



**Wind Energy Science, Engineering, and Policy (WESEP)  
Integrative Graduate Education and Research Traineeship  
(IGERT)**

**2015 Evaluation Report**

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## **WESEP IGERT 2015 Evaluation Report**

### **Executive Summary**

In the student focus group and individual interviews, students discussed a variety of topics, noting program aspects that they particularly liked and also suggestions for improvement. The topic areas included: coursework, internships, graduate student climate, student community outreach and recruitment efforts, industry connections and employment, research and publications, and the WESEP IGERT program sustainability. Overall, students were pleased with their experiences in the WESEP IGERT program with several specific criticisms. Student responses and comments regarding the WESEP IGERT program are discussed in detail below.

Faculty and administrators discussed a variety of topics, noting elements that they particularly liked about the program and also made suggestions for program improvement. Overall, faculty expressed a high level of support for the WESEP IGERT program, and deemed it a valuable asset to the university and the field. They offered that the IGERT student Fellows were of exceptional quality, and felt the program was very well-managed by the IGERT PI. Their survey and interview responses are provided below. Administrators were also enthusiastic about the program, made suggestions for program improvements, and responded favorably to program improvements that they could help facilitate. Suggestions for program improvement are discussed in detail below.

It is of considerable note that the collective contingent of WESEP IGERT students has been very active in scholarly productivity. Six of the students were either the primary author or a co-author of papers in the peer reviewed literature in the last year, and 12 of the students reported that they were an author or co-author on at least one manuscript currently in preparation. Eleven students reported that they had made at least one conference paper/poster presentation in the last year, and eleven students reported that they were currently in preparation on at least one conference paper or poster presentation. Finally, the students have filed for three patents. These numbers speak to the quality of the WESEP-IGERT program and to the students enrolled in the WESEP.

The WESEP IGERT program faculty reported having vastly increased the number of times they reported serving as a primary author on a variety of publications from 2014 to 2015, including journal articles, conference presentations, books, patent applications, approved patents, grant proposals, and other publications. However, the faculty reported having decreased the number of times they served as a co-author on publications, including journal articles, conference presentations, book chapters, and grant proposals. The faculty also reported having decreased the number of times they worked with interdisciplinary authors/co-authors on publications such as journal articles, conference presentations, and grant proposals. However, this was the first year in which any of the WESEP IGERT faculty reported on having worked with interdisciplinary authors/co-authors on any patent applications. It is important to note the decrease in faculty productivity on collaborative and interdisciplinary work, in that one of the goals of IGERT program is to foster collaborative and interdisciplinary research.

# **1 Introduction and Methodology**

## **1.1 WESEP IGERT Program Background**

The Integrative Graduate Education and Research Traineeship (IGERT) program has been developed by the U.S. National Science Foundation (NSF) to meet the challenges of educating U.S. Ph.D. scientists and engineers with interdisciplinary backgrounds, deep knowledge in chosen disciplines, and technical, professional, and personal skills. The program is intended to establish new models for graduate education and training in a fertile environment for collaborative research that transcends traditional disciplinary boundaries. It is also intended to facilitate diversity in student participation and preparation, and to contribute to a world-class, broadly inclusive, and globally engaged science and engineering workforce.

Building upon the NSF IGERT platform, the purpose of the IGERT Graduate Program in Wind Science, Engineering and Policy (WESEP) at Iowa State University, in collaboration with the University of Puerto Rico-Mayaguez, is to provide doctoral students with multi-disciplinary training in the skills required for conducting research at the disciplinary interface between wind engineering and technology, atmospheric science - meteorology, agriculture - economics, journalism – communication and public policy. The WESEP program is a new model in graduate education in which students are engaged in an environment that supports innovation to learn through hands - on experience how their own research may contribute in new ways to benefit society and to learn the processes for the successful implementation of such contributions.

## **1.2 Evaluation Methods and Procedures**

As a key part of the annual evaluation of the program, students enrolled in the WESEP IGERT program are asked annually to fill out a survey related to their experiences in the program and research productivity. This survey was distributed in August 2015. All 18 students currently enrolled in the program were invited to participate in the survey, and 17 of the 18 students completed a survey. At that time, the single non-responding student was in the process of relocating her family and finishing up her dissertation.

As a separate but related component of the annual programmatic evaluation process, an annual survey for faculty engaged in the program was distributed in August 2015 and reflects the responses of 15 of the 18 faculty who are affiliated with the program as “WESEP Faculty” and have been involved in a variety of ways in the academic program.

The external evaluator reviewed all data collected, performed interviews with 17 of the WESEP IGERT fellows in person and on campus, and with 9 selected faculty, including 2 department heads/chairs and 3 college deans, and developed constructive conclusions regarding the effectiveness of the program. Detailed notes of the discussions held during the interviews and with the focus groups were recorded during and immediately following the discussions. Additionally, the student focus group was audio-recorded, with the consent of all participants. Analyses of these discussions were based on an objective assessment of the overall content of the perceptions of the students, faculty and administrators.

The evaluation questions were intended to assess student and faculty perceptions of the program. The evaluations questions were related to student recruiting methods, multi-disciplinary efforts; inter-institutional efforts; training and mentoring; the Real Time Research Collaborative (the RTRC); interdisciplinary features; student progress, skills, student achievements in the program including scholarly research and activities on the national to international stage; career placement for graduates; community impacts; and program sustainability.

Focus groups and interviews were conducted with students, faculty, and university administrators involved with the program. Generally the interviews with students, faculty, and university administrators were thirty minutes in length. Additionally, the students were invited to participate in a one hour focus group discussion. Exit interviews and surveys of anticipated graduates of the program are scheduled for Spring 2016.

## **2 Results**

The results are presented below in four sections: 2.1) Annual student survey; 2.2) Annual faculty survey; 3) Student focus groups and interviews; and 4) Faculty focus groups and interviews. Each of these sections is further broken down into subsections in order to group similar questions and organize the data to aid in the understanding of the IGERT program.

