 25% of off-campus tuition revenue for courses. Elective courses will only be offered when there is sufficient student enrollment and instructor availability. We anticipate that during the first two years, we will offer a limited number of elective options to maintain course enrollment.

This revenue sharing follows the established CoE Credit Courses at a Distance revenue sharing model. It assumes that one quarter (25%) of the tuition revenue generated by graduate students enrolled in this program will be returned directly to the department and instructor teaching the course, to be distributed at their discretion. Another 25% will be used to provide partnering faculty with instructional technology and support, student services, and teaching assistance. A third 25% will be allocated to support the development of future CoE distance learning initiatives. The remaining 25% will be used for marketing, administration, and online delivery infrastructure, as shown below.
7.0 COLLABORATIONS AND PARTNERSHIPS

EPD has partnered with multiple partners throughout the UW Campus in the design and development of the SSE program curricula and instruction. Support letters from participating faculty, the Chair of the Civil and Environmental Engineering Department, the Chair of the Biological Systems Engineering Department, the Nelson Institute for Environmental Studies, the UW-Madison Division of Continuing Studies, and the UW-Madison Office of Sustainability are included with this request for approval to demonstrate how the program aligns well with the CoE’s strategic goal of expanding distance education and the College’s selection of sustainability as a key area of research emphasis.

The campus’s support for this program is further evidenced by the commitment by the Division of Continuing Studies to provide $250K in start-up funds as a loan to fund development and launch efforts, and the Office of Sustainability’s $50K funding for EPD Professor Patrick Eagan, a key member of the SSE faculty.

8.0 ENROLLMENT PROJECTIONS

EPD’s market study surveyed over 300 potential students and companies targeted for enrollment. Based on the results of this survey and our experience with existing online Master of Engineering options, we project that SSE enrollment will consist of mid-career engineers studying at a distance. These will be new students for UW-Madison who would be unlikely to resign their jobs and move to Madison to pursue a graduate degree:
Pilot Year (Conservative, will take up to 25 students)
  - 12 students
Year One Full Enrollment
  - 50-60 students
Year Two – Steady State Enrollment
  - 50-60 students

9.0 FACULTY

The following faculty from Engineering Professional Development will be participating in the SSE Program:

Pat Eagan, PhD, is a professor with Department of Engineering Professional Development, University of Wisconsin–Madison and a Faculty Fellow for Sustainability Education.
Don Hanna, PhD, is director of educational communications, University of Wisconsin–Extension.
Mark Millard, MS, is the instructional design and technology specialist for the Department of Engineering Professional Development, University of Wisconsin–Madison.
Bulent Sarlioglu, PhD, is as assistant professor for the University of Wisconsin–Madison's Department of Engineering Professional Development.
Tom Smith, MS, is director of telecommunications programming in the Department of Engineering Professional Development, University of Wisconsin–Madison.

The following faculty from UW-Madison have provided support letters for the program and will be working with EPD to develop elective courses for the program:

Mark P. Finster, PhD, is an associate professor for the University of Wisconsin-Madison’s School of Business.
Alan Carroll, PhD, is a professor for the University of Wisconsin-Madison’s Department of Geoscience.
James Schauer, PhD, is a professor for the University of Wisconsin-Madison’s Civil and Environmental Engineering Department.
Giri Venkataramanan, PhD, is a professor for the University of Wisconsin-Madison’s Electrical and Computer Engineering Department.
Douglas Reinemann, PhD, is a professor for the University of Wisconsin-Madison’s Biological Systems Engineering Department.

10. FINANCIAL SUPPORT

The initial development of this program is being funded by a $250K loan from the Division of Continuing Studies. The Office of Sustainability is also providing $50K for EPD Professor Patrick Eagan, a key member of the SSE faculty, to promote sustainable
educational initiatives on campus. The design and launch of degree is the first initiative under his appointment.

