

***National Science Foundation Workshop
on the Future Power Engineering Workforce***

University Survey Results

Responding Universities

Arizona State Univ.	Univ. of Missouri-Rolla
Cornell Univ.	Mississippi State Univ.
Drexel Univ.	New Mexico State Univ.
Florida State Univ.	Texas A&M Univ.
Univ. of Illinois at Urbana-Champaign	Univ. of Texas at Austin
Illinois Institute of Technology	Virginia Tech
Iowa State Univ.	Washington State Univ.
Michigan Tech Univ.	

- 1. In your power program, please estimate the amount of research expenditures in thousand dollars for academic year 2006/7 from the following sources:**

Source	Min	Max	Average
Industry (all sources including EPRI)	\$30K	\$600K	\$251K
Regulated electric utilities only (share-holder owned, public power, coops):	\$0K	\$300K	\$75K
NSF	\$0K	\$350K	\$166K
DOE	\$0K	\$1,500K	\$310K
DOD	\$0K	\$400K	\$76K
ONR	\$0K	\$5,500K	\$566K
State	\$0K	\$120K	\$14K
Other government	\$0K	\$150K	\$17K
Total	\$270K	\$7,700K	\$1,400K

- 2. In your power program, how would you characterize the trend over the last three years in research funding from industry?**

0: Rapidly growing (more than 10% growth per year)
 8: Growing (up to 10% per year)
 4: Stable
 2: Declining (down by as much as 10% per year)
 1: Rapidly declining (down by more than 10% per year)

- 3. In your power program, how would you characterize the trend over the last three years in research funding from government?**

0: Rapidly growing (more than 10% growth per year)
 7: Growing (up to 10% per year)
 7: Stable
 1: Declining (down by as much as 10% per year)
 0: Rapidly declining (down by more than 10% per year)

4. Please provide estimates of the following number of students who graduated in the 2006/7 academic year:

Choice	Min	Max	Average
Undergraduates who have taken one or more elective power systems classes	15	200	56.3
Masters students in power systems engineering	2	30	10.9
Masters students in power electronics	0	20	5.7 (for >0 responses)
Doctoral students in power systems engineering	1	15	5.2
Doctoral students in power electronics	0	15	5.4 (for >0 responses)

5. In your power program, how would you characterize the trend over the last three years in the number of undergraduate students enrolled in electrical and computer engineering?

- 0: Rapidly growing (more than 10% growth per year)
- 5: Growing (up to 10% per year)
- 3: Stable
- 6: Declining (down by as much as 10% per year)
- 1: Rapidly declining (down by more than 10% per year)

6. In your power program, how would you characterize the trend over the last three years in the number of undergraduate students who are taking elective courses in power systems?

- 2: Rapidly growing (more than 10% growth per year)
- 9: Growing (up to 10% per year)
- 3: Stable
- 1: Declining (down by as much as 10% per year)
- 0: Rapidly declining (down by more than 10% per year)

7. How do you explain this trend?

Response: Rapidly Growing

- (Regarding ECE in total) Mechanical and Civil are perceived as more stable and less likely to be outsourced.
- Modernizing power systems courses to include topics in renewable/wind power and laboratory (hardware-based) experience.

Response: Growing

- Reputation of the power program, outreach by faculty and the fact that electric utilities are now looking for people.
- More employment opportunities in power industry (when compared to the 1990-2002)
- Students see and are interested in a very visible and successful power research and education program on campus.

- Increased interest in sustainability, coupled with new interprofessional projects focused on power systems: renewables, demand response, markets, preventing blackouts.
- An increase in hiring by consultants, manufacturers, and utilities.
- Strong power program at university. Lots of jobs in the power area. Lots of students co-op with power companies. More companies looking for power expertise
- Better recruiting, more career paths available, good hiring opportunities
- good job market

Response: Stable

- Overall ECE enrollments have dropped; however, students are aware that hiring in the Power industry is phenomenally strong at the moment
- For the decline in students enrolled in ECE, I think it is due to the perception that ECE engineers are outsourced.
- Good job opportunities for students in the power systems area.