### **2.1 Annual Student Survey**

This section of the report details students' responses to the annual student survey and is broken down into three subsections: 2.1.1) Program Activities, 2.1.2) Research, Publications, and Other Scholarly Activity, and 2.1.3) Learning, Preparation, and Suggestions for Improvement. Each of these subsections is comprised of similar questions. Eighteen students are currently enrolled in the WESEP IGERT program, and 17 of the 18 students currently enrolled in the program completed the survey. including three students who entered the program in the Fall 2012 cohort, eight students who entered the program in Spring, Summer, or Fall of 2013, two students who entered the program in Spring, Summer, or Fall 2014, and four students who entered the program in Spring, Summer, or Fall 2015. Not all of the students responded to every question.

#### **2.1.1 Student Program Activities**

This section details students' activities within the WESEP IGERT program. Specifically, students were asked to respond to three questions related to formal training they had received in the program, types of collaborators with whom they were working, and types of internships that they may have participated in as part of the program.

Table 1 addresses formal training received by the students. At least half of the students in the 2012, 2013, and 2014 cohorts reported that they had received training in the responsible conduct of research, statistics, "bridge" courses to learn background content knowledge outside of their field, and working on a team research project. Interestingly, no students in the 2012 cohort reported that they had received formal training in professional writing, and only a third of the students reported formal training in research methods, state-of-the-art instrumentation, communicating with people outside their home discipline, and

communicating to the general public – in general, higher proportions of the 2013 and 2014 students reported receiving training in these areas. A higher proportion of students in the 2012 cohort did report that they had received formal training in professional speaking and presentation (66.7%), as compared to the 2013 cohort (37.5%) and 2014 cohort (0.0%). Students in the 2015 cohort tended to report less training overall than the other students, which would be expected as they have been in the program for a short period of time. As shown in Figure 1, higher percentages of WESEP IGERT students reported receiving formal training in professional speaking/presentation skills and professional writing on the 2015 annual survey than they had on the 2014 annual survey, though the percentages of students reporting that they had received formal training in each of the other areas listed decreased from the time of the 2014 annual survey to the time of the 2015 annual survey.

**Table 1: Formal Training Received**

	2012 Cohort n	2012 Cohort (%)	2013 Cohort n	2013 Cohort (%)	2014 Cohort n	2014 Cohort (%)	2015 Cohort n	2015 Cohort (%)
Responsible conduct of research (ethics)	2	66.7	8	100.0	1	50.0	1	25.0
Statistics	2	66.7	8	100.0	1	50.0	2	50.0
“Bridge” courses to learn background content knowledge outside your field	3	100.0	6	75.0	2	100.0	1	25.0
Research methods	1	33.3	8	100.0	1	50.0	3	75.0
State-of-the-art instrumentation	1	33.3	4	50.0	0	0.0	1	25.0
Professional speaking/presentation skills	2	66.7	3	37.5	0	0.0	2	50.0
Communicating to people outside your home discipline	1	33.3	6	75.0	1	50.0	0	0.0
Professional writing	0	0.0	4	50.0	1	50.0	2	50.0
Communicating to the general public	1	33.3	6	75.0	2	100.0	0	0.0
Working on a research team project	3	100.0	5	62.5	2	100.0	2	50.0

### Percentages of Total Students Reporting Formal Training Received on the 2013-2015 Annual Surveys

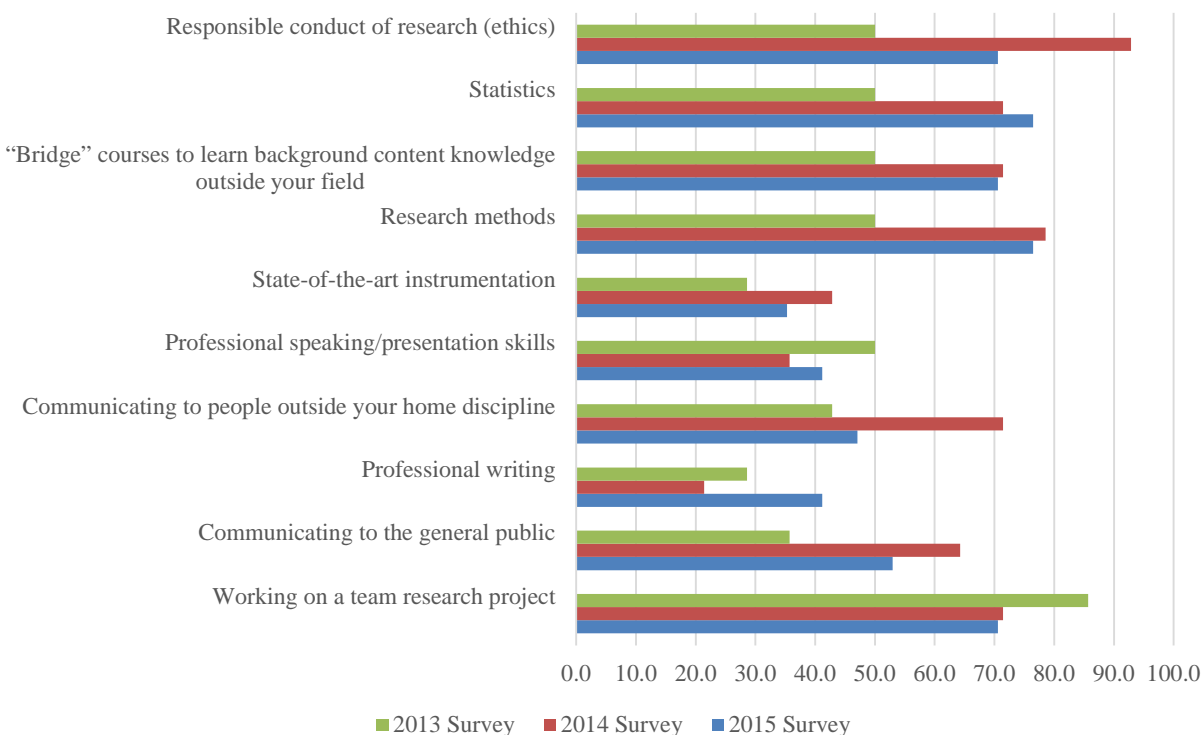


Figure 1. Percentages of total students reporting formal training received on 2013-2015 annual surveys. (2013 n = 14, 2014 n = 14, 2015 n = 17).