Using data from our market study, EPD’s financial analysis found that the SSE degree program would be generating net positive cash flow in the second full year of operation. The financial pro forma for the SSE degree program was built upon a combination of our experience with existing Master’s degree programs and marketing intelligence gathered specifically for this project. Under this model, the program will be cash positive after the second year of operation, assuming that expenditures follow the engineering credit courses at a distance model, where 25% of tuition revenue is returned to the department of the instructor. Using these assumptions and a Fall 2012 start, EPD found that following the initial (two-year) start-up phase, SSE represents a significant, ongoing business opportunity for at least five years.

The following revenue, expenditure, and enrollment assumptions were used in the development of the pro forma, shown below:

Revenue:
- Tuition based on constant per credit rates for graduate students in effect for Spring 2012
- No other revenue sources beyond tuition and DCS loan

Expenditures:
- 25% gross revenue pay out to departments providing courses
- Administrative and Marketing charges for EPD oversight
- Instructional expenses for direct cost of curriculum and instruction

<table>
<thead>
<tr>
<th>Year</th>
<th>Revenue</th>
<th>Expenses</th>
<th>Balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pilot Year (FY2013)</td>
<td>$84,640</td>
<td>($269,725)</td>
<td>($185,085)</td>
</tr>
<tr>
<td>Year One (FY2014)</td>
<td>$805,550</td>
<td>($733,456)</td>
<td>$72,094</td>
</tr>
<tr>
<td>Year Two (FY2015)</td>
<td>$1,446,710</td>
<td>($893,746)</td>
<td>$552,964</td>
</tr>
</tbody>
</table>
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Supplemental Materials:
1.0 Support Letters from Departments and Faculty
2.0 Approval from the College of Engineering Master of
Oversight Committee

College of Engineering
Engineering Professional Development
1.0 Department and Faculty Support Letters

College of Engineering
Engineering Professional Development
February 24, 2012

Philip R. O’Leary, PhD, PE
Professor and Chair
Department of Engineering
Professional Development
432 North Lake Street
Madison, Wisconsin 53706

Dear Dr. O’Leary,

Please accept the support of the Division of Continuing Studies for the development of a new online Master of Engineering in Sustainable Systems Engineering (SSE) program. We look forward to partnering with EPD to help provide sufficient financial resources and revenue sharing to assist the participating faculty with the appropriate instructional and technical support to achieve high quality learning experience for the students. We understand that the instructional materials developed for this online program will also be made available for on campus instruction. This kind of leveraging of our academic assets is an excellent example of Educational Innovation on campus.

We applaud EPD’s continued leadership in online learning, and look forward to moving ahead with you and additional partnering departments in this endeavor.

Sincerely,

[Signature]
Jeffrey S. Russell, P.E., Ph.D
Vice Provost for Lifelong Learning and Dean

Vice Provost for Lifelong Learning and
Dean, Division of Continuing Studies
21 N. Park Street, 7th Floor Madison, WI 53715-1218
608/262-5821  Fax: 608/265-4555    ContinuingStudies.wisc.edu
11 March 2012

Philip R. O’Leary, PhD, PE
Professor and Chair
Department of Engineering Professional Development
432 North Lake Street
Madison, Wisconsin 53706

Re: Master of Engineering in Sustainable Systems Engineering

Dear Professor O’Leary:

This letter is to acknowledge support from the Office of Sustainability (OS) regarding the development of a new online Master of Engineering in Sustainable Systems Engineering (SSE) program by the Department of Engineering Professional Development (EPD). The Office of Sustainability is happy to collaborate with EPD in developing this degree program and has included this support as one of our strategic initiatives, including program and course development support from our Education Faculty Fellow, Professor Patrick Eagan. We are convinced that commitment to this important effort will deliver strategic advantages to the UW-Madison, and most importantly to our students, their employers, and society at large.

We look forward to moving ahead with you and the partnering departments in this endeavor.

