

ECE Strategic Vision: Focus Areas

Originally Approved by Faculty on January 11, 2019

Power Engineering

Current team: R. Bass (Associate Professor), J. Bird (Associate Professor) and M. Gupta (Assistant Professor)

- Total average expenditures per year approximately \$700-1000k
- Current number of of MS/PhD research students: Bass - 2/2, Bird - 1/7, Gupta- 1/2
- Graduated MS thesis students, 2013-2018: 11

Why and why ECE @ PSU?

The power engineering group shall address the engineering research and education opportunities arising from the emergence of large-scale societal challenges. Specifically, the group shall address research and education opportunities that mitigate the impacts of natural disasters, climate change, and cyber-physical security threats to the electric power system. Opportunities for impactful engineering research arise as technological responses to large-scale societal challenges. These challenges include risks posed by the Cascadia subduction zone, massive western wildfires, destructive and unusually large storms, cyber-physical security attacks, and climate change. Such scenarios challenge electric power systems beyond their design limits. The responses to these challenges provide opportunities for developing specialized research programs within the Maseeh College.

Table 1 Major societal challenges that impact electric power systems. Engineering responses to these challenges point towards potential niche Research & Education (R&E) opportunities.

	Societal Challenges	Engineering Responses	Pillars & Cross-Cuts ¹	R&E Tracks
1	Cascadia subduction zone	Resiliency, Reliability	P2	C,D,E
2	Superstorms & wildfires	Resiliency, Reliability	P2	C,D,E
3	Cyber-physical system security	Resiliency, reliability, data science	P2,P5,CC1	C,D,E
4	Data proliferation	Reliability, data science, demand response	P2, P5, CC1	B,C,D,E
5	Climate change	Renewable generation	P4	-
	5a. Renewable generation	Demand response	P4, CC1	B,C,E
		Distributed generation	P4, CC1	A,B,C,E
		Asset aggregation	P4, CC1	B,C,E
		Reliability	P2,P4, CC1	C
	5b. Superstorms & wildfires	<< as above in 2 >>	<< as above >>	<< as above >>

Research programs align with education opportunities; together these are defined as “R&E tracks.” Five such tracks have been identified and related to the aforementioned societal challenges. Three of these have been identified as potential “niche” tracks, meaning that few, if any, other engineering

¹ Abbreviations: (P1) reimagine engineering education, (P2) transform the resiliency of physical and cyber systems, (P3) reinvent the built environment for human health, (P4) bend the carbon and environment footprints, (P5) weave the computational fabric – from sensors to decisions, (CC1) data science and machine learning, (CC2) community engagement

programs address these research topics explicitly. In order to differentiate PSU’s research and education portfolios, hiring and investment decisions shall target these niche tracks.

Table 2 Research and education programs to be developed to address the large-scale societal challenges noted in Table 1.

	Research & Education Tracks	Niche	Societal challenges
A	Controls, both classical & modern	no	5
B	Utility-scale power electronics	no	4,5
C	Cyber-physical power systems	yes	1,2,3,5
D	Resource planning, system modelling	yes	1,2,3,4
E	Power system data science	yes	1,2,3,5

Research objectives: Faculty members with expertise in multiple niche power areas will enable PSU to:

1. Sustain a consistent and balanced graduate student body in power engineering.
2. Enable faculty to pursue large power-related, high-impact grants.
3. Create visibility within the major IEEE Power Engineering societies.
4. Enable an integrated approach to sustainable energy research.

Table 3 Opportunities for research collaboration

PSU	Dr. Raul Cal (MME)
Regional	Continuous Solutions, Bonneville Power Administration, Oregon State University, Oregon Torrefaction, Pacific Northwest National Labs, Portland General Electric, Schweitzer Engineering Laboratories, VertueLab, Washington State University-Vancouver, Xzeres Wind Turbines
National	Sandia National Laboratory, University of Minnesota, CUSP, University of North Carolina at Charlotte, Verdant Power, Resolute Marine Energy, Aqua HarmonicsWisconsin Electrical Machines and Drives Consortium

Educational objectives: A diverse power engineering faculty will permit the ECE department to offer a wide range of power engineering courses. In addition to serving our graduate students, a varied suite of power engineering courses will provide the local power engineering community with continuing education opportunities.

1. Offer nine graduate and five undergraduate classes per year focused on power engineering.
2. Ensure that courses provide significant laboratory and project opportunities.
3. Assign every BS power student a capstone project focused on power engineering.
4. Provide continuing education opportunities for working professionals.
5. Establish niche “mini-tracks” of courses that complement research.

Hiring Targets: A dynamic and capable power engineering research program should have five faculty members, representing a wide range of power engineering expertise. The addition of three new tenure-track faculty members will create a high-quality power engineering group with the breadth of knowledge needed to address several of these large-scale societal challenges. The new positions shall compliment the current strengths provided by Dr. Bird and Dr. Bass while diversifying the power group's body of expertise in salient directions. One new faculty member shall join the faculty every other year for the next five years, starting in Fall 2019.