Students were asked about the types of collaborators they were working with during their graduate education in the WESEP IGERT program (Table 2). All 2012-2014 students reported that they were collaborating with ISU faculty in their home department (one 2015 student indicated that he was not collaborating with ISU faculty in his home department), and over half of 2012-2013 students reported collaborations in other departments at ISU and with international faculty. No students in any of the cohorts reported collaborations with government laboratory scientists on the ISU campus, international industrial scientists, or international public/government laboratory scientists. As shown in Figure 2, the proportion of students who reported collaborations with faculty at other universities in the US, international faculty members, and government/laboratory scientists in the US was strongly increased from the time of the 2013 and 2014 annual surveys. There were, however, noticeable drops in the percentages of students who reported working with international industrial scientists and international public/government laboratory scientists; as several students in the 2013 and 2014 cohorts reported during the on-campus visit with the WESEP IGERT program reviewers that they have yet to take advantage of the opportunity, and the 2015 students have not had time to do so. It appears that it would be good for the WESEP students to have more policy faculty engaged in the instructional program, perhaps during the upcoming 594 series, though an ISU political science faculty

member delivered Lecture 1 in 594 in F15. The same can be said for the Federal Lab representatives, though the Iowa Renewable Energy Center Program Manager delivered Lecture 4 and Lecture 14 was presented by the Legislative Affairs Director of DOE, both F15. Perhaps the students in 594 should be required to provide brief synopses of each lecture in the series, at the end of the semester, to refresh their memories of who made presentations and what was presented.

**Table 2: Students' Collaborators**

	2012 Cohort n	2012 Cohort (%)	2013 Cohort n	2013 Cohort (%)	2014 Cohort n	2014 Cohort (%)	2015 Cohort n	2015 Cohort (%)
Faculty at my institution in my home department	3	100.0	8	100.0	2	100.0	3	75.0
Faculty at my institution in other departments	2	66.7	5	62.5	1	50.0	1	25.0
Faculty at other universities in the United States	2	66.7	2	25.0	1	50.0	1	25.0
International faculty members	3	100.0	5	62.5	0	0.0	1	25.0
Government laboratory scientists on the ISU campus	0	0.0	0	0.0	0	0.0	0	0.0
Industrial scientists in Iowa	0	0.0	1	12.5	0	0.0	0	0.0
Industrial scientists in the United States (outside of Iowa)	0	0.0	0	0.0	0	0.0	1	25.0
International industrial scientists	0	0.0	0	0.0	0	0.0	0	0.0
Public/government laboratory scientists in the United States	0	0.0	0	0.0	1	50.0	1	25.0
International public/government laboratory scientists	0	0.0	0	0.0	0	0.0	0	0.0
Policymakers or planners	0	0.0	0	0.0	0	0.0	1	25.0
Other scholars or consultants	2	66.7	0	0.0	1	50.0	0	0.0



Percentages of Total Students Reporting Collaborations  
on the 2013-2015 Annual Surveys

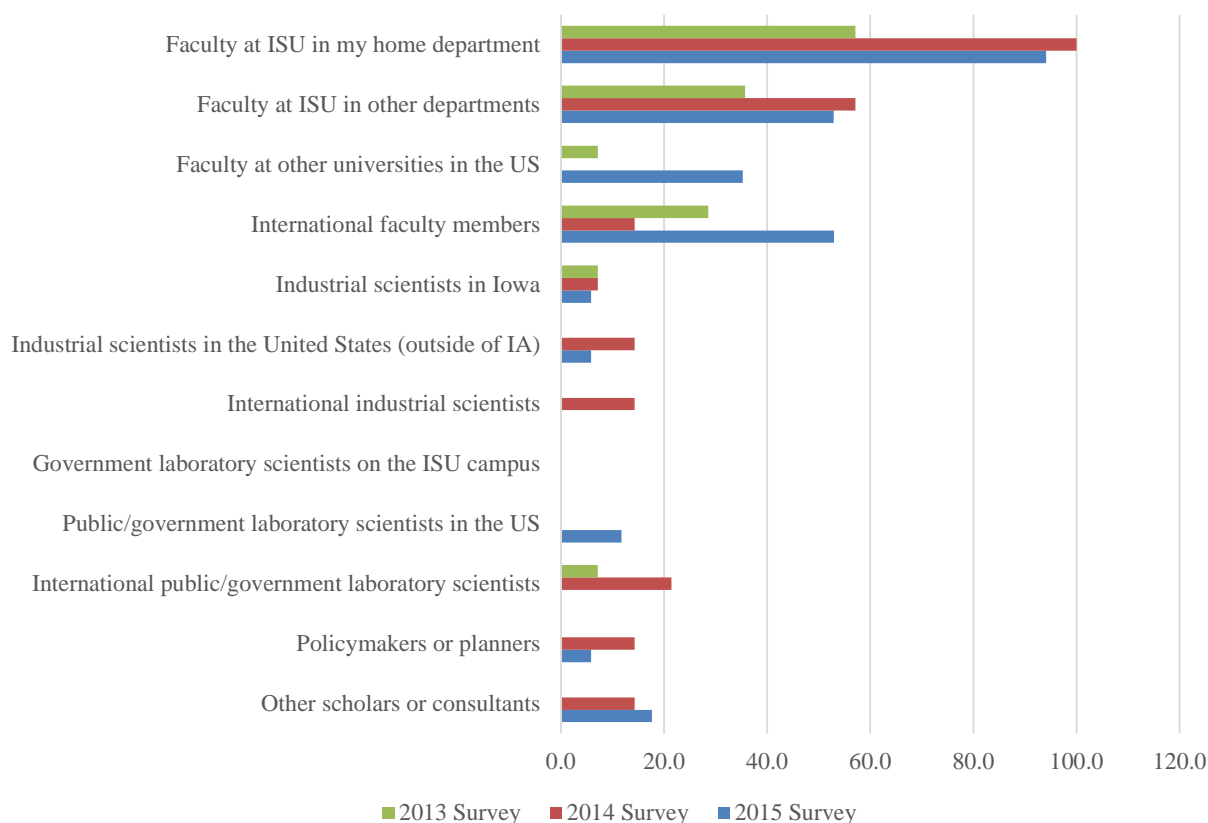


Figure 2. Percentages of total students reporting collaborations on 2013-2015 annual surveys. (2013 n = 14, 2014 n = 14, 2015 n = 17).