Sincerely,

Craig H. Benson, PhD, PE, DGE, NAE
Co-Director and Director of Research & Education
19 February 2012

Philip R. O’Leary, PhD, PE
Professor and Chair
Department of Engineering Professional Development
432 North Lake Street
Madison, Wisconsin 53706

Re: Master of Engineering in Sustainable Systems Engineering

Dear Professor O’Leary:

Please accept the support of the Department of Civil and Environmental Engineering (CEE) for the development of a new online Master of Engineering in Sustainable Systems Engineering (SSE) program by the Department of Engineering Professional Development (EPD), in cooperation with the Office of Sustainability (OS) and the Division of Continuing Studies (DCS). Sustainable systems design and applications of sustainability are integrated throughout the engineering process, and are foundational principals in many of our courses.

As we prepare to help engineering students compete and excel against the backdrop of globalization, resource use issues, and growing population, there is a need to develop in our engineers the skills and competencies for systems thinking and analysis of products, services and infrastructure. Learning how to use “tools” without an understanding of this broader context can lead to problems in decision-making or unintended impacts on the environment and society.

We would be happy to participate with your department in the Sustainable Systems Engineering program. We will support the program with appropriate faculty support and relevant courses as negotiated. We appreciate EPD’s partnership in supporting our faculty with instructional design and delivery support for teaching in a virtual learning environment, and are convinced that CEE’s commitment to this important effort will deliver strategic advantages to the College of Engineering, the University, and most importantly to our students, their employers and society at large.

We look forward to moving ahead with you and additional partnering departments in this endeavor.

Sincerely,

Craig H. Benson, PhD, PE, DGE, NAE
Wisconsin Distinguished Professor and Chair
March 6, 2012

Philip R. O’Leary, PhD, PE
Professor and Chair
Department of Engineering Professional Development
432 North Lake Street
Madison, Wisconsin 53706

Dear Dr. O’Leary,

Please accept the support of the Nelson Institute for Environmental Studies for the development of a new online Master of Engineering in Sustainable Systems Engineering (SSE) program. We understand that EPD will provide sufficient financial resources and revenue sharing to assist our participating faculty with the appropriate instructional and technical support to achieve high quality learning experience for the students. We also appreciate that instructional materials developed for this program will be available for on campus instruction.

We look forward to moving ahead with you and additional partnering departments in this endeavor.

Sincerely,

[Signature]

Gregg Mitman
Nelson Institute, Interim Director
March 5, 2012

Philip R. O’Leary, PhD, PE
Professor and Chair
Department of Engineering Professional Development
432 North Lake Street
Madison, Wisconsin 53706

Dear Dr. O’Leary(Phil):

Please accept the support of the Biological Systems Engineering for the development of a new online Master of Engineering in Sustainable Systems Engineering (SSE) program. We understand that EPD will provide sufficient financial resources and revenue sharing to assist our participating faculty with the appropriate instructional and technical support to achieve high quality learning experience for the students. We also appreciate that instructional materials developed for this program will be available for on campus instruction.

We look forward to moving ahead with you and additional partnering departments in this endeavor.

Sincerely,

Richard Straub
Professor and Chair
February 17, 2012

Philip R. O’Leary, PhD, PE
Professor and Chair
Department of Engineering Professional Development
432 North Lake Street
Madison, Wisconsin 53706

Dear Dr. O’Leary,

Please accept my support for the new online Master of Engineering in Sustainable Systems Engineering (SSE) program being developed by the Department of Engineering Professional Development (EPD), in cooperation with the Office of Sustainability (OS) and the Division of Continuing Studies (DCS). Sustainable systems design and applications of sustainability are integrated throughout the engineering process, and are foundational principals in many of my courses in Energy Resources.

As we prepare to help engineering students compete and excel against the backdrop of globalization, resource use issues, and growing population, there is a need to develop and learn skills and competencies for systems thinking and analysis of products, services and infrastructure. Learning how to use “tools” without an understanding of context will lead to problems in decision-making or unintended impacts on the environment and society.

I would be happy to participate with your department in the Sustainable Systems Engineering program, and look forward to teaching an online course with you in the future. I will work together with the Program Director to determine a mutually convenient schedule, and utilize EPD’s resources in instructional design and delivery support as needed.

