PA 510 Making the Smart Grid Work in the Real World
This is the second term of our two-term course series called Designing the Smart Grid for Sustainable Communities.

Spring 2015 (CRN 65367)
Wednesdays, 6:40 – 9:40 PM, from April 8 through June 10
URBN 204 (Distance Learning Center Classroom) – 506 SW Mill Street

Introduction and Background

The Smart Grid and Sustainable Communities: Making the Connections is the second term in the two-term course series with the overall title of Designing the Smart Grid for Sustainable Communities.

During the Winter Term course component called The Smart Grid and Sustainable Communities: Making the Connections, 14 graduate students and 17 professional development students from throughout the Northwest and beyond learned the foundational concepts from a first-rate, six-person multidisciplinary faculty team and well-known guest presenters. The class included lectures, panel discussions, team projects, course readings tailored to a wide range of knowledge and experience, and optional field trips. The students also fine-tuned their ability to work effectively in multidisciplinary small group teams in preparation for the Spring Term projects described below.

We explored the implications of many of the new and emerging technologies and concepts that are associated with or can be enhanced by the “Smart Grid”: smart grid edge and core grid technologies, demand response, energy efficiency, energy storage, distributed generation, energy imbalance markets and other renewable resource integration strategies, and more. We also considered conceptual frameworks to help us explore these topics, learned about the existing physical grid and how it operates, and received a whirlwind history of the grid technology, markets, planning, and regulation.

Going well beyond the latest technological innovations and current practices, the course explored the implications of:

- The growth of “disruptive” technologies and financing models, calls for new business and regulatory models, related issues associated with the anticipated “utility death spiral”, and their relationship to the Northwest’s energy profile.
- Wholesale markets and managing variable resources in a fixed obligation world.
- Demand manipulation strategies by technology and pricing.
- Stakeholder hopes and concerns with smart meters, the smart grid, distributed generation, demand response, renewables integration, and other emerging technologies and business and financing models.
- Interoperability opportunities and challenges.
- The concepts behind the vision of “community energy sustainability”.
- New strategies to encourage the successful integration of more wind, solar, and other cleaner but more intermittent and distributed forms of energy.
- Calls for transformative change and the emergence dramatically different visions of our energy future.
- Workforce challenges and job opportunities associated with the transition to a greener energy economy.
The Spring Term course, called **Making the Smart Grid Work in the Real World**, has a project-oriented focus that will explore real world applications of technology and policy development. It will also feature new presentations from our expert faculty and additional guest speakers that will explore new topics and delve more deeply into issues we have already touched on. In addition, students will work together in **small group student teams** (their formal academic title is “Small Group Learning Communities”) on projects that determine if and how the Smart Grid and related technologies and approaches can support sustainable development and a cleaner and more sustainable energy future.

We want to emphasize that professional development students are also welcome to simply attend (or stream or watch later) class sessions, listen to the presentations from faculty members and nationally known guest speakers, and not get deeply involved in one of the small group projects if this becomes a burden. Professional development students are free to choose to participate, fully, partially, or not at all in the small group projects. Of course, we will encourage all students to participate in a small group team if they are able since some of the learning in this class will emerge from the group process. But we will certainly understand if some can’t make this additional commitment. We will make sure that this course meets their needs as well.

During the first Spring Term class session, students will be asked to indicate whether they would like to be involved in a student team project. Those who are interested will be asked to submit their first, second, and third choices among the candidate projects. The one group of students who are required to join a student team are the graduate students taking this course for a letter grade; this is because their grade will be based primarily on their performance on their team’s project. Professional development students who want to join a student team will also be asked to provide an assessment, on a scale of 1-10, of how much time and effort they expect to be able to commit to their project. The faculty will take this information into account as we establish the composition of each student team, and team members will have a good idea of the level of commitment they can expect from their team members. We will do our best to ensure that students with strong preferences will be assigned to a project that interests them.

### Candidate Small Group Student Team Projects

The faculty team has been consulting with several potential partners – including the Northwest Power and Conservation Council, Portland General Electric, Smart Grid Northwest, demand response visionaries, and the Living Cully Ecodistrict - on fascinating candidate projects. A faculty member and a team of expert advisors will support each student team. During our final class session of Winter Term, the faculty presented a preliminary slate of potential projects and asked the class to help us narrow down and clarify the field by offering us guidance and a “straw vote.” Later that evening, we received one more idea for a candidate project from our partners at Portland General Electric. These candidate projects have been refined since the end of Winter Term and they will be refined further as the term progresses.