Students were also asked about the types of internships in which they had participated as part of the WESEP IGERT program (Table 3). One of the three students from the 2012 cohort and three of the five students from the 2013 cohort indicated that they had participated in an internship through the WESEP IGERT program, though no students from the 2014 or 2015 cohorts had participated in an internship at this point in the program. Of the four students who had participated in internships, two reported private sector industry internships and two reported an internship with a public sector laboratory or agency. The proportions of students who had participated in internships as part of the WESEP IGERT program at the time of the 2015 annual survey remained relatively similar to the proportions of students who had participated in internships at the time of the 2014 annual survey (Figure 3).

**Table 3: Internships in which Students Participated**

	2012 Cohort n	2012 Cohort (%)	2013 Cohort n	2013 Cohort (%)	2014 Cohort n	2014 Cohort (%)	2015 Cohort n	2015 Cohort (%)
Private sector industry	0	0.0	2	25.0	0	0.0	0	0.0
Business	0	0.0	0	0.0	0	0.0	0	0.0
Public sector laboratories or agencies	1	33.3	1	12.5	0	0.0	0	0.0
I have not yet participated in an internship as part of the IGERT program	2	66.7	5	62.5	2	100.0	4	100.0

Percentages of Total Students Reporting Participation in Internships on the 2013-2015 Annual Surveys

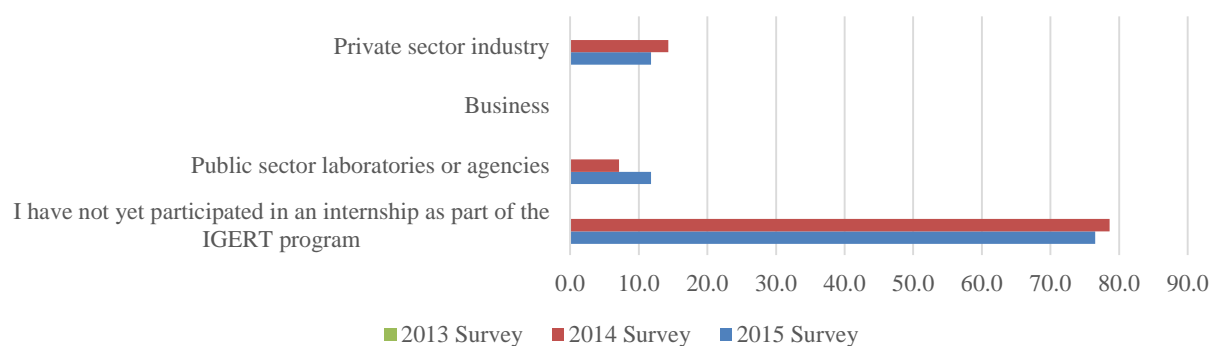


Figure 3. Percentages of total students reporting collaborations on 2013-2015 annual surveys. (2013 n = 14, 2014 n = 14, 2015 n = 17).

### 2.1.2 Student Research, Publications and Other Scholarly Activity

Students were asked to respond to eight closed-ended response items related to research and publications. Specifically, they were asked about their participation in collaborative research projects, interdisciplinary research publications, number of research publications, the conferences and workshops attended, and the usefulness of the RTRC.

As shown in Table 4, students were asked to indicate what types of collaborative research projects they had worked on as part of the WESEP IGERT program. Eleven of thirteen students in the 2012-2014 cohorts had worked on a research project involving multiple disciplines and worked on a research projects with other students who both shared a disciplinary background similar to their own and had diverse disciplinary backgrounds. Ten students from the 2012-2014 cohorts had worked on a team research project. The 2015 cohort, unsurprisingly, reported less involvement in collaborative research projects within the WESEP IGERT program – only one student reported involvement in each of the areas queried. The percentage of students working on research projects involving multiple

disciplines and working on research projects with students who shared a similar disciplinary background increased from the time of the 2014 annual survey to the time of the 2015 annual survey (Figure 4). However, the percentage of students reporting that they had worked on a team research project or worked on a research project with students from different disciplinary backgrounds decreased from the time of the 2014 annual survey to the time of the 2015 annual survey.

**Table 4: Collaborative Research Projects**

	2012 Cohort n	2012 Cohort (%)	2013 Cohort n	2013 Cohort (%)	2014 Cohort n	2014 Cohort (%)	2015 Cohort n	2015 Cohort (%)
Working on a research project involving multiple disciplines	3	100.0	6	75.0	2	100.0	1	25.0
Working on a research project with other students who share a similar disciplinary background to my own	2	66.7	7	87.5	2	100.0	1	25.0
Working on a team research project	3	100.0	5	62.5	2	100.0	1	25.0
Working on a research project with other students with disciplinary backgrounds different from my own	3	100.0	6	75.0	2	100.0	1	25.0

Percentages of Total Students Reporting Collaborative Research Projects on the 2013-2015 Annual Surveys

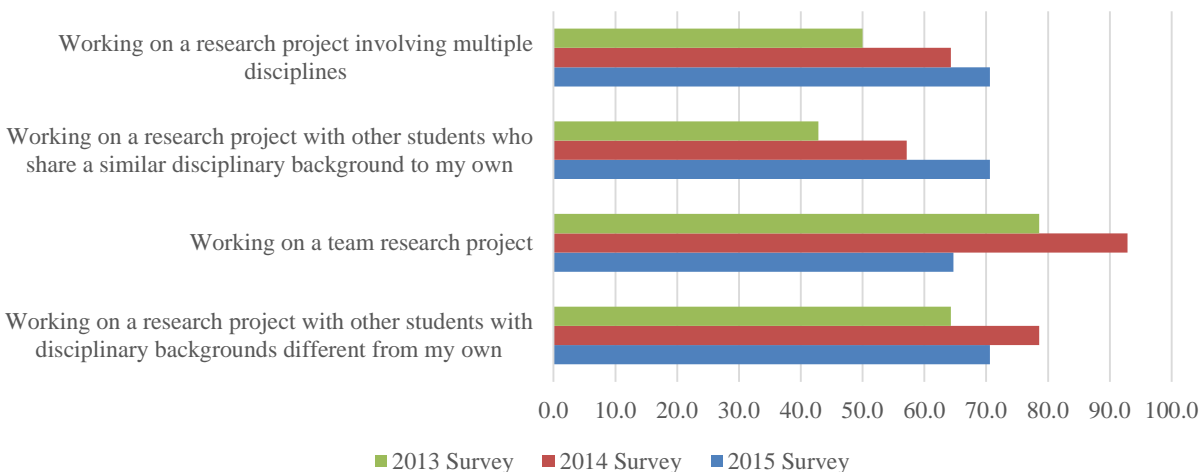


Figure 4. Percentages of total students reporting collaborative research projects on 2013-2015 annual surveys. (2013 n = 14, 2014 n = 14, 2015 n = 17).

