PENNSTATE

College of Engineering

2014 – 2019 STRATEGIC PLAN

CEE MOVING FORWARD

CSASN image by M. Gooseff

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Current Profile

The Penn State Civil and Environmental Engineering Department, established in 1881, is internationally recognized for excellence in the preparation of undergraduate and graduate engineers through the integration of education, research, and leadership. We offer a B.S. degree in Civil Engineering, an undergraduate minor in Environmental Engineering, and M.S., M.Eng., and Ph.D. degrees in both Civil and Environmental Engineering. In 2011-2012, the Civil Engineering undergraduate program was ranked 17 by U.S. News and World Report, the graduate program in Civil Engineering was ranked 20, and the graduate program in Environmental Engineering was ranked 17.

More than 400 juniors and seniors are enrolled in the ABET accredited undergraduate program, and approximately 120 students in the graduate program, with about half pursuing doctoral degrees. Our outstanding, award-winning faculty offers a wide variety of courses from freshman to graduate level, encompassing all areas of civil and environmental engineering. We strive to maintain a well-balanced program in which the scholarship of research, teaching, and service are integrated into a world-class education for our students.

Mission

The mission of the Department of Civil and Environmental Engineering is to prepare students for professional practice, graduate study, life-long learning, societal leadership and to improve the scientific and technological basis for civil and environmental engineering practice. To fulfill this mission, the Department seeks to provide a high quality undergraduate program with instruction in all the fundamental areas of civil engineering, to conduct a distinguished program of research and graduate study in selected areas of civil and environmental engineering, and to disseminate advanced technical knowledge to engineers, other professionals, and the public.

Our Faculty

The current CEE faculty consists of 30 tenure-line and 3 non-tenure-line faculty members (see appendices for current listing). The 30 tenure-line faculty are divided amongst the research areas of Environmental, Geo-Materials, Structural, Transportation, and Water Resources Engineering. There are 10 assistant, 8 associate, and 12 full professors. One of the professors is a full-time administrator (department head), and another is a ½ time administrator (PTI director). Diversity on the tenure track faculty is represented by 20% women and 6% minorities. In 2011, the faculty published, or had accepted for publication, more than 130 articles in peer-reviewed journals and had research expenditures that exceeded $2 million.

Our faculty members have won many prestigious awards. Most recently, Dr. Bruce Logan was elected to the National Academy of Engineering. Other significant awards include the

Evan Pugh Professorship awarded to Dr. Bruce Logan. Drs. Michael Gooseff and Rachel Brennan have won the PSEAS Outstanding Teaching awards and Dr. Patrick Reed won the Outstanding Advising Award. Three of our faculty, Drs. Laman, Gooseff, and Banerjee, have won our departmental Harry West Teaching award.

Our three non-tenure-line faculty have provided energy and renewal to our undergraduate program in many different ways. Dr. Folmar, our Director of the Undergraduate Program, oversees our accreditation process, advises our undergraduate students, in addition to teaching undergraduate courses in the water resources area. Dr. Skibinski has energetically overhauled our undergraduate construction engineering program and revived our concrete canoe team. Dr. Velegol has led the way in developing innovative teaching techniques, including classroom flipping and online teaching.

Table 1 shows the hires and departures since 2001. Turnover of tenure-line faculty appears to be constant. Table 2 shows the total number and distribution of tenure-line faculty, comparing 2008 to 2012 numbers. We have maintained a reasonable distribution across the ranks of faculty.

Table 1. Faculty hires, retirements, and departures since 2001.

AY	New Hires (w/ rank)	Retirements	Departures (w/ rank)
01-02	J. Regan (A)	Unz	
02-03	Reed (A), Lopez (A)	Anderson, Kilareski	Miller-Hooks (A), Niemann (A)
03-04	Brennan (A)		Gourlias (F), Hiltunen (S), Elefteriadou (S)
04-05	Chehab (A), Donnell (A), Shankar (A), Wagener (A)		
05-06	Kasal (F), Palomino (A)	Burnett, Miller	Tikalsky (S)
06-07		Krauthammer	Sinha (A)
07-08	Folmar (N), Gooseff (A)		
08-09	Warn (A)	Matson, R. Regan	Schokker (S), Chehab (A)
09-10	Banerjee (A), Rajabipour (A)	Thomas	Hill (S)
10-11	Basu (A), Qiu (A)	Wang	Kasal (F); Palomino (A)
11-12	Skibinski (N)		Wagener (S)
12-13	Gayah (A), Radlinska (A), Mejia (A), Shen (A), Gorski (A), Memari (F), Velegol (N)	Dempsey	Linzell (F)

A = assistant professor; S = associate professor; F = full professor; NT = non-tenure-track faculty

Table 2. Comparison of faculty numbers since 2008 (writing of current plan) to 2012.

Year	Asst	Assoc	Full*	Non-tenure line	Total	% women (tenure line)	% minorities (tenure line)
2008	9	8	13	0	30	19	9
2012	10	8	12	2	32	20	7

*2 were full-time administrators in 2008; 1.5 in 2012.

Our Academic Programs

The department offers the BS, MS, MEng, and PhD degrees in Civil Engineering and MS, MEng, and PhD degrees in Environmental Engineering. Table 1 shows the enrollment trends over the last 27 years. The enrollment in CEE grew substantially in the last decade. Thus, an enrollment cap was implemented and took effect in Fall, 2009. In the most recent class (AY 2011-12), 15.6% women graduated with B.S. degrees in CE. This is up from less than 10% just four years prior. In general, the percentage of women in the undergraduate program is rising each year (see Figure 1). The percentage of minorities graduating with a B.S. degree tends to be about ½ that of the percentage of women in most years.

The department received a 6-year accreditation in the summer, 2009. Our next ABET visit will be in the Fall, 2014. In preparation for that important visit, our Director of the Undergraduate Program has collected data each year for specific classes to provide evidence of educational assessment for all desired outcomes. We are well on track to develop an outstanding report for this review.

The department has implemented several curriculum-based and extra curricular initiatives that have attracted an outstanding and diverse pool of students.