I look forward to moving ahead with you in this endeavor.

Sincerely,

Alan Carroll
Professor
7 March 2010

Philip R. O’Leary, PhD, PE
Professor and Chair
Department of Engineering Professional Development
432 North Lake Street
Madison, Wisconsin 53706

Dear Dr. O’Leary,

Please accept my support for the development of a new online Master of Engineering in Sustainable Systems Engineering (SSE) program. Sustainable systems design and applications of sustainability are integrated throughout the engineering process, and are foundational principals in many of my courses in Renewable Energy Systems and Integral Ecology.

As we prepare to help engineering students compete and excel against the backdrop of globalization, resource use issues, and growing population, there is a need to develop and learn skills and competencies for systems thinking and analysis of products, services and infrastructure. Learning how to use “tools” without an understanding of context will lead to problems in decision-making.

An online Master of Engineering degree in Sustainable Systems Engineering will provide students with a background in engineering to assess and evaluate the impact and performance of complex systems on the quality of water, land, air, energy, economics, and society. It will complement our existing degree programs and the needs of its target student population of practicing, mid-career engineers.

I would be happy to participate with your department in the Sustainable Systems Engineering program, and look forward to teaching my courses in renewable energy in the future. I will work together with the Program Director to determine a mutually convenient schedule, and utilize EPD’s resources in instructional design and delivery support as needed.

I look forward to moving ahead with you in this endeavor.

Sincerely

Douglas J. Reinemann, Ph.D., Professor of Biological Systems Engineering, University of Wisconsin-Madison
Dear Dr. O’Leary,

Please accept my support for the development of a new online Master of Engineering in Sustainable Systems Engineering (SSE) program. I look forward to working with you to learn how my interests in electrical power processing for alternative energy systems can be adapted to the SSE program.

I understand that EPD will be able to provide sufficient financial resources and revenue sharing for myself and my department to assist with instructional and technical support. I also appreciate that instructional materials developed for this program will be available for on campus instruction or to benefit my existing course offerings.

I look forward to moving ahead with you in this endeavor.

Sincerely,

Giri Venkataramanan
Professor
On Feb 25, 2012, at 7:09 AM, JAMES J SCHAUER wrote:

Phil,

I would be very interested in developing an online module for my air pollution control course for the subject degree and would be very interested in participating in this effort in other ways that would be helpful. As you may recall, I have a distance learning MBA and very interested in your efforts.

Thanks
Jamie

On Thu, 09 Feb 2012 15:13:30 -0600 "Philip R. O'Leary" wrote

Hi,

Starting in the Fall of 2012, the Department of Engineering Professional Development (EPD) and partnering College of Engineering (CoE) departments will build on the University of Wisconsin’s reputation in engineering, environmental science, and sustainability to offer a new Master of Engineering in Sustainable Systems Engineering (SSE). The degree will build on the University of Wisconsin’s reputation in engineering, environmental science, and sustainability to prepare students with a background in engineering to lead sustainability initiatives and engage stakeholders, understand how sustainability affects design, and use performance tools to analyze the sustainability of complex systems.

The curriculum for this online-only 27 credit Master of Engineering Degree includes a series of required courses and approved courses in an area of specialization. Initially, specializations will focus on facilities and the built environment, energy production and distribution, and public infrastructure, allowing students to tailor their learning to better meet professional and personal objectives.

You are currently listed as an instructor of a course that could be very relevant as an elective in our new degree program - ME 466: Air Pollution Effects, Measurement and Control. We would therefore like to meet with you to discuss this opportunity at your earliest convenience. We can introduce the program design, EPD’s ability to provide faculty with adequate instructional design and delivery support for teaching in a virtual learning environment, and our revenue model.

Please let me know your availability so we can present additional information on this new distance degree.