As shown in Table 5, three WESEP IGERT students reported that they had presented research findings at a conference outside their home discipline in the last year, and five

WESEP IGERT students reported publishing research findings in journal outside their home discipline in the last year. As shown in Figure 5, this is a notable increase from the 2013 and 2014 surveys, when only one student engaged in either of the activities listed. Kudos to the students for this significant accomplishment.

**Table 5: Interdisciplinary Research Publications**

	2012 Cohort n	2012 Cohort (%)	2013 Cohort n	2013 Cohort (%)	2014 Cohort n	2014 Cohort (%)	2015 Cohort n	2015 Cohort (%)
Published research findings in a journal outside your home discipline.	1	33.3	2	25.0	0	0.0	0	0.0
Presented research findings at a conference outside your home discipline.	1	33.3	2	25.0	1	50.0	1	25.0

Students Reporting Interdisciplinary Research Publications  
on the 2013-2015 Annual Surveys

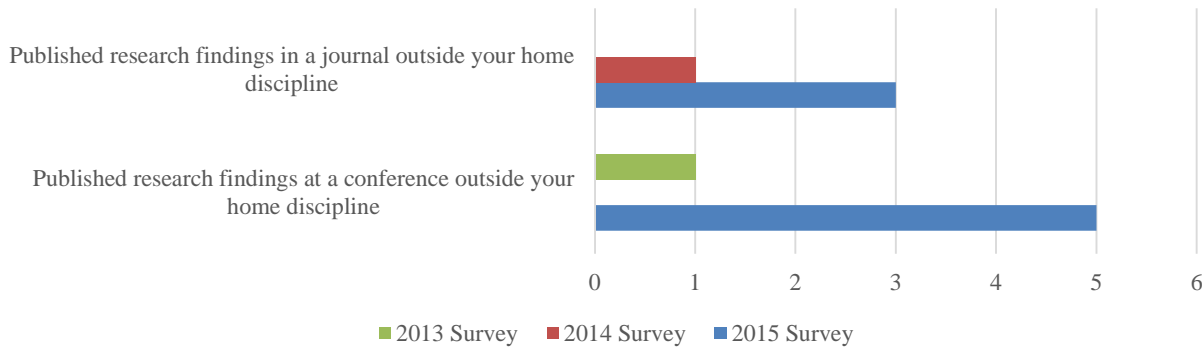


Figure 5. Students reporting interdisciplinary research publications on the 2013-2015 annual surveys. (2013 n = 14, 2014 n = 14, 2015 n = 17).

Table 6 displays reported student publications and presentations related to wind energy that were completed in the last year. One 2015 cohort student reported serving as a co-author on a conference presentation in the past year, but 2015 students reported no other publications or scholarly activity at this time. Overall, WESEP IGERT students reported serving as the primary author on a journal article twice, a co-author on a journal article four times, and reported being in process on a journal article 19 times. Students served as a primary author on a conference presentation 14 times, a co-author on a conference presentation nine times, and in process on a conference presentation 16 times. Students reported serving as the primary author on a patent application twice, and co-author on a patent application once. No students reported working on approved patents or grant proposals. Once student reported serving as a primary author on another type of publication, and one student reported serving as a co-author on another type of publication. As shown in Figure 6, students' publications in wind energy over the last year have

increased in most areas from the time of the 2014 survey to the time of the 2015 survey. In particular, there were sharp increases in the number of times that students had served as a primary author, co-author, or worked with interdisciplinary authors on a journal article, as well as a large increase in the number of times students had served as a co-author on a conference presentation. Again, kudos to the students for having affected these significant accomplishments.

**Table 6: Student Research Publications, Conferences and Other Scholarly Activity**

	2012 Cohort			2013 Cohort			2014 Cohort			2015 Cohort		
	n	mean	s.d.	n	mean	s.d.	n	mean	s.d.	n	mean	s.d.
Journal articles in refereed journals												
Primary Author	0	0.00	-	2	0.25	0.463	0	0.00	-	0	0.00	-
Co-author	2	0.67	0.577	1	0.13	0.354	1	0.50	0.707	0	0.00	-
Interdisciplinary author/co-authors	3	1.00	1.000	3	0.38	0.518	0	0.00	-	0	0.00	-
In process	2	0.67	0.577	14	1.75	0.886	3	1.50	0.707	0	0.00	-
Conference paper or poster presentations												
Primary Author	2	0.67	1.155	10	1.25	0.886	2	1.00	1.414	0	0.00	-
Co-author	3	1.00	1.732	4	0.50	1.069	2	1.00	1.414	1	0.25	0.500
Interdisciplinary author/co-authors	0	0.00	-	0	0.00	-	0	0.00	-	0	0.00	-
In process	5	1.67	1.155	10	1.25	0.886	1	0.50	0.707	0	0.00	-
Book chapters												
Primary Author	0	0.00	-	0	0.00	-	0	0.00	-	0	0.00	-
Co-author	0	0.00	-	0	0.00	-	0	0.00	-	0	0.00	-
Interdisciplinary author/co-authors	0	0.00	-	0	0.00	-	0	0.00	-	0	0.00	-
In process	0	0.00	-	0	0.00	-	0	0.00	-	0	0.00	-
Books												
Primary Author	0	0.00	-	0	0.00	-	0	0.00	-	0	0.00	-
Co-author	0	0.00	-	0	0.00	-	0	0.00	-	0	0.00	-
Interdisciplinary author/co-authors	0	0.00	-	0	0.00	-	0	0.00	-	0	0.00	-
In process	0	0.00	-	0	0.00	-	0	0.00	-	0	0.00	-
Patent applications												
Primary Author	2	0.67	1.155	0	0.00	-	0	0.00	-	0	0.00	-
Co-author	1	0.33	0.577	0	0.00	-	0	0.00	-	0	0.00	-
Interdisciplinary author/co-authors	0	0.00	-	0	0.00	-	0	0.00	-	0	0.00	-
In process	0	0.00	-	0	0.00	-	0	0.00	-	0	0.00	-

