A senior/graduate course (MAE4120/4121 & EAS4120 Community Wind Energy Research) was developed between 3 partners at Cornell and 4 external partners. It offers students the opportunity to develop research projects in community wind energy that are design based (senior design project with significant engineering element) and with other components such as developing and presenting educational material. Working with our local community we are collaboratively developing new research projects and educational opportunities.

**Summary**

**Lectures by Cornell partners (30%)**  
Project work with community partners (60%)

**MAE 4120/4120 & EAS 4120: Spring syllabus ‘17**

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
<th>Assignments and grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Wind farm basics (Prof Barthelmie)</td>
<td>Assignment 1 Wind farm (8%)</td>
</tr>
<tr>
<td>2</td>
<td>Projects &amp; education project discussion (Prof Pryor)</td>
<td>Assignment 4 Project outline (8%)</td>
</tr>
<tr>
<td>3</td>
<td>Wind meteorology (Prof Pryor)</td>
<td>Assignment 2 Wind meteorology (8%)</td>
</tr>
<tr>
<td>4</td>
<td>Atmospheric measurements (Prof Pryor)</td>
<td>Project development</td>
</tr>
<tr>
<td>5</td>
<td>Education project work</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Acoustic measurements (Dr Klinck)</td>
<td>Assignment 3 Acoustics (8%)</td>
</tr>
<tr>
<td>7</td>
<td>Acoustic measurements</td>
<td>Education project</td>
</tr>
<tr>
<td>8</td>
<td>Bill Evans, Old Bird Inc!</td>
<td>Assignment 6 Mid semester project progress report (10%)</td>
</tr>
<tr>
<td>9</td>
<td>Enfield Elementary School</td>
<td>Assignment 5 Education project (10%)</td>
</tr>
<tr>
<td>10</td>
<td>Marguerite Wells, Invenergy</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Project work</td>
<td>Feedback on projects</td>
</tr>
<tr>
<td>12</td>
<td>Project work in the lab</td>
<td>Feedback on projects</td>
</tr>
<tr>
<td>13</td>
<td>Deployments in the field</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Analysis and report writing</td>
<td>Draft project reports due</td>
</tr>
<tr>
<td>15</td>
<td>Project presentations</td>
<td>Assignment 7 Presentations (10%)</td>
</tr>
<tr>
<td>16</td>
<td>Project writing</td>
<td>Assignment 8 Final project reports (40%)</td>
</tr>
</tbody>
</table>

- **Spr 2016**: Students worked with Weaver Wind Energy to evaluate blade designs for upscaling a domestic-scale wind turbine. 3D blades printed and tested in the wind tunnel. Spr 2017: A design for turbine vibration measurements was implemented at a small wind turbine in the field.

- **Spr 2016**: Project to evaluate feasibility to acoustically detect bird strikes with turbine blades (awarded MAE Bart Conta Prize in Energy & Environment). Spr 2017: A design for turbine vibration measurements was implemented at a small wind turbine site, to be deployed at operating wind farm.

- **Spr 2016**: Students learnt about and applied wind measurement types & field techniques. Met. station deployed. Spr 2017: Meteorological station was deployed at a local small turbine site, in addition to data analysis and modeling on the impact of wind gusts using wind farm data.

- **Spr 2016**: Students worked with Weaver Wind Energy to evaluate blade designs for upscaling a domestic-scale wind turbine. 3D blades printed and tested in the wind tunnel. Spr 2017: A design for turbine vibration measurements was implemented at a small wind turbine site, to be deployed at operating wind farm.

- **Spr 2016**: A design for turbine vibration measurements was implemented at a small wind turbine site, to be deployed at operating wind farm.

- **Spring 2016**: Students worked with Weaver Wind Energy to evaluate blade designs for upscaling a domestic-scale wind turbine. 3D blades printed and tested in the wind tunnel. Spr 2017: A design for turbine vibration measurements was implemented at a small wind turbine site, to be deployed at operating wind farm.