- We hired a non-tenure-line faculty member to head up an undergraduate program in construction engineering and management. This new faculty member is a practicing professional and a previous member of our advisory committee.
- We hired a second non-tenure-track faculty member to lead our new online graduate programs and assist faculty in developing their courses for online delivery.
- Renewed the concrete canoe competition team. After hearing from numerous alumni regarding the concrete canoe, our CEM took leadership of this program and the students entered the competition in 2012 for the first time in 4 years.
- Engaged students in a variety of activities that have enhanced their educational experiences in many ways, including:
    - Engineers without Borders. Many of our undergraduates and graduate students are actively engaged in local and global projects. Several of our faculty advise students on their projects.
    - Engineering Ambassadors. Currently, we have 4 students involved in this program.

- CEE Alumni Society. A group of our students worked side-by-side with alumni to develop this CEEAS, as well as a speakers bureau which the students can use to invite alumni in to give seminars, speak in classes, lead field trips, and serve on panels.
- Bridges to Prosperity. Our students will be involved in projects that seek to provide isolated communities with access to essential health care, education and economic opportunities by building footbridges over impassable rivers.
- Steel bridge competition. Our students usually place highly in this national competition.

In recent years, as shown in Table 3 and Figure 1, we have experienced a decline in the number of B.S. degrees due to our enrollment cap. We remain one of the largest B.S. granting CE programs in the country, currently in the top 12. However, we also have a far larger B.S. / faculty ratio than any of our peer institutions, as will be shown in the benchmarking section. As shown in Figures 1 and 2, the percentage of women in our undergraduate is slowly rising after a dramatic decrease since 2000. We currently have over 13% women enrolled in the undergraduate program and have a long way to go to return to the 20% levels prior to 2000. Minority populations have remained very low.

The following student organizations are hosted or co-hosted by CEE:

- The American Concrete Institute
- The American Society of Civil Engineers
- Chi Epsilon: Civil Engineering Honors Fraternity
- Earthquake Engineering Research Institute (EERI)
- Engineering Undergraduate Council (COE)
- Engineers Without Borders
- The Institute of Transportation Engineers
- National Association of Home Builders
- North American Society of Trenchless Technology
- Schreyer Honors College
- Sustainability Coalition
- Tau Beta Pi: National Engineering Honor Society
- Bridges to Prosperity

Table 3. Civil and Environmental Engineering Enrollment and Degrees Granted

Year	Undergraduate Students	Undergraduate Minorities	Undergraduate Women	Percent women undergrads	Graduate Students	B.S. Degrees	B.S. Degrees Women	M.S. Degrees	M.E. Degrees	Ph.D. Degrees
85-86	339				103	115	18	22	27	1
86-87	334				103	122	20	14	13	1
87-88	383				95	124	20	11	22	4
88-89	427				118	126	18	14	11	3
89-90	465				126	161	15	19	5	7
90-91	451				134	169	17	18	12	7
91-92	469				144	173	16	25	10	6
92-93	490				134	149	25	21	15	8
93-94	507				145	196	30	18	11	7
94-95	484				143	202	21	26	21	9
95-96	452				157	153	29	26	20	6
96-97	450				161	154	31	27	25	10
97-98	454				134	174	33	18	43	8
98-99	426				120	143	18	25	29	17
99-00	432				129	141	22	15	28	11
00-01	411	18	84	20.4%	139	161	36	17	31	7
01-02	387	16	75	19.4%	152	134	27	27	16	4
02-03	362	12	72	19.9%	147	140	36	28	8	13
03-04	380	24	63	16.6%	147	126	20	34	9	10
04-05	423	30	63	14.9%	128	141	28	30	15	16
05-06	466	40	64	13.7%	107	163	22	15	7	11
06-07	522	40	66	12.6%	134	175	29	21	9	14
07-08	601	44	67	11.1%	133	236	31	8		6
08-09	548	45	63	11.5%	107	237	23	24	4	18
09-10	486	45	68	14.0%	101	225	30	16	10	7
10-11	470	37	70	14.9%	117	225	26	24	3	8
11-12	405	28	53	13.1%	121	179	28	15	7	10

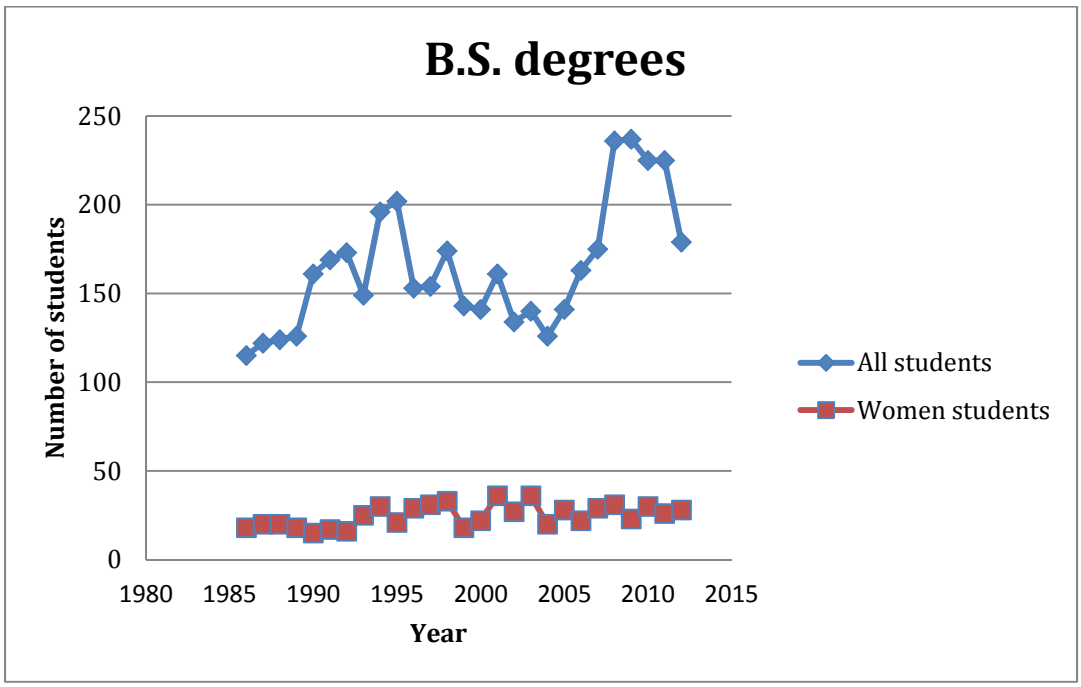

Figure 1. B.S. degrees in CEE since 1986.