As the Spring Term begins there are five candidate projects for the class to consider. Each project proposal is discussed in some detail in the course website called **Candidate Projects for Student Teams**; just click on the topic to be taken to additional information. As a result, we will only offer a very brief summary here. Three of the project proposal emerged from discussions with the Northwest Power and Conservation Council’s Director of Power Planning. Each deals with a different aspect of the overall topic of how the smart grid, demand response, energy storage, and related technologies and strategies can be incorporated into the Council’s Seventh Northwest Power Plan, the guiding plan for the entire region over the next five years. To the best of our knowledge, never before has the Council allowed university students participate in the development of key aspects of this important plan. It is very likely that senior Council staff and at least some Council members
will attend our Public Form during the last week of class to receive the small group team’s reports and listen to their presentations. The other two projects are equally exciting. One involves working with the Living Cully Ecodistrict to explore the development of a community power project in the Cully neighborhood. The other involves working with Portland General Electric to explore the role that microgrids could play as a grid resilience strategy in preparation for a major earthquake or other natural disaster.

Depending on the number of students who enroll and the assessment of time and effort provided by the professional development students, we should be able to support at least three and possibly four projects.

Faculty and Staff (detailed faculty bios available at http://www.pdx.edu/cps/faculty-for-smart-grid-courses)

Core Faculty:
- **Jeff Hammarlund**, Lead Faculty, Adjunct Professor and Senior Research Fellow, Mark Hatfield School of Government, PSU, and President, Northwest Energy and Environmental Strategies, hammarj@pdx.edu, 503-249-0240;
- **Ken Dragoon**, Principal, Flink Energy Consulting, LLC, k.dragoon@flinkenergy.com, 503-545-8172
- **Pamela Morgan**, President and Principal Consultant Graceful Systems, Pamela@gracefulsystems.com; 503-701-2875
- **Mark Osborn**, Senior Vice President, Five Stars International; mark.osborn@fivestarsintl.com, 503-709-9373

Contributing Faculty:
- **Dr. Robert Bass**, Associate Professor, Department of Electrical and Computer Engineering, and Director, Power Engineering Laboratory, PSU, rbass2@pdx.edu; 503-867-4018
- **Michael Jung**, Policy Director, Silver Spring Networks, mjung@silverspringnet.com, 503-360-3881
- **James Mater**, Co-founder and General Manager of Smart Grid Business Unit, QualityLogic; Chair, Board of Directors, Smart Grid Northwest, jmater@qualitylogic.com, 503-780-9796

Graduate Student Assistant: Lauren Patton, Masters of Urban & Regional Planning Candidate, lapatton@pdx.edu; 503-726-6034

Course Readings

Many of the course readings for Spring Term will be posted and available on the course's password protected online learning platform (D2L) or can be accessed with links from the course syllabus.

In addition, we will be using Eugene Bardach’s gem, *A Practical Guide for Policy Analysis: The Eightfold Path to More Effective Problem Solving*, during the second week of class. The 4th edition is the most recent one. We have requested that the PSU Bookstore order 15 copies of this edition. You might be able to find cheaper used copies or copies of earlier editions from other booksellers.

We used three books during the Winter Term. They are:
- Peter Fox-Penner, *Smart Power: Climate Change, the Smart Grid and the Future of Electric Utilities*, 2014 (best to get the new, 2014 "anniversary edition")
- Tony Seba, *Clean Disruption of Energy and Transportation*, 2014; and
- Fereidoon P. Sioshansi (editor), *Smart Grid: Integrating Renewable, Distributed & Efficient Energy*, 2012 (this book is more expensive; consider cheaper options such as renting, Kindle, etc.)
We may not assign specific chapters from these books during the Spring Term, but they do offer valuable background that should be helpful for those students who are joining us for the first time during Spring Term. We particularly recommend newcomers get ahold of copies of Peter Fox-Penner’s *Smart Power* and Tony Seba’s *Clean Disruption*. We have asked the PSU Bookstore to order 5-7 copies of these two books. Sioshansi’s *Smart Grid* book would also be useful, but it will not be as important for the Spring Term course. Plus, it is more expensive. If you are a newcomer and want access to this book, you might want to consider renting it or purchasing it through Kindle or other options. We have not placed a new order for this book through the PSU Bookstore.