Regards,
Phil
Philip R. O'Leary, Professor and Chair, EPD
March 5, 2012

Philip R. O’Leary, PhD, PE
Professor and Chair
Department of Engineering Professional Development
432 North Lake Street
Madison, Wisconsin 53706

Dear Dr. O’Leary,

Please accept my support for the development of a new online Master of Engineering in Sustainable Systems Engineering (SSE) program. I look forward to working with you in the future on incorporating techniques for operational system improvements into the SSE program.

I look forward to moving ahead with you in this endeavor.

Sincerely,

Mark P. Finster
Wisconsin School of Business
College of Engineering

975 University Ave
Madison, WI 53716

608.262.1998
mfinster@wisc.edu
2.0 Master of Engineering Oversight Committee Authorization Documentation

College of Engineering
Engineering Professional Development
March 15, 2012

Associate Dean Steve Cramer
College of Engineering
University of Wisconsin - Madison

Dear Dean Cramer:

The Masters of Engineering Oversight Committee met on February 28, 2012 to discuss a new degree specialty for the Masters of Engineering degree program. Minutes of the meeting are attached.

The new degree program will be called a Masters of Engineering in Sustainable Systems Engineering. The committee voted unanimously to recommend that the degree specialty be approved by the College of Engineering.

Best regards,

Christopher J. Rutland

Encl.
MINUTES
Master of Engineering Oversight Committee
Tuesday, February 28, 2012

Present: Blanchard, DeMarco, Pferdehirt, Rutland, Cramer (ex oficio)

1. Phil O’Leary and Doug Reindl from EPC meet with the committee to present their plan for a new specialty to the Masters of Engineering degree program. The new degree specialty will be called a Master of Engineering in Sustainable Systems Engineering. The slides from O’Leary’s presentation are attached.

2. After O’Leary’s presentation and discussion by committee members, O’Leary and Reindl left and the committee moved into closed session.

3. The committee’s discussion of the new degree specialty was generally positive. Rutland made a motion, seconded by Pferdehirt, that the committee recommend to the College of Engineering that the new degree specialty be approved. The vote for the motion was unanimous.

4. Rutland will write a letter to Cramer reporting the outcome of the vote.

Submitted by Rutland, March 6, 2012
Master of Engineering in Sustainable Systems Engineering

The purpose of the ME-Sustainable Systems Engineering program is fill an unmet demand for engineers prepared to meet the technical and business challenges of maximizing sustainable performance in their workplace.

Program Goals

The Sustainable Systems Engineering program is designed for mid-career engineers that wish to build technical and leadership skills to:

- Lead sustainability initiatives
- Understand how sustainability relates to design
- Engage stakeholders in sustainability issues
- Apply tools to perform needs assessments, environmental modeling, life-cycle cost analyses, optimization, and impact statements

Strong Support Across Campus

- Support letters received from:
  - Division of Continuing Studies
  - Also provided $250K loan for development
  - Department of Civil and Environmental Engineering
  - Interested faculty in Geol, Civil & Engr, Engr, and Environi
- Verbal support with letters forthcoming:
  - Office of Sustainability
  - Also provided $50K in appointment funding
  - Nelson Institute for Environmental Studies
  - Numerous additional faculty

Market Feasibility Study

- An initial market assessment was performed in October of 2010 to determine the feasibility of a design concept for SSE.
  - Assessment gauged interest among engineers and technical professionals, level of employer support, potential funding sources, and program design requirements.
  - Results also revealed specialties of greatest demand

- We found a sufficient pool of degree candidates in the near and long-term, a sufficient level of employer support, a high degree of recognition and value assigned to the UW brand, and a positive valuation and willingness to hire program graduates.
  - Need for 2-3 year online program
  - Risk to program success is student funding

Sustainable Business Plan

- Our financial analysis found that, using the standard tuition schedule, SSE can generate a positive cash flow by the second year of full enrollment.
  - Following the 2-year start-up, SSE represents a significant, ongoing business for at least five years.
- Revenue:
  - Base tuition from published UW Spring 2012 tuition schedule
- Expenditures follow credit courses at a distance model