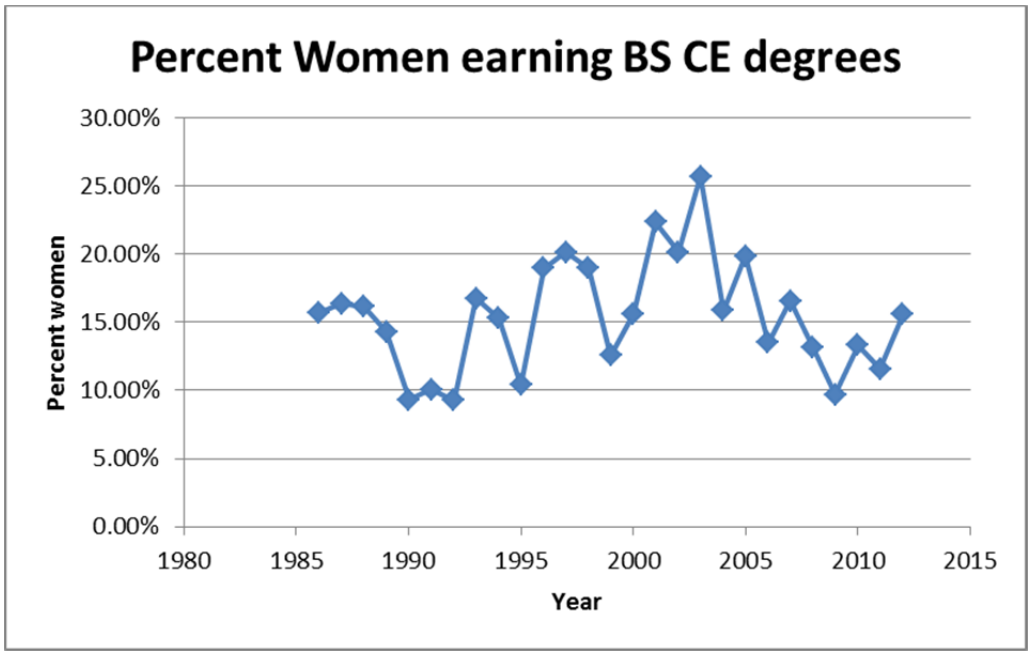

Figure 2. Women earning B.S. degrees in CEE since 1986.

The CEE department offers MS, MEng, and PhD degrees in both Civil Engineering and Environmental Engineering. The total number of graduate degrees, including MS, MEng, and PhD, has been fairly steady in recent years. There are currently 143 students enrolled in all CEE graduate programs, with 71 (about ½) of the students being international. Women are represented at a significantly higher rate across all of the graduate programs than in the undergraduate program.

The total number of PhD degrees awarded in CEE has been highly variable since the year 2000, as shown in Figure 3 and Table 1. Table 4 provides the current enrollments in the graduate program. Approximately 1/3 of the degrees are in environmental engineering, with the remainder in Civil. Tables 5 and 6 shows the percentage accepts for the PhD program, along with the GRE scores and degrees awarded. The percentage of students accepted into the PhD program has dropped significantly for the environmental PhD program to around 8% in recent years.

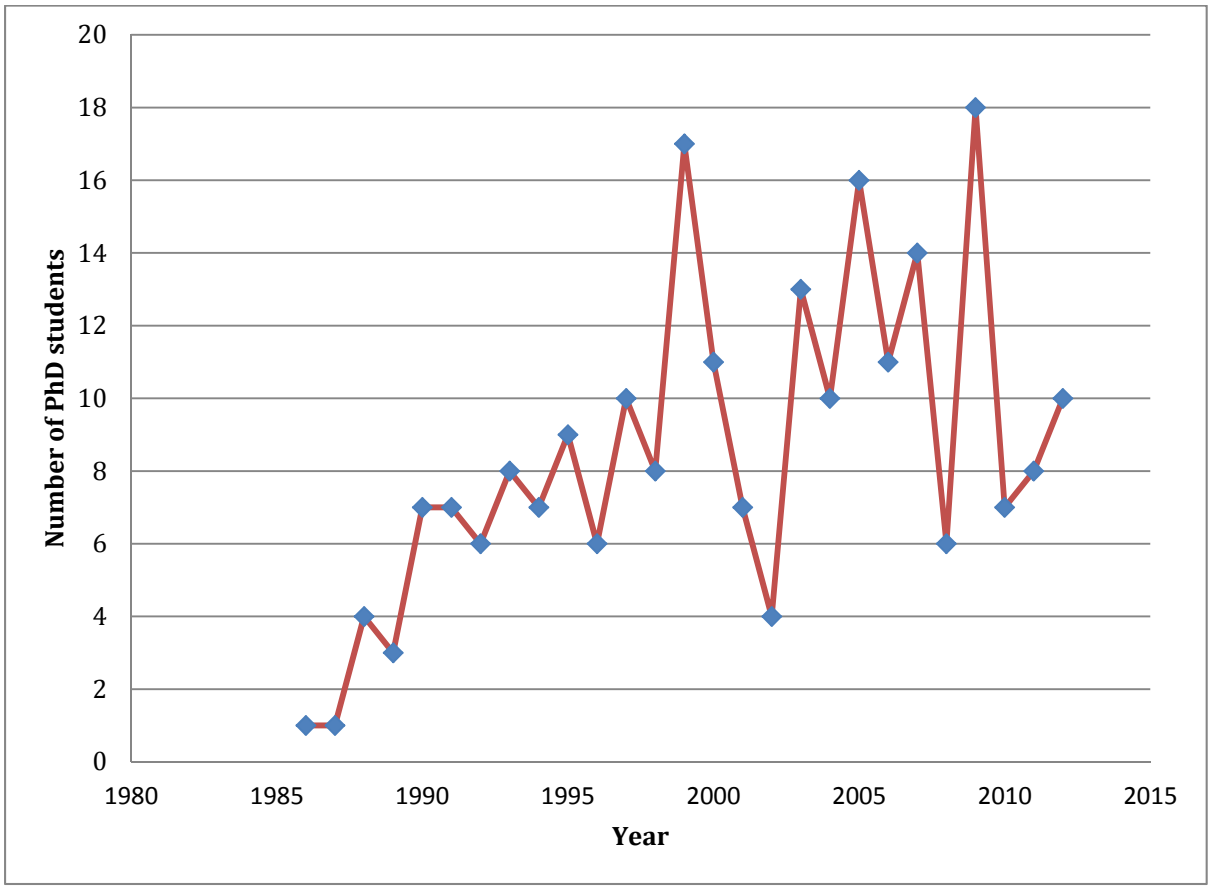

Figure 3. Total PhD degrees awarded per year.