**Preliminary Course Schedule**

The project-oriented focus of our Spring Term course and we won’t know which candidate projects will be selected until April 15. Our recruitment of guest presenters and the members of the advisory team for each of the small group teams sessions and advisory council members will depend largely on which student team projects that the class selects during the first two weeks of the term. As a result, it is not yet possible to provide a complete syllabus. However, we can offer a preliminary course plan. This will be converted into a full course syllabus as additional information become available.

**Week 1: April 8**

Faculty and student introductions  
Overview of the Class (Jeff)  
**Module 1: Presentation of possible projects** (all core faculty)  
- How the selection process works/distribute Individual Assignment 1 (Jeff)  
- Role of Small Group Learning Communities /student teams (Jeff)  
- Assignments and grading (Jeff)  
D2L Overview if needed (Lauren)  
Territory map, updated for Spring term and the projects (Pamela; If time permits)

**Assignments for Week 1**  
Individual Assignment 1 will be presented in class and is due by 5 pm on April 11.

**Reading Assignment for Week 1** (most of this will be review readings for winter term students)  
**Priority Reading:**  
**Course texts:**  
- Fox-Penner, *Smart Power: Climate Change, the Smart Grid, and the Future of Electric Utilities*, chapters 1-3  
- Sioshansi, *Smart Grid: Integrating Renewable, Distributed & Efficient Energy*, Introduction and Chapter 1  
**Posted on Desire to Learn (D2L):**  
- Friedman, *The Energy Internet: Where IT Meets ET*  
- GTM Research, *Grid Edge – Utility Modernization in the Age of Distributed Generation*  
**Web links:**  
- Litos Strategic Communications for US DOE, *The Smart Grid: An Introduction*
Additional Recommended Reading:
Web links:
- Litos Strategic Communications for US DOE, *Smart Grid Primers* (targeted toward different stakeholder groups)

**Week 2: April 15**

**Module 2: A “Tool Kit” to help Student Teams analyze, organize, and prepare their project reports and recommendations** (Jeff)

Formation of Small Group Learning Communities (Student Teams)

**Assignments for Week 2**
Small Groups meet and receive Student Team Assignment 1: Preliminary Problem Statement, Work Plan, and Group Communication Strategy, due by April 22 at 5 pm. Each student team should place their response in D2L Dropbox.) Faculty will try to provide feedback by Noon on April 25.

**Reading for Week 2**

**Course Text:**

**Week 3: April 22**

**Module 3: The Role of Solar Energy**
Overview of solar technology (Mark)
- Utility scale solar
- Customer-sided solar
- Hawaii as a case study
- Solar policy issues
- Potential guest speakers: Tom Starrs, Vice President, Market Strategy and Policy, SunPower Corporation; Ryan Edge, Research Analyst, Solar Electric Power Association (and an alum of this course); Jim Lazar, Consulting Economist

**Assignments for Week 3**
Student Team Assignment 1 due by 5 pm; faculty will try to provide feedback by Noon on April 25.

**Reading for Module 3**
To be determined.

**Week 4: April 29**

**Module 4: Overview of Community Power Movements** (Pamela)
- Solar gardens
- Community choice aggregation
- Planning/coordination with the utility (Minneapolis)
- Municipalization (Boulder)
- Potential speakers: Clean Energy Collective (solar gardens) Ellensburg community power project
Module 5: Overview of Microgrid (Mark)

Assignments for Week 3
Student Team Assignment 2: Revised Problem Statement and Work Plan, due by 5 pm on April 29. Faculty will try to provide feedback by Noon on May 2.

Readings for Modules 4 and 5
To be determined.

Week 5: May 6

Module 6: A Student Team consults with its Advisory Team. All other class participants observe and are welcome to ask questions toward the end of the session.

Readings for Module 6
To be determined.

Week 6: May 13

Module 7: A Student Team consults with its Advisory Team. All other class participants observe and are welcome to ask questions toward the end of the session.

Assignment for Week 6
Student Team Assignment 3: Detailed Report Outline due for the Student Team that meets with its Advisory Team on May 6.

Readings for Module 7
To be determined.

Week 7: May 20

Module 8: A Student Team consults with its Advisory Team. All other class participants observe and are welcome to ask questions toward the end of the session.