Response: Declining

- If Q6 asked about percentages, then the answer would be "Stable" or maybe "Growing." This is important because it rightly reflects interest in power/energy from EE population. The declining NUMBERS trend is due to the declining EE population. I speculate that the declining EE population is not due to singular reason but a combination of reasons, among which are the dot-com crash of early 2000's (EE/CprE is perhaps unfairly perceived as related to the dot-com industry due to both being high-tech), a perceived shift in EE/CprE jobs overseas (have you ever gotten a response to an inquiry to a software-help-desk in Bombay?), and the "personality" of this new generation which has some attribute that causes avoidance of the more difficult, the more technical, and/or the more introverted.

Response: No Response

- One

8. In your power program, how would you characterize the trend over the last three years in the number of undergraduate students who are pursuing an engineering education focusing on power electronics applications in the power industry?

0: Rapidly growing (more than 10% growth per year)

4: Growing (up to 10% per year)

8: Stable

0: Declining (down by as much as 10% per year)

0: Rapidly declining (down by more than 10% per year)

9. How do you explain this trend?

Response: Growing

- More employment opportunities in power industry (when compared to the 1990-2002)
- Students see and are interested in a very visible and successful power research and education program on campus.
- Better recruiting, more career paths available, good hiring opportunities

- The students are looking for something exciting that is different from Telecomm.

Response: Stable

- Interest in subject and need for such trained in engineers.
- More undergrads in this area leads to more grad students.
- Power electronics and motor drives are very popular. There is a Formula Hybrid Team and several student projects in hybrid vehicles. So, there is a rapidly growing interest in power electronics and motor drives, but not necessarily in power electronics applications in the power industry.
- Our PE program has been relatively small and it is hard to characterize any changes as growing or declining. We have recently hired a PE faculty and so this will change.
- Students still are trying to figure out what power electronics is and how it relates to power and electronics.
- Overall ECE enrollments have dropped; however, students are aware that hiring in the Power industry is phenomenally strong at the moment

Response: No Response or not applicable (don't have power electronics program)

- 3: No responses or not applicable.
- We just hired a new professor in power electronics and it is too early to respond to Q8 and 9.

10. In your power program, how would you characterize the job market for undergraduate students who are pursuing engineering degrees focusing on power systems?

4: Rapidly growing

9: Growing

1: Stable

0: Declining

0: Rapidly declining

11. In your power program, how would you characterize the trend over the last three years in the number of graduate students who are pursuing engineering degrees focusing on power systems?

1: Rapidly growing (more than 10% growth per year)

6: Growing (up to 10% per year)

7: Stable

0: Declining (down by as much as 10% per year)

0: Rapidly declining (down by more than 10% per year)

12. How do you explain this trend?

Response: Rapidly Growing

- Better job opportunities.

Response: Growing

- Reputation of program and visibility of research activity.
- More employment opportunities in power industry (when compared to the 1990-2002)
- More undergrads in this area leads to more grad students.

- Professional masters program is growing as industry is sponsoring master programs once again. There was a downturn several years ago as mergers and downsizing reduced engineering ranks, but the trend has reversed in the last few years. Of course, PhD students don't pay their way, except for a few sponsored by their home governments, so the PhD population tracks research funding.
- Increased interest is mostly from foreign students
- We have several large projects in the power systems/high voltage/ power electronics areas and the word is out. Many of the graduate students are interested in power due to available funding.