Table 4. Enrollments in the CEE graduate program, as of spring, 2013.

Category of students	Civil MS/MEng	Civil/PhD	Env MS/MEng	Env PhD
Total current enrollment	73	40	17	13
Women	20	10	4	6
Minorities	4	2	0	0
International	33	25	3	9

Table 5. PhD accepts and degrees for Civil Engineering.

Academic Year	Percent Accepts	GRE median Verbal	GRE median quantitative	Number PhD Degrees
2001-2002	15			3
2002-2003	28			9
2003-2004	12	650	790	4
2004-2005	30	370	780	11
2005-2006	23	520	740	9
2006-2007	28	470	760	8
2008-2009	12	400	670	10
2009-2010	17	410	660	7
2010-2011	13	450	600	5
2011-2012	12	450	620	5

Table 6. PhD accepts and degrees for Environmental Engineering.

Academic Year	Percent Accepts	GRE median verbal	GRE median quantitative	Number PhD Degrees
2001-2002	25			2
2002-2003	29			2
2003-2004	13	650	790	6
2004-2005	36	610	750	5
2005-2006	37	480	700	2
2008-2009	23	490	740	7
2009-2010	8	460	730	3
2010-2011	8	470	560	3
2011-2012	8	520	560	5

Development

The department has been engaged in many development activities. Table 7 shows the results of these activities as of July 15, 2012. In addition, an estate gift of $500K for a Career Development Professorship in Environmental Engineering has been secured.

Table 7. Development successes for CEE, July 1, 2006 – July 15, 2012.

Category	Funds Raised
Scholarships	$436,953
Academic excellence Funds	$391,680
General Department Gifts	$354,813
Endowed Lectures	$36,250
Professorships	$753,455
Research Gifts	$10,010,000
Harry West Endowment	$74,120
Housing center	$88,674
Housing scholarship (NAHB)	$26,500
Grand Total	**$12,172,445**

The Harry West Endowment for the Advancement of Civil Engineering Education was endowed with the assistance of our engineering development officers, along with a committee of alumni. The endowment is intended to be used to advance our educational mission. Through this endowment, we annually award the Harry West Teaching Award to advance the department's continuing efforts in support of the scholarship of teaching and learning. The award is designed to inspire a broad range of faculty at all ranks to pursue excellence in teaching. The award is open to all full time faculty (tenured, tenure-track, and non-tenure track), regardless of rank and at any career stage. Each award recipient receives a small monetary award, which can be applied to professional needs (e.g., research expenses, travel to conference, support for a graduate assistant, or other professional expenses). In accepting this award, recipients are expected to work on a teaching issue during the award year, present the work at a faculty meeting following the academic year in which the award was received, and write a brief summary of the work that is published on the CEE website and in the newsletter. The Leonhard Center has been very supportive of this award and each year so far has matched the funding for the faculty member.

Research

The CEE program has a thriving research program. NSF Total S&E Research Expenditure Rankings for FY2010 (released in March, 2012) showed CEE as #24. Figure 4 provides the expenditures since 2008. As a whole, our department has clearly increased research funding from the federal government, as well as from private industry. Our average research expenditures per faculty member have increased from $235,600 in 2008 to $405,134 in 2011.

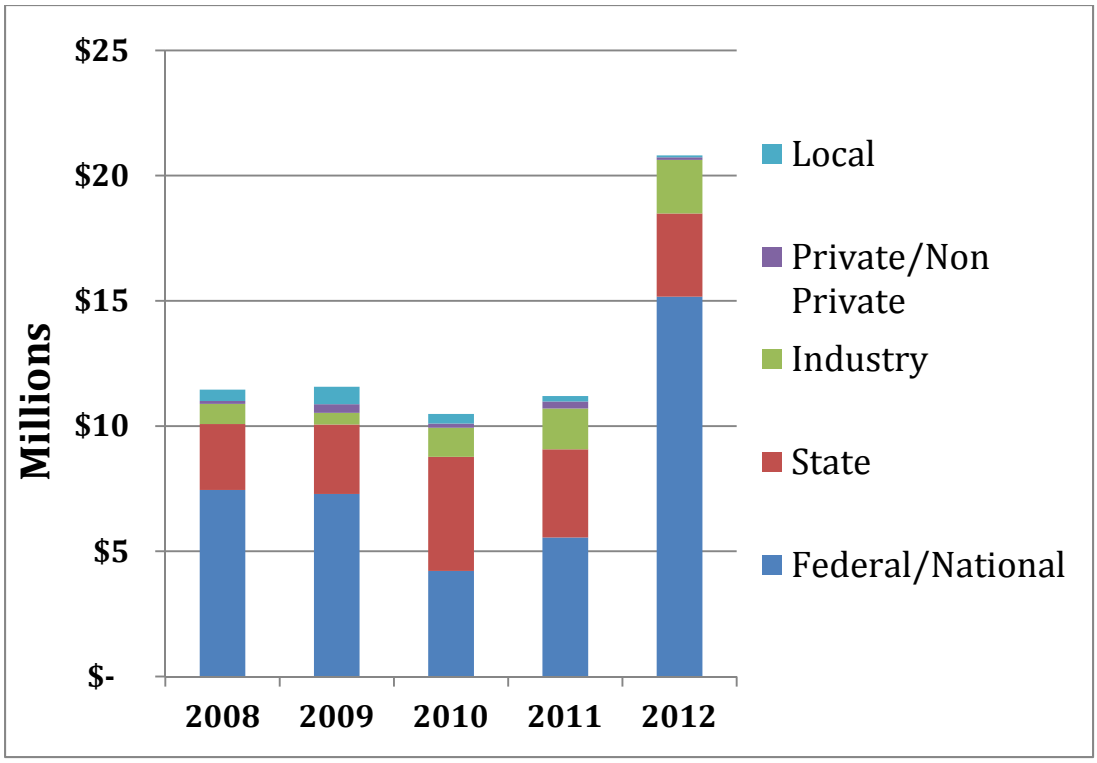

Figure 4. Research expenditures in Civil and Environmental Engineering for 2008 through 2012.