Assignment for Week 7
Student Team Assignment 3: Detailed Report Outline, due May 20 by 5 pm for the Student Team that meets with its Advisory Team on May 13. It is due by May 23 by 5 pm for the Student Team that meets with its Advisory Team on May 20.

Readings for Module 8
To be determined.

Week 8: May 27

Module 9: An Evening with a Smart Grid Dream Team
Invited Speakers:
  - Ron Ambrosio, IBM Distinguished Engineer & CTO, Smarter Energy Research, Thomas J. Watson Research Center, New York
- **Edward Cazalet**, CEO and founder of TeMix Inc., a transactive energy services company, and author of *Transactive Energy: A Sustainable Business* and Regulatory Model for Electricity; named by Public Utilities Fortnightly as "innovator of the year"
- **Erich Gunther**, Chairman, CTO and Co Founder, EnerNex

**Assignment for Week 8**
Student Team Assignment 4: First Draft of Report due for all Student Teams on May 27 by 5 pm.

**Readings for Module 9**
To be determined.

**Week 9: June 3**
Student Teams give dry run presentations with critiques from faculty and students.

**Assignments for Week 9**
Student Team Assignment 5: Draft Presentation and Slides due in class.

**No new readings.**

**Week 10: June 10**

**Smart Grid Public Forum: Powering the Future**
Presentations by student project teams to a select audience of senior energy professionals, community leaders, and potential employers.

**Assignments for Week 10**
Final Draft of Presentations due on June 10 at the Public Forum.
Final Draft of Reports due on June 14 at 5 pm.

**No new readings.**

**Other Course Information**

**Optional Field Trip:**
There will be an optional class field trip related to our case study projects. More information will become available as it develops.

**Evaluation of student work:**
Course evaluations and grades will be based on student performance in four areas. The six small group Student Team assignments will focus on the various steps that will lead to the final group report and final group presentation will count for 30% of the grade. Each assignment will be worth 5 points for a total of 30 points. They are:
- Student Team Assignment 1: Preliminary Problem Statement, Work Plan and Group Communication Strategy
- Student Team Assignment 2: Revised Problem Statement and Work Plan
- Student Team Assignment 3: Detailed Report Outline
- Student Team Assignment 4: First Draft of Report
- Student Team Assignment 5: Draft Presentation and Slides
- Student Team Assignment 6: Near-Final Draft of Report
The Final Report (Green Paper) itself will count for 35% of the grade (and 35 points) and the Final Group Presentation given at the June 10 Public Forum will count for 25% (25 points). Class participation, observance of due dates, and attendance will count for the remaining 10% (10 points).

The faculty will ask all students to complete an evaluation of the small group leaning community process as a whole, a self-assessment of the student's participation in this process, and an anonymous assessment of the level of participation and performance of fellow group members. This information will play a significant role in the final evaluation of each student's performance in the course.

Students taking the course for professional development are encouraged to participate actively in their small group learning communities if possible. This is where a significant amount of your learning will take place. Some organizational sponsors may require an evaluation of performance as a condition for reimbursing course payment. The faculty will follow their direction and/or we will establish an understanding with the organizational sponsor.

Grades will be determined as follows:

- A = 93%
- A- = 90%
- B+ = 87%
- B = 83%
- B- = 80
- C+ = 77%
- C = 73%
- C- = 70%
- D+ = 67%
- D = 63%
- D- = 60%
- F = below 60%

**Late Assignment and Report Submission Policy**

Unless arrangements have been made with us well in advance, late assignments will be assessed a late penalty of one grade increment for every day late. Please plan your schedule accordingly.

**Desire2Learn (D2L)**

We have activated a D2L site for this course. If this is the first time you are using the D2L, please go to the following site for instructions.


To log in, go to the following site: [https://d2l.pdx.edu](https://d2l.pdx.edu).

**Attendance and Etiquette**

Please email Jeff Hammarlund and Lauren Patton in advance if you are normally attending the class live and will need to miss a class session. You will be able to view the session as early as the next morning by going to the appropriate week on D2L. Please come to class on time and turn all cell phones off.

**Faculty Office Hours**

This becomes difficult since all members of the faculty team have other full time jobs. However, it is possible to email or phone faculty members. In addition, Jeff Hammarlund will hold semi-regular office hours on Thursday mornings between 10 am-12 Noon. If you make prior arrangements, you can meet him in person at his home office or speak with him by phone. The other three core faculty members are available by appointment.