**Table 6: Student Research Publications, Conferences and Other Scholarly Activity (con't)**

	2012 Cohort			2013 Cohort			2014 Cohort			2015 Cohort		
	n	mean	s.d.	n	mean	s.d.	n	mean	s.d.	n	mean	s.d.
Approved patents												
Primary Author	0	0.00	-	0	0.00	-	0	0.00	-	0	0.00	-
Co-author	0	0.00	-	0	0.00	-	0	0.00	-	0	0.00	-
Interdisciplinary author/co-authors	0	0.00	-	0	0.00	-	0	0.00	-	0	0.00	-
In process	0	0.00	-	0	0.00	-	0	0.00	-	0	0.00	-
Grant proposals												
Primary Author	0	0.00	-	0	0.00	-	0	0.00	-	0	0.00	-
Co-author	0	0.00	-	0	0.00	-	0	0.00	-	0	0.00	-
Interdisciplinary author/co-authors	0	0.00	-	0	0.00	-	0	0.00	-	0	0.00	-
In process	0	0.00	-	0	0.00	-	0	0.00	-	0	0.00	-
All other publications												
Primary Author	0	0.00	-	1	0.13	0.354	0	0.00	-	0	0.00	-
Co-author	0	0.00	-	1	0.13	0.354	0	0.00	-	0	0.00	-
Interdisciplinary author/co-authors	0	0.00	-	0	0.00	-	0	0.00	-	0	0.00	-
In process	0	0.00	-	0	0.00	-	0	0.00	-	0	0.00	-

Number of Times Students Reported Serving as an Author on Research Publications, Conference Presentations and Other Scholarly Activity in the 2013-2015 Annual Surveys.

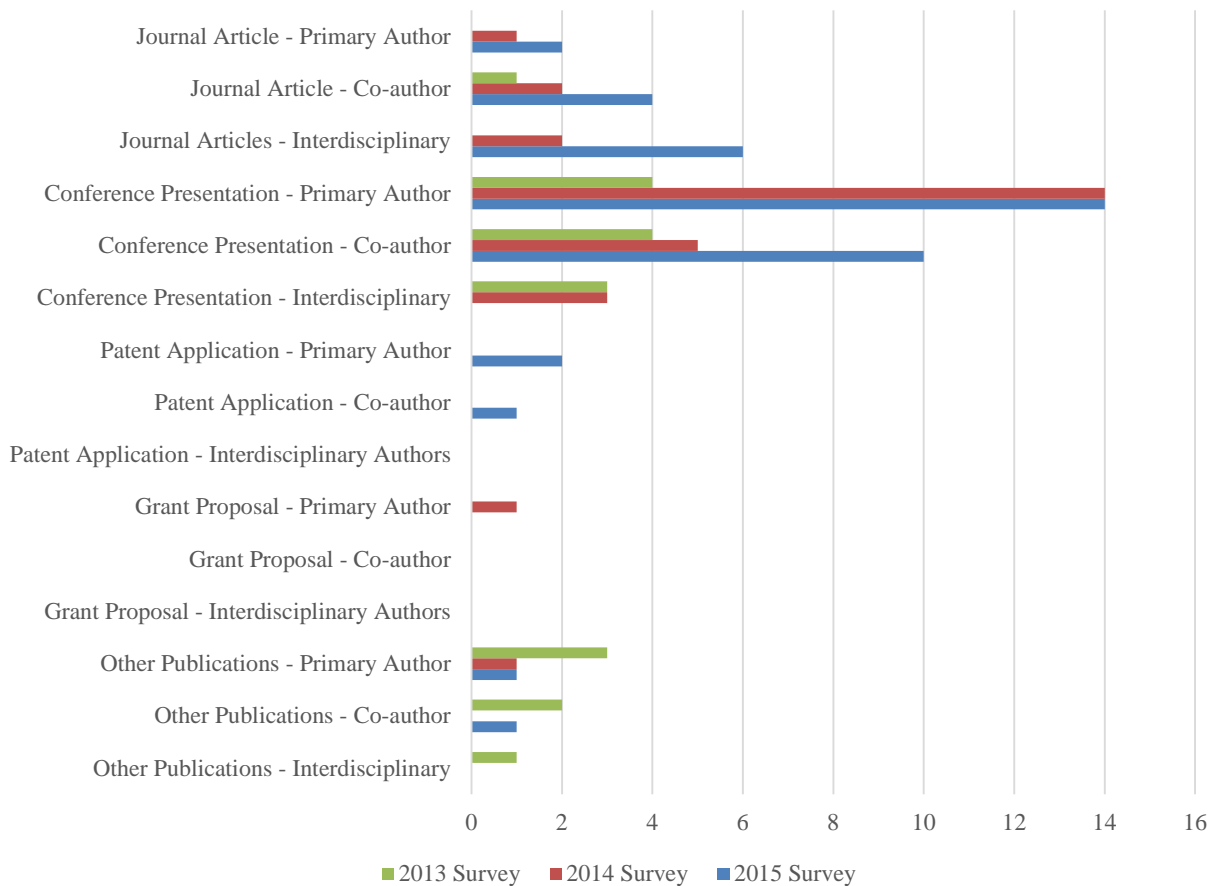


Figure 6. Number of times students reported serving as an author on research publications, conference presentations and other scholarly activity in the 2013-2015 annual surveys. (2013 n = 14, 2014 n = 14, 2015 n = 17). Book chapters, books, and approved patents are not included in the table as students have not yet reported engaging in these types of research activities in any of the annual surveys conducted.

Table 7 addresses conferences and workshops that WESEP IGERT students attended and/or presented at. A total of seven of the WESEP IGERT students reported that they had attended a conference at ISU, 14 had attended a conference within the U.S. (outside of ISU), and five attended an international conference. Six students presented a poster at ISU, and five presented a poster within the U.S. (no students presented a poster internationally). One student presented a paper at ISU, six presented a paper within the U.S., and three presented a paper internationally. Unsurprisingly 2014 and 2015 cohort students reported engaging in these activities less often than did 2012 and 2013 cohort students. As shown in Figure 7, student conference attendance and presentation rates remained similar from the time of the 2014 survey to the time of the 2015 survey, although a higher percentage of students reported attending U.S. conferences, a higher percentage of students reported



presenting papers in the U.S., and a lower percentage of students reported presenting a poster within the U.S.