Facilities

The Civil and Environmental Engineering department is housed in the Sackett Building with additional offices and laboratory space at the Larson Transportation Institute (LTI) and Cato Park. CEE currently maintains the following laboratories and centers:

- *Bernard Hankin Construction Engineering and Management Research Laboratory.* The Building Enclosure Test Laboratory (BeTL), located at Cato Park in State College, is a facility that was developed to conduct performance tests on building enclosure systems and their component parts. Test specimens can include: complete wall or roof assemblies or sub-assemblies, windows, and joints.
- *Civil Infrastructure Testing and Evaluation Laboratory (CITEL).* The Civil Infrastructure Testing and Evaluation Laboratory (CITEL), affiliated with the Dept of Civil Engineering and The College of Engineering at Penn State, is a world-class laboratory focused on improving civil infrastructure. CITEL utilizes advanced testing and computational systems housed within a 56,000-square-foot facility to examine numerous issues related to the performance of the world's civil infrastructure. Our capabilities include: a concrete mixing area, environmental chambers that can simulate a number of climatic conditions, a composite materials laboratory, an accelerated pavement testing facility, computational facilities for advanced infrastructure analysis, a housing research

laboratory and a 10,000-square-foot structures laboratory for large- or small-scale testing.

- *Protective Technology Center (PTC).* The Protective Technology Center (PTC) at Penn State was established prior to the events of 9/11 to focus research and development activities with the goal of protecting people and infrastructure from terrorist attacks. The center encourages the use of multi-disciplinary research teams to address problems related to blast, shock, impact, and biological terrorism related concerns. The center is house in the Department of Civil and Environmental Engineering, but researchers include faculty, staff, and students from multiple Colleges within Penn State as well as the Applied Research Laboratory.
- *Hydraulics and Environmental Fluid Mechanics Laboratory.* The Hydraulics and Environmental Fluid Mechanics Laboratory is a facility for studies of sediment transport, scour, turbulence in stratified flows, turbulence studies in rivers and lakes, and other fluid phenomena and processes. Equipment includes a tilting sediment and water recirculating flume, venturi meter, manometer, acoustic doppler velocimeters, cameras and lasers for particle image velocimetry, an acoustic doppler current profiler, and microscale conductivity and temperature instruments.
- *Kappe Environmental Engineering Laboratories.* The environmental engineering laboratories cover an area of approximately 16,000 sq. ft., including a 2,000 sq. ft. laboratory at the University Wastewater Treatment Plant (less than one mile from the Department of Civil and Environmental Engineering). The Water Quality Lab at the Environmental Resources Research Institute performs contract analyses for research projects.
- *Pavement Laboratories.* The Pavement Laboratories include state-of-the-art pavement materials research facilities that consist of specimen fabrication, binder and mixture testing labs, accelerated testing and full-scale testing facilities. Currently the labs are equipped with three Universal Testing Machines, SST (Simple Shear Tester) tester, MMLS3 (Mobile Model Load Simulator) with test-bed and slab testing configurations, in addition to a comprehensive setup of specimen- and full- scale instrumentation. Binder labs are equipped with Superpave grading equipment: BBR DSR, RV, and DTT. Marshall testing equipment and volumetric instruments are also available.
- *Penn State Experimental Forest.* For more than 40 years, the Penn State Experimental Forest has been the site of water resource and environmental investigations focusing on sustainability of hardwood forests, water yield, and water quality. The Pennsylvania State University has played a key role in this effort by internally supporting the Leading Ridge, Shale Hills, and Shaver's Creek experimental watersheds and outreach programs.
- *Test Track.* A major research and testing facility of the Larson Transportation Institute (LTI) is the track and the facility located in Bellefonte, PA. The 5042-foot long oval shaped track provides the needed place for a wide range of transportation related research.

Recent upgrades in the Sackett, Hammond, and Engineering Units related to CEE include fire alarms and smoke detectors, lighting efficiency, second floor hallway upgrades, environmental lab renovation, and a Universal Testing Machine for the undergraduate lab. Problems in Sackett remain, including an antiquated HVAC system, asbestos, pests

(especially on the 4th floor), peeling paint, window leakage, operability, emissivity, frequent utility shutdowns for repairs (which greatly affects research), lack of shipping and receiving avenue for large parcels and equipment departures, elevator does not go to the 4th floor, lack of planned maintenance upgrades showcased by the first floor crumbling floor tile and rusted exposed radiators, the basement is prone to flooding with strong storms (we still have sand bags lining our rear basement stairwell), huge energy losses from the building, lack of an adequate conference or seminar room, and potential for additional fatigue and bursting of steam pipes often incased in asbestos.

At Cato Park, we have had a number of equipment purchases and upgrades, mainly associated with new faculty startups, including a Triaxial Load Apparatus, Resonance Column, Direct Shear Soil Tank, Glove Box, Environmental Chamber, 4 Table top Vena Environmental Chambers, and a Split Hopkinson Pressure Bar.

Benchmarking / Big 10 comparison

Data for the academic year 2011-2012 were collected from the Big 10 schools as a way to conduct comparisons with our peer institutions. Nine of the 12 schools, including Penn State, responded. Table 8 provides the mean, median, maximum, and minimum for a set of departmental characteristics for all nine schools, compared to the values for Penn State. Penn State CEE clearly has an unusually high undergraduate student population, given the size of the faculty. We have a median PhD graduation rate, and one of the highest research expenditures. Our faculty has done an incredible job of keeping a lively graduate research program going in spite of the large undergraduate program.

The diversity of our faculty is quite good compared to the Big 10; however, diversity in the undergraduate program is comparatively low. Penn State CEE has the lowest percentage of women in the undergraduate program in the Big 10. This number may, however, be skewed by the fact that most of the other Big 10 programs count undergraduates over all four years, where Penn State counts only over the junior and senior years. The percentages may be lower in those last two years than overall. The percentage of international graduate students is quite high across the Big 10, ranging from 30 to 62% of all graduate students. Penn State falls just above the average, at about half international students.