Response: Stable

- Difficulty in placing students into industry or university
- We have declined in number of power faculty but remaining faculty have grown their programs larger relative to previous faculty.
- Faculty preference
- Again, the relative enrollment in the Power area is slightly higher, but that has been offset by the previous declines in engineering enrollment. Engineering enrolment is increasing and we hope to see a modest increase as well. Maintaining stable enrolment is made possible by the reputation of the Electric Utility Management program and the efforts of the faculty
- We tend to keep our admissions numbers consistent.
- The number of U.S graduate students is growing moderately, however, I see rapid increase in the number of international students interested in the power area. The power industry is hiring rather aggressively.
- Graduate student numbers are a function of available funding.

Response: No Response

- One: No response.

13. In your power program, how would you characterize the job market for graduate students who will be pursuing engineering degrees focusing on power systems?

- 3: Rapidly growing
- 10: Growing
- 2: Stable
- 0: Declining
- 0: Rapidly declining

14. In your power program, how would you characterize the trend over the last three years in the number of graduate students who are pursuing an engineering education focusing on power electronics applications in the power industry?

- 1: Rapidly growing (more than 10% growth per year)
- 4: Growing (up to 10% per year)
- 7: Stable
- 0: Declining (down by as much as 10% per year)
- 0: Rapidly declining (down by more than 10% per year)

15. How do you explain this trend?

Response: Rapidly Growing

- Better job market

Response: Growing

- Strong research activity and funding.
- More employment opportunities in power industry (when compared to the 1990-2002)
- Employer hiring of students
- More opportunities are application-oriented.

Response: Stable

- Not sure of the numbers.
- Again, most of our power electronics graduate students (numbers are growing rapidly due to funding and a new hire -- we now have two faculty in power electronics) are headed for the automotive industry or some other industry, but not the power industry.
- Again, we have had a small PE program. Now we have hired a PE faculty and so it should grow.
- Lots of retirements. MSU students have expertise in power and computers that is a valued combination
- Faculty preference
- We tend to keep our admissions numbers consistent.

Response: No Responses or not applicable (due to not having a power electronics program)

- 3: No responses.
- Our power electronics area is just starting.

16. Please list and briefly describe any Univ. programs that are specifically designed to increase interest in power engineering degrees.

- We also have a regular graduate seminar which is held each Friday and brings in eminent speakers to address a broad range of topics in the power systems and power electronic areas. Active research experience for undergraduate projects.
- Our ECE curriculum has EE tracks in power engineering, systems, telecommunications and electronics, as well as a BS in Computer Engineering. Overview sessions on tracks are given to sophomores. We also have a Coop program with mandatory 6 month industry coops in the 2nd, 3rd and 4th year. Many students make decision which track to pursue based on availability of coop jobs. Our ECE curriculum has EE tracks in power engineering, systems, telecommunications and electronics, as well as a BS in Computer Engineering. Overview sessions on tracks are given to sophomores. We also have a Coop program with mandatory 6 month industry coops in the 2nd, 3rd and 4th year. Many students make decision which track to pursue based on availability of coop jobs.
- We give graduates \$6,000 when they take at least 3 courses in power.
- Grainger Foundation Scholarship Program; S&C Electric Scholarship Program
- Not sure we have a program per se, but we work hard at maintaining a good required course in the EE curriculum, at teaching that course well, and at seeing that students

from those courses have job offers. This last effort is important - we are the most active in our department of doing this, word gets around that power faculty will help in this way, and it, together with the fact that we teach our courses well, has significant influence on the fact that our percentage pull from the EE population is highest in the department.

- We have developed an online Masters Degree and are developing an online undergraduate Certificate program. These bring in many part time students.
- Grainger power engineering awards - awards to students who are designated "power" - applies to both systems and electronics. GAANN - Dept of Education program - Graduate Assistance in Areas of National Need.
- We have a utility-partnership program called the Electric Utility Management Program which provides fellowships for graduate study. This is supported by utilities, and students who go through this graduate program are required to take 30 credit hours including courses in public policy and regulatory economics. We also have an undergraduate "Directed Mentoring" program, also utility-supported, which we use to recruit students for the graduate program.