**Table 7: Conferences and Workshops Attended**

	2012 Cohort n	2012 Cohort (%)	2013 Cohort n	2013 Cohort (%)	2014 Cohort n	2014 Cohort (%)	2015 Cohort n	2015 Cohort (%)
Attended a conference								
At ISU	2	66.7	4	50.0	0	0.0	1	25.0
Within the U.S.	3	100.0	8	100.0	1	50.0	2	50.0
Outside the U.S.	1	33.3	4	50.0	0	0.0	0	0.0
Presented a poster								
At ISU	2	66.7	3	37.5	0	0.0	1	25.0
Within the U.S.	2	66.7	2	25.0	1	50.0	0	0.0
Outside the U.S.	0	0.0	0	0.0	0	0.0	0	0.0
Presented a paper								
At ISU	1	33.3	0	0.0	0	0.0	0	0.0
Within the U.S.	1	33.3	4	50.0	1	50.0	0	0.0
Outside the U.S.	1	33.3	2	25.0	0	0.0	0	0.0

**Percentage of Students Attending and Presenting at Conferences on the 2013-2015 Annual Surveys**

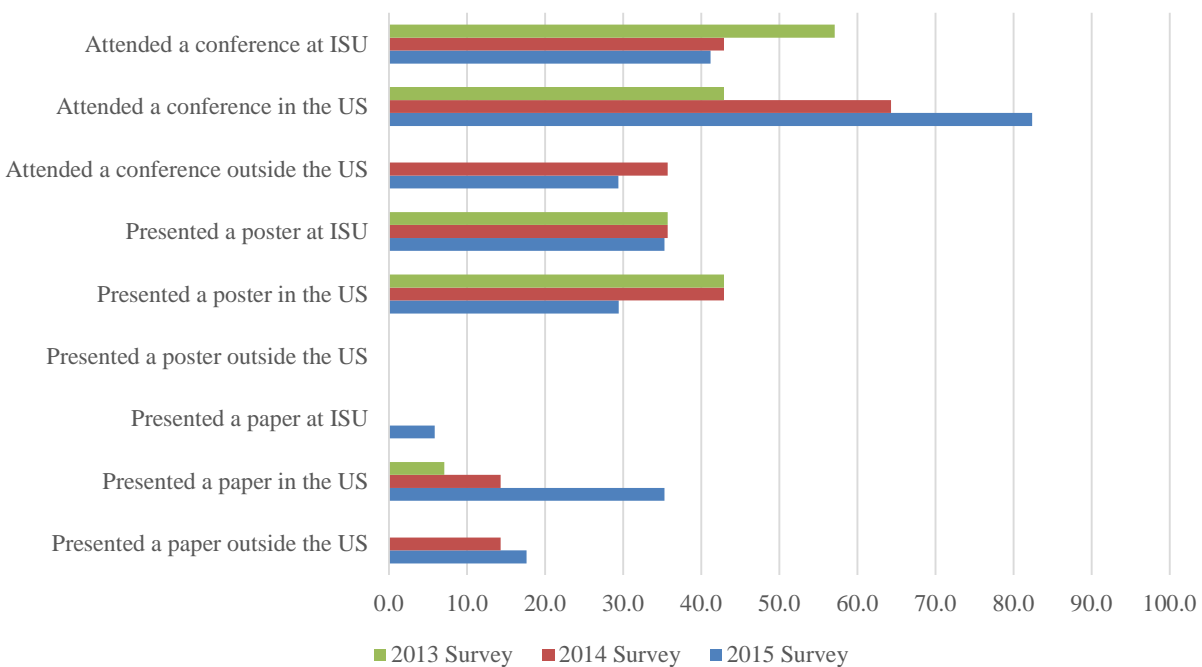


Figure 7. Percentage of students attending and presenting at conferences in the 2013-2015 annual surveys. (2013 n = 14, 2014 n = 14, 2015 n = 17).

Students from the 2012, 2013, and 2014 cohorts were asked about the usefulness of WESEP 594: the RTRCs (Table 8). Fall 2015 students were not included due to limited exposure to the RTRC, and the remaining 2015 student was not included in the table for confidentiality reasons. On average, students indicated that the RTRC was “somewhat useful,” reporting that it was most useful for learning about environmental and policy issues, and less useful for facilitating interdisciplinary work. Notably, students from the 2014 cohort rated the RTRC lower than did students in the 2012 or 2013 cohorts. As shown in Figure 8, students rated WESEP 594 similarly in the 2014 and 2015 annual surveys, although students rated WESEP 594 notably higher at stimulating and enhancing research productivity, learning about environmental and policy issues, and making industry connections in the 2015 annual survey than they had in the 2014 annual survey.

**Table 8: Usefulness of the WESEP 594: Real Time Research Collaborative.**

	2012 Cohort			2013 Cohort			2014 Cohort		
	n	Mean	s.d.	n	Mean	s.d.	n	Mean	s.d.
Learning how to do research	3	2.67	1.155	8	3.13	0.835	2	2.50	0.707
Stimulating and enhancing your research productivity	3	3.33	1.155	8	3.25	0.463	2	2.50	0.707
Facilitating your interdisciplinary work	3	3.00	0.000	8	3.00	1.069	2	1.50	0.707
Enhancing your communication skills	3	2.67	0.577	8	3.25	1.035	2	2.00	0.000
Enhancing your awareness of and ability to respond to ethical issues	3	2.67	0.577	8	3.50	0.756	2	3.00	0.000
Learning about environmental and policy issues	3	3.67	0.577	8	3.63	0.518	2	3.50	0.707
Making industry connections	3	3.33	1.155	8	3.25	0.707	2	2.50	0.707

Scale: 1 = Not at all Useful, 2 = A Little Useful, 3 = Somewhat Useful, 4 = Very Useful

Fall 2015 cohort students were not included in this table due to limited exposure to the RTRC. The remaining 2015 cohort student is not included for confidentiality purposes.