The tenure line faculty members in the CEE department at Penn State are fairly evenly distributed across the ranks, as they are at most of the other Big 10 schools. One exception has about ¾ of their faculty members in the Full Professor rank. Although all of the Big 10 hires part-time instructors, most have not hired many full-time non-tenure-line faculty. Penn state has 2 faculty members in this category.

Research expenditures range over an order of magnitude, with Penn State CEE near the highest value. About 70% of our funding expended during 2011-12 came from Federal sources. This is slightly above average for the Big 10 schools.

Table 8. Comparison of departmental characteristics with nine peer institutions from the Big 10, including Penn State.

	Degrees Granted			
	BS/faculty*	PhD/faculty*	BS/PhD	BS/FT faculty**
average	3.9	0.40	21.9	3.8
median	4.0	0.33	9.3	3.8
max	6.2	0.74	123.0	6.2
min	1.5	0.05	2.0	1.5
Penn State	6.0	0.33	17.9	5.6

*per tenure-line faculty only

**tenure-line plus non tenure track

	Diversity				
	%women on TL fac	% minorities on TL fac	% women in UG program	% minorities in UG program	Percent Int'l grad students
average	17.4	4.6	22.8	7.5	44.4
median	16.7	5.3	19.4	7.7	43.5
max	25.0	12.5	46.5	14.7	61.6
min	9.1	0.0	13.5	0.0	29.8
Penn State	16.7	6.7	13.5	7.1	49.0

	Faculty			
	Percent rank of Tenure-line faculty			Percent F-T non-tenure-line
	Assistant	Associate	Full	
average	21.3	26.5	52.2	3.5
median	19.6	26.7	50.0	3.4
max	33.3	47.6	72.7	7.4
min	13.6	10.5	33.3	0.0
Penn State	33.3	26.7	40.0	6.3

	Research	
	Research Expenditures	% from Federal
average	$13,256,803	69
median	$11,844,689	65
max	$30,230,081	100
min	$3,371,556	52
Penn State	$20,806,457	73

Strategic Initiatives for 2013-2018

Strategic Planning Process

The planning process began with a consultation with Penn State's Office of Institutional Planning and Assessment. Guidelines from Dean Wormley were reviewed with the planners. During faculty meetings in October and November, 2012, the prior strategic plan was reviewed and the assignments were given to the five groups and the faculty with report assignments included. The assignments are provided in Appendix 1. The results of the group and staff assignments were compiled. During a retreat on January 4, the faculty reviewed the group summary, and presentations were given by Deans Wormley and Engel to provide a summary of the status of the current strategic plan as well as ongoing initiatives in the college of engineering. With the assistance of staff from the Leonhard Center and the Office of Planning and Assessment, the faculty were divided into groups of three to discuss three areas, identified by the group summaries: development of horizontal research areas, restructuring of the graduate programs, and renewal of the undergraduate program. An additional faculty meeting was held on Feb. 18 to discuss the initiatives developed as a result of the faculty retreat.

Following the February faculty meeting, a full draft plan was circulated to the faculty and staff for review and input, then to the CEE IPAC. Revisions were made to the plan accordingly.

The Strategic Initiatives

Strategic Initiative 1. Develop horizontal research programs that cut across our existing vertical programs.

The Civil and Environmental Engineering Department has identified 5 horizontal research programs that will cut across the existing vertical programs and transform the state of research in the department. The faculty members in each of the current vertical areas (environmental, geotechnical /materials, structures, transportation, and water resources) are listed in the appendix. It is expected that new faculty hires during the next 5 years will be concentrated in these interdisciplinary programs to compliment our existing strengths. The horizontal programs were identified based on our existing strengths, growth areas in the industry, cutting edge science and engineering as identified by our faculty, and the National Academy of Sciences Grand Challenges. Departmental visibility and growth in these programs will greatly improve our ability to engage in other initiatives across the university, especially as part of the campus institutes and pursue major, collaborative funding, such as the NSF IGERT, PIRE, and ERC, as well as similar major program funding from the FHWA, NCHRP, DOE, and DOD, thus providing an income stream for our faculty and students.

Sustainable infrastructure and infrastructure renewal.
Ubiquitous sensing and control in CEE cyber-physical systems provides a pathway to auto-adaptive "smart" infrastructure where sensing and simulation systems are used to meet the dynamic and evolving needs of society. CEE services must effectively balance their efficiency, reliability, resilience, and tailored functionality when meeting society's growing expectations and constraints. Smart infrastructure research will focus on recognizing and managing CEE infrastructure systems holistically. This will necessarily envelope and engage larger societal systems.

Hazard and Threat Mitigation
The growing variability of natural and built systems as well as the need for improved protective technologies for security threats arising from extreme events make it vital to identify hazards and predict and manage the effects of hazards on the CEE infrastructure systems' resiliency over extended periods of time. We recognize that shaping our national and global capabilities to address these threats will require building broad partnerships with leaders in industry, governmental, and academic organizations.

Big Data
Future CEE infrastructure will combine rapid sensing, simulation, and control to form complex cyber-physical systems, for which conventional methods will not apply. Designing and managing these systems will require that our students are leaders in using state-of-the-art design visualization and computing technologies. These technologies will be core tools for the future CEE innovations that will be required to effectively exploit ubiquitous multi-media sensing, new powerful simulations, and the exponential growth of design relevant information. Big data issues, including capture, curation, storage, search, sharing, analysis, and visualization presents new challenges across civil and environmental engineering.

Water-Energy Nexus
Civil and Environmental Engineering play a major role in energy production and transport. For example, water is an integral component of gas extraction and production technologies. Water that has been used in energy extraction can contain high levels of salts, heavy metals, radionuclides, and organic compounds. Effective treatment of the water from these processes, as well as prediction of water quantity and the management of the water supply are needed. Given the dynamic changes that accompany energy exploration, production, and transport, there is a need for travel demand forecasting and transportation networks analysis.