Key Competencies Addressed by SSE

- Targeted competencies have focused course selection and curriculum development
  - Engineering science and technologies
  - Business practice and economics
  - Principles, tools, and methods for engineering systems analysis
  - Engineering management and planning
  - Environmental justice, poverty, consumption and equity
  - Ideas and technical innovation
  - Personal effectiveness and leadership
  - Working across boundaries and disciplines
  - Global perspective
SSE Program Structure Meets Requirements of CoE Master of Engineering Degrees

<table>
<thead>
<tr>
<th>Master of Engineering Degree</th>
<th>Sustainable Systems Engineering Curriculum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Admissions standards</td>
<td>B.S. in AEE Engineering, GPA of 3.0</td>
</tr>
<tr>
<td>Minimum of 28 credits</td>
<td></td>
</tr>
<tr>
<td>Minimum of 22 credits in engineering</td>
<td></td>
</tr>
<tr>
<td>Minimum of 6 credits in all other areas</td>
<td></td>
</tr>
<tr>
<td>Minimum of 12 credits at the 600 level or above</td>
<td></td>
</tr>
</tbody>
</table>

If students do not complete the core requirements, they must provide 6 credits of engineering electives.

Proposed Core Courses

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EFD 461</td>
<td>Essential Skills for Engineering Productivity (Smith)</td>
<td>2</td>
</tr>
<tr>
<td>EFD 660</td>
<td>Core Competencies of Sustainability (Eagan)</td>
<td>3</td>
</tr>
<tr>
<td>EFD 661</td>
<td>Industrial Ecology Sustainability Tools (Eagan)</td>
<td>3</td>
</tr>
<tr>
<td>EFD 662</td>
<td>Sustainable Improvements of Complex Systems (Feuster)</td>
<td>3</td>
</tr>
<tr>
<td>EFD 669</td>
<td>Sustainability Initiative Capstone (Faculty Advisor)</td>
<td>3</td>
</tr>
</tbody>
</table>

Proposed Initial Specializations

- Energy Resources
- System Modeling and Analysis
- Sustainable Design and Construction
- Renewable Energy
- Sustainable Building Design
- Wind, Solar
- Infrastructure
- Geospatial Modeling and Analysis
- Sustainable Infrastructure Design
- Air and Water

General Education and Seminar
- Assessment of Environmental Impact
- Economic and Policy Analysis
- Change Management
- Global, Regional, and Local Strategies

Sample Student Track

<table>
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<td>EFD 669</td>
<td>Sustainability Initiative Capstone (Faculty Advisor)</td>
<td>3</td>
</tr>
<tr>
<td>EnvEn 575</td>
<td>Assessment of Environmental Impact (Ventura)</td>
<td>3</td>
</tr>
<tr>
<td>CEE 429</td>
<td>Air Pollution Effects, Measurement and Control (Schauer)</td>
<td>3</td>
</tr>
<tr>
<td>CEE 696</td>
<td>Sustainability of Infrastructure Systems (Menassa)</td>
<td>3</td>
</tr>
<tr>
<td>CEE 699</td>
<td>Sustainable Energy Building Design (Wilson)</td>
<td>3</td>
</tr>
<tr>
<td>EFD 669</td>
<td>Sustainability Initiative Capstone (Faculty Advisor)</td>
<td>3</td>
</tr>
</tbody>
</table>

Support for Teaching Electives

- All faculty will receive funds, instructional design and technical support for courses taught in SSE
- Participating departments will receive 25% of tuition revenue for courses
- Courses will be offered when there is sufficient student enrollment and instructor availability
- The first two years of the program will have reduced elective options to maintain course enrollment

The opportunity exists to create new courses in areas of SSE specializations that can also be applied to on-campus instruction.

Proposed Program Rollout

- 2012
  - 12 students
  - 60% out-of-state
- 2013
  - 60 new students
  - 60% out-of-state
- 2014
  - 80 new students
  - 60% out-of-state
  - 80% graduation of initial 2012 class

Data taken from business plan assumptions with a Fall 2012 pilot vs. Spring 2013