Students' Ratings of WESEP 594: RTRC  
on the 2013-2015 Annual Surveys

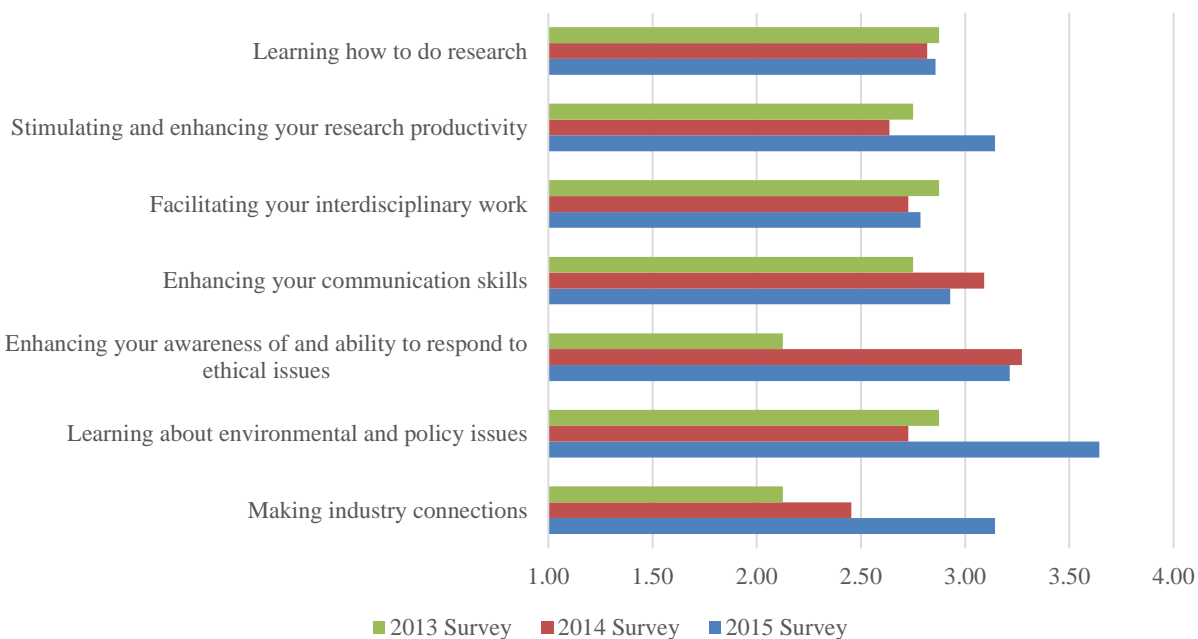


Figure 8. Students' ratings of WESEP 594: RTRC in the 2013-2015 annual surveys. (2013 n = 8, 2014 n = 11, 2015 n = 14). Students entering the program the fall semester that the survey was administered are not included in this table due to their limited exposure to the WESEP 594 at the time of the survey. Scale: 1 = Not at all Useful, 2 = A Little Useful, 3 = Somewhat Useful, 4 = Very Useful.

### 2.1.3 Student Learning, Preparation, and Suggestions for Improvement

Students were asked three closed-ended response items related to their perceptions of their individual preparedness, the opportunities provided by their graduate program, and their career plans and perceptions of preparedness. Students were asked to provide suggestions for improving the IGERT program, and students planning to graduate within a year were asked about their graduation plans, the highlights of their experiences of the program, and any aspects of the program that might be lacking.

Table 9 displays students' reported perceptions of their preparedness to engage in a variety of academic and research-related activities. Overall, students rated themselves highly in each of the areas listed, and on average, indicated that they were at least somewhat prepared in each area. On average, students felt most prepared to write research articles or books. Students reported that they were least prepared to write research articles or books, know their own discipline in depth, and communicate with people outside their field. As would be expected, 2015 cohort students rated themselves as less prepared than 2013 and 2014 students in most of the areas listed – however, 2012 cohort students tended to rate themselves, overall, at about the same level as the 2015 cohort students. As shown in Figure 9, students rated themselves higher in seven of these areas on the 2015 survey as compared to the 2014 survey, and lower in six areas on the 2015 survey as compared to the 2014 survey.

**Table 9: Students' Perceptions of Preparedness**

	2012 Cohort			2013 Cohort			2014 Cohort			2015 Cohort		
	n	Mean	s.d.	n	Mean	s.d.	n	Mean	s.d.	n	Mean	s.d.
Conduct high-quality research	3	4.00	0.000	8	4.50	0.535	2	4.00	0.000	4	3.00	0.816
Communicate with people inside your field	3	3.67	0.577	8	4.38	0.518	2	4.00	0.000	4	3.25	0.500
Understand and work in an academic setting	3	3.33	1.528	8	4.50	0.756	2	3.50	0.707	4	4.00	0.816
Conduct research in an ethical manner	3	4.00	1.000	8	4.75	0.463	2	3.50	0.707	4	4.00	1.155
Present research findings to scientific peers	3	3.33	0.577	8	4.50	0.756	2	4.50	0.707	4	3.50	1.000
Know your discipline in depth	3	2.67	1.528	8	4.50	0.535	2	4.50	0.707	4	3.50	0.577
Work in teams of researchers from more than one discipline	3	3.33	1.155	8	4.50	0.535	2	3.50	0.707	4	3.25	1.258
Work in research teams within your discipline	3	3.00	1.000	8	4.75	0.463	2	3.50	0.707	4	3.75	0.500
Collaborate with international scientists	3	3.33	1.155	8	4.50	0.756	2	2.50	0.707	4	3.00	0.816
Write research articles or books	3	3.00	0.000	8	4.63	0.518	2	3.00	1.414	4	3.25	0.500
Communicate with people outside your field	3	3.33	1.155	8	4.25	0.707	2	3.50	0.707	4	3.25	0.500
Communicate research findings to the general public	3	3.33	1.155	8	3.75	1.035	2	3.50	0.707	4	3.50	1.000
Work outside of academia (industry, public sector)	3	4.00	1.000	8	4.00	0.756	2	3.50	0.707	4	3.00	1.414

Scale: 1 = Not Prepared, 2 = A Little Prepared, 3 = Somewhat Prepared, 4 = Mostly Prepared, 5 = Very Prepared

## Students' Ratings of their Preparedness on the 2013-2015 Annual Surveys