Civil Engineering Materials
Materials research is needed in all areas involving civil infrastructure. The development of a new generation of high performance construction materials that are highly recycled and energy/CO2 efficient on a life-cycle basis will be integral to designing and implementing sustainable civil construction. Advancements in understanding of deterioration mechanisms and effective mitigation tools are of great significance to ensure durability and enable a 100+ year service-life for infrastructure. Smart materials

are also needed to allow health monitoring and timely rehabilitation of structures. The connection between our faculty, the potential collaborations, and the ability of our faculty to conduct cutting edge research in these areas is clearly displayed.

Strategic Initiative 2. Re-engineer our graduate programs.

In order to attract top graduate students, both domestic and foreign, our graduate programs and offerings as well as the methods of delivery will need to be assessed and re-engineered. The CEE department will explore taking advantage of new financial resources available as part of program delivery and will also create new programs that mirror the research initiatives developed in Strategic Initiative 1. We will explore both online and residential programs, especially those that cut horizontally across the department as well as across other departments and colleges.

Residential programs are a critical part of engineering education. Many students, including our foreign students, often prefer to have a residential experience over an online experience so that they learn the language and culture at the same time they learn the technical aspects of the graduate program. Assuming that the university approves a new budget model wherein the departments will be financially rewarded for establishing new programs, we will explore the development of one or more new residential programs at the MEng degree. A large percentage of civil and environmental students and professionals require this degree for professional advancement and the courses required for this program can also be included in other existing or new core programs. Courses will be taught by existing and adjunct faculty. The department will determine which of the new programs is to be offered first based on factors, such as anticipated demand, existing strengths in the department, availability of courses to include in the program either from CEE or other departments, and the availability of current or new faculty to teach the core courses on a regular basis. Anticipated contenders for the new programs include:

Sustainable infrastructure. This program would include courses based on research associated with the smart infrastructure and infrastructural renewal initiative, including sensors, smart materials, environmental impacts, and statistical and economic analyses of data. Faculty from all areas of the department have potential to provide courses and advise graduate students as part of this program.

Civil Engineering Materials. The program follows the research initiative by the same name and would focus on methods for modeling material behavior, understanding processes that effect materials, and adapting materials for harsh environments. The program would include courses taught by faculty in the structures, geotechnical, materials, environmental, and pavements areas of the department.

Hazard and Threat Mitigation. This program would teach students to recognize, prevent, and adapt to a wide variety of hazards and threats to our infrastructure, water supply, and environment. Faculty from water resources, environmental, transportation, and structures would likely contribute courses to this program.

Online graduate programs will also be explored as a way to reach a larger, more diverse set of graduate students, especially those who cannot relocate or give up their jobs to return to graduate school. Currently, the Penn State World Campus offers several graduate engineering programs. As part of the online World Campus, CEE could offer either existing programs, such as Structural or Environmental Engineering, or could combine with the new residential programs to provide a multiple delivery mechanisms for our new and existing programs. The online programs would also be focused on the MEng degree.

As part of re-engineering our graduate programs, we will explore the idea of offering "mini" sessions and/or compressed sessions of many of our courses. The mini sessions would consist of courses broken into 1-credit sections that would focus intensely on a given topic. Students would take 3 of these mini courses to fulfill a full 3 credits. Mini sessions would allow for maximum flexibility in the students scheduling, permitting them to create a focus from a combination of courses. The compressed sessions would provide a 3-credit course in 1/3 of the time. This way, rather than focusing on multiple courses at once, the graduate student could focus on one course at a time, before moving on to the next course.

Strategic Initiative 3. Renew the undergraduate experience.

The department has a strong undergraduate program that is consistently in high demand. In order to maintain this high quality, we will undertake an in-depth curriculum review. As part of the review we will assess:

- The relevance and need for each of the courses offered.
- The relevance of the courses in the technical electives listing.
- New courses across the university that could be added to the technical electives.
- Total curriculum for years 1 and 2 to determine whether our students are sufficiently prepared for the CEE curriculum.
- Whether we expect well rounded civil engineers or expertise in specific areas of civil engineering.
- A review of the capstone courses and their capstone prerequisites, particularly in light of the previous bullet.
- Ways to incorporate sustainability more broadly across the CEE curriculum.
- The First Year Seminar and ways to create consistency across the seminars and use the seminars to reach out to the students at the campuses.

In addition to the curriculum review, we desire to enhance the teaching and learning environment for our students and faculty through the following activities:

- Enhance the hands-on aspect of the learning process through the use of facilities, such as the Learning Factory.
- Create a bridge to professional practice through the CEE Alumni Society networking program currently under construction and the CEE Alumni Society mentoring program, which will be developed in the near future.

- Create in-house teaching and learning workshops to follow up on the Fall, 2012, retreat. Such workshops could include dealing with new work habits, the millennial generation, and the use of MOOCs to test mastery of subjects.
- Develop methods to reach out to the campuses to better advise, inform, and prepare the 50% of our students that will join the CEE department at UP. For example, we will explore the use of a CEE FYS that could be delivered/shared at the campuses. ASCE/Chi-Ep student groups could host several virtual events per year that are webcast to the campuses.

Strategic Initiative 4. Upgrade facilities.

The needs of the department are significant in terms of space for visiting scholars and post-docs, graduate students, new faculty, and storage. These needs are being addressed in the university's remodeling plan for Sackett, the Units, and Hammond. However, this major upgrade is likely years away. In the interim, we will plan for the construction of a video conferencing room that might also be used for limited online teaching. In addition, we will seek development funds to name and upgrade our undergraduate labs.

Computational facilities continue to be insufficient for our students and faculty. Efforts will be made to raise funds to continue supporting and upgrading our existing facilities, and provide our faculty with funds to upgrade theirs and their students computational equipment.

In addition to educational spaces, we will also continue to purchase new equipment and upgrades to current equipment at both Cato and Sackett in support of our thriving research program.

Implementation Plan

Following the adoption of this strategic plan by the CEE faculty, a strategic plan implementation committee will be formed to develop an implementation plan that will include the timeline for undertaking each initiative, a plan for implementing each of those initiatives, and indicators of success. The implementation plan will be the focus of the first retreat following acceptance of the strategic plan.