None or No Response

- 6: None or no response.
- Nothing much from University level. Area utility has helped attract undergraduate students into power area

17. In your power program, what is your estimate of the number of faculty members whose dominant activity is conducting research and teaching courses in power systems?

Rank	Min	Max	Average
Full professors	0	8	2.7
Associate professors	0	3	1.2
Assistant professors	0	1	2
Total	1	10	4.8

18. Who else is the primary instructor of power systems courses in your power program?

- 1 university: Academic staff
- 4 universities: Teaching assistants
- 8 universities: Adjunct professors
- 1 university: Visiting professors

19. In the last three years, how many new power systems faculty members have you added?

- 2 universities hired one full professor**
- 1 university hired one associate professor
- 7 universities hired assistant professors (2 of those universities hired 2 assistant professors)

20. By the 2007/8 academic year, how many power systems faculty members are anticipated to reach retirement?

- 4 universities reported one professor will reach retirement

21. By the 2007/8 academic year, how many new power systems faculty members do you think will be hired?

0 universities: Full professors

0 universities: Associate professors

7 universities report that one assistant professor will or may be hired (one university reported that two assistant professors will or may be hired)

22. How do you explain the hiring trend indicated by your response to question 21?

Universities hiring or may be hiring:

- Strong recognition by the university administration of the excellence of the program and increase in research funding.
- We pound on the table and offer money if necessary.
- There is an increased emphasis on "energy" on campus. May be able to successfully argue that for hiring someone focused on "electrical energy delivery". Depends on the research potential compared with other energy related candidates.
- Have more demand for classes and research than we have faculty. Power is very hot right now with lots of opportunities. Our department is committed to make power/high voltage one of our focus areas and to get more faculty in the area to help with teaching and research activities.
- Nationwide, the interest/enrolment in engineering declined in the last decade. This has made it difficult to increase 'state funded' faculty lines at most universities. We continue to request new lines consistent with educational and research production as well as seek industry support for 'soft' positions.
- This is a replacement hire for a faculty who left two years ago.
- Likely to replace one faculty member leaving.

Universities not hiring:

- One: No response.
- Hiring decisions are not made in order to accommodate undergraduate teaching. Most important factor in hiring decisions is perceived funding opportunities. Upper administration still focusses hiring efforts of ECE faculty active in biomedical engineering as well as nano technology. Traditionally signal processing and telecommunications has received a lot of hiring support in our department, despite the fact that the numbers of students enrolled in these tracks has been rapidly dropping to single digits.
- Department faculty are of the opinion that there are sufficient power faculty within the department. There are greater needs for material, bio, and nano technology faculty.
- Recently added two faculty, so not planning to hire anyone new in power this academic year.
- There is no trend indicated in question 21, just a singular data point. We hired a power electronics faculty last year and so it is unlikely to get a position in PS or PE this year. We might get one next year. But here I am talking about "pure" PS or PE people. Actually, the PE faculty we got has significant capability in PS as well. In addition, there was a faculty hired in IE who does nodal pricing/electricity markets work, and as a result, has a 10% appointment in our department. Our department also

hired a guy that works in solar-cell fabrication and from department's perspective, that guy is "energy" (but from power group's perspective, he adds very little to our group). Point to all of this is, there may not be much hiring in PS and/or PE, but the department wants to work in energy. But they may not want to do so in the traditional sense. Key here is to find people that the traditional PS/PE people can work with but also look like something else (e.g., operations research or electronic fabrication). Having said all of that, there is no doubt that "energy" is on the rise as a topic of interest to the general public, to the government, and to academia. I feel positive about the future.

- We already have two new assistant professors - will not adding any additional faculty unless we have an unanticipated departure
- We just hired 1 assistant prof in power electronics last year.
- No change.

23. Does your power program regularly offer credit courses in power systems engineering via distance learning?

10: Yes

5: No

0: Not now, but planning to do so in the near future