**Blade design & aerodynamics mechanics**  
**Meteorology & wind resource, turbine response**  
**Acoustic, social & environment impacts**  
**Education & community interactions**

**Acknowledgements**: Funding from Engaged Cornell
Community wind farm research

Cornell partners: R.J. Barthelmie¹, S.C. Pryor² and H. Klinck³

¹Sibley School of Mechanical & Aerospace Engineering ²Department of Earth & Atmospheric Sciences ³Laboratory of Ornithology  rb737@cornell.edu

Do students value this engaged-based learning? Yes!

Direct quotes from 2016 course evaluations

“As a graduating senior, I was surprised to find this was by far the best course I have ever taken in my entire life. It fundamentally changed my understanding of how research is conducted, made me aware of the limitations working professionals have in the STEM fields, and showed me that with a little work, one can actually make a difference in the world.”

“I learned how to improve my thinking process. Instead of simply working on a problem in isolation, I was able to bring everything we learned throughout the course and not only apply it to my research, but have it shape my research in a direction that would be most suitable to people in the field.”

“Great class! I really liked the project-based concept - I find I learn things much better when I need to use or present them in the context of project work.”

“I think a course project allows us to apply engineering knowledge to a real-world problem. This idea is often talked about in the engineering curriculum but is never as ‘real’ as it was in this course. I like that we contributed (in however small a way) to the local wind energy industry.”

“The greatest gift this class gave me was not only an appreciation and greater interest for wind energy, clean tech, and the environment, but I actually won two (job) offers while taking this course.”

Follow up with students from 2016 spring one year on:

“I had a great time in your course; yours was one that helped to pique my interest in renewable energy. I’m an energy and sustainability consultant at *** now, and I use what I learned in your classes for wind energy feasibility assessments on a regular basis. I’d love to help out any way I can to ensure the class continues.”

“The level of autonomy afforded to the students in Professor Barthelmie’s class drove one to think like a researcher. Guidance and resources were always available, but students were encouraged to select and design their own study. This was both engaging and exciting, and differed in structure from the vast majority of other classes available. This was the first class I took where I had an active role in choosing the work in which I was involved, which more closely mimics a true research environment. This course was inspiring, and helped to plant a desire to seek out additional research opportunities at my current company.”

“I presented on the research I did for this class during the interview for my current job; Professor Barthelmie’s class directly helped me to get hired. Because I helped to develop the question I researched, I was passionate about the work I did, and that certainly showed in an interview setting. The structure of the class allowed students to demonstrate initiative and technical competence, both of which are highly valued in the workplace.”

“I enjoyed the course, it felt intriguing and very different from a traditional class. As a research based elective class, it has high value in giving me what I needed before I headed out into the real world. The variety of professionals who came gave unique perspectives on the wind power industry. This open-mindedness helps show the opportunities out there. I personally developed my wind blade CAD modeling skills (now useful in exactly what my *** engineering job does), with the understanding of how its design and performance affects the overall turbine and external features. I’m glad to see the course has progressed and hope it continues to do well in the future.”

What is needed to run this type of course?

Keys to success:

• Faculty willing to undertake this kind of experience where they have less control over the content & outcomes and to invest time way above and beyond the normal course load without additional credit

• Students with open minds and a determination to connect their traditional course work to community-based projects in exchange for an enhanced learning experience

• Administration willing to invest in real terms for project equipment, other resources and TA’s and to be flexible in assigning credit to faculty participation

• Community willing to invest time and energy, sometimes for rather intangible benefits

Are there other benefits? Yes!

Students actively engage in their own research and in the community, learn new skills
Faculty engage with students, other Cornell Departments, the community, develop, evaluate opportunities
Community learns more about Cornell and gets useful research results
Opportunities for training including TA, internships etc
Cornell is a better community partner and offers improved student/faculty experience