Budgetary Issues

Over the next five years, we anticipate a number of retirements and other departures. We expect that new faculty will be hired in accordance with this plan to fill those slots. In addition, we will continue to take advantage of new faculty positions as they come available, such as those in the cyberscience and natural gas initiatives. However, maintaining only the current number of faculty with the current enrollment cap will mean that we will continue to be out of line compared to our peer institutions in terms of the high number of B.S. degrees and the low number of PhD students for the number of faculty we have. The only way to change these ratios in a favorable way is to decrease the enrollment cap (i.e., the number of B.S. students) and/or increase the number of faculty. With the current CEE budget, we cannot hire additional faculty outside of those we gain through the rare new university initiatives. Thus, we will make every effort to argue the case for a reduced enrollment cap and additional faculty positions.

The annual loss of permanent budgetary funds is a significant concern and will necessarily prohibit the successful implementation of this strategic plan. Although development activities in the department will continue as they have in the prior five years, these funds are not anticipated to replace the loss of permanent funds. Given that we have the highest undergraduate student/faculty ratio in the Big 10, we cannot afford to lose additional faculty lines to pay for other needs; neither can we afford to give up graduate TA positions as a way to pay for programs. We currently have only 14 TA positions per year in the department and desperately need those to assist with the large undergraduate courses. As described in the strategic initiatives, we will move forward in offering online and residential programs that will provide a revenue stream for the department to help offset the loss of other funds.

APPENDICES

CEE Faculty, Spring, 2013

Faculty

Photo	Name & Title	Specialization
	Banerjee Basu, Swagata Assistant Professor in Civil Engineering	Civil Infrastructure: Structures
	Basu, Prasenjit Assistant Professor in Civil Engineering	Civil Infrastructure: Geotechnical and Materials
	Blansett, Katherine Lecturer, PHRC	Water Resources, Land Development
	Brennan, Rachel Associate Professor of Environmental Engineering and Advisor, Environmental Engineering Minor	Environmental
	Burgos, William Professor of Environmental Engineering and Professor in Charge of Graduate Programs	Environmental
	Cannon, Fred Professor of Environmental Engineering	Environmental
	Donnell, Eric Associate Professor of Civil Engineering	Civil Infrastructure: Transportation
	Duffy, Christopher Professor of Civil Engineering	Water Resources
	Folmar, Norman Instructor / Director of Undergrad Programs	Water Resources
	Gayah, Vikash Assistant Professor in Civil Engineering	Civil Infrastructure: Transportation
	Gooseff, Michael Associate Professor of Civil Engineering Hartz Family Career Development Professor	Water Resources
	Gorski, Christopher Assistant Professor in Civil Engineering	Environmental

	Johnson, Peggy Department Head & Professor of Civil Engineering	Water Resources
	Jovanis, Paul Professor of Civil Engineering	Civil Instrastructure: Transportation
	Laman, Jeffrey Professor of Civil Engineering	Civil Infrastructure: Structures
	Linzell, Daniel Shaw Professor of Civil Engineering and Director, Protective Technology Center	Structures
	Logan, Bruce Kappe Professor of Environmental Engineering Evan Pugh Professor	Environmental
	Lopez de Murphy, Maria Associate Professor of Civil Engineering	Civil Infrastructures: Structures
	Mejia, Alfonso Assistant Professor in Civil Engineering	Water Resources
	Memari, Ali Professor of Architectural Engineering and Hankin Chair of Residential Building Construction	Residential Construction
	Pietrucha, Martin Professor of Civil Engineering	Civil Infrastructure: Transportation
	Qiu, Tong Assistant Professor in Civil Engineering	Civil Infrastructure: Geotechnical and Materials
	Radlinska, Aleksandra Assistant Professor in Civil Engineering	Civil Infrastructure: Geotechnical and Materials
	Rajabipour, Farshad Assistant Professor in Civil Engineering	Civil Infrastructures: Geotechnical and Materials
	Reed, Patrick Associate Professor of Civil Engineering	Water Resources

	Regan, John Associate Professor of Environmental Engineering	Environmental
	Scanlon, Andrew Professor of Civil Engineering	Civil Infrastructure: Structures
	Scheetz, Barry Professor of Civil Engineering	Civil Infrastructure: Geotechnical and Materials
	Shankar, Venky Associate Professor of Civil Engineering	Civil Infrastructure: Transportation
	Shen, Chaopeng Assistant Professor in Civil Engineering	Water Resources
	Skibinski, Tom Lecturer, Project development	Civil Infrastructure: Construction Management
	Stoffels, Shelley Associate Professor of Civil Engineering	Civil Infrastructure: Geotechnical and Materials
	Velegol, Stephanie Lecturer	Environmental
	Warn, Gordon Assistant Professor of Civil Engineering	Civil Infrastructure: Structures

Strategic Planning Assignments
October 18, 2012

Groups:
Discuss the following and provide a report to me by Friday, November 16:

- New teaching and research initiatives within the group, across the department, and with other colleges over the next 5 years.
- The group structure (is it working, what arrangement/organization might be more effective, is the role of the coordinator appropriate and effective, etc.)
- How might the undergraduate and graduate programs be improved to be more cross-cutting to accommodate areas of the profession that go beyond the traditional areas of CEE, such as sustainable infrastructure, energy conservation and production, materials, etc.?
- What areas of faculty hiring should we concentrate on over the next 5 years? This should relate to the initiatives discussed in the first bullet.
- Is there a need for restructuring how we use our TA's?

Staff:
Discuss the following and provide a report to me by Friday, November 16:

- What new initiatives might we consider in terms of new and/or reorganized positions, increased involvement of students in the department, interactions with alumni, etc.?
- How might we improve the working conditions in the office to allow flexibility while improving efficiency at the same time?
- Should we change the layout of the staff offices to improve flow, accessibility, and working environment?

Report responsibilities:
There will be 5 academic groups and 1 staff group as follows. The names in bold are responsible for submitting the reports.

Environmental – **Logan**, Brennan, Burgos, Cannon, Dempsey, Gorski, Regan, Velegol
Geo-materials – **Stoffels**, Basu, Qiu, Radlinska, Rajabipour
Structures – **Scanlon**, Banerjee-Basu, Linzell, Laman, Lopez, Memari, Skibinski, Warn
Transportation – **Jovanis**, Donnell, Gayah, Pietrucha, Shankar
Water Resources – **Gooseff**, Duffy, Folmar, Mejia, Reed, Shen, Katie B.
Staff – **Garner**, Faulds, Hamby, Heltman, White (input from staff not included in this list should be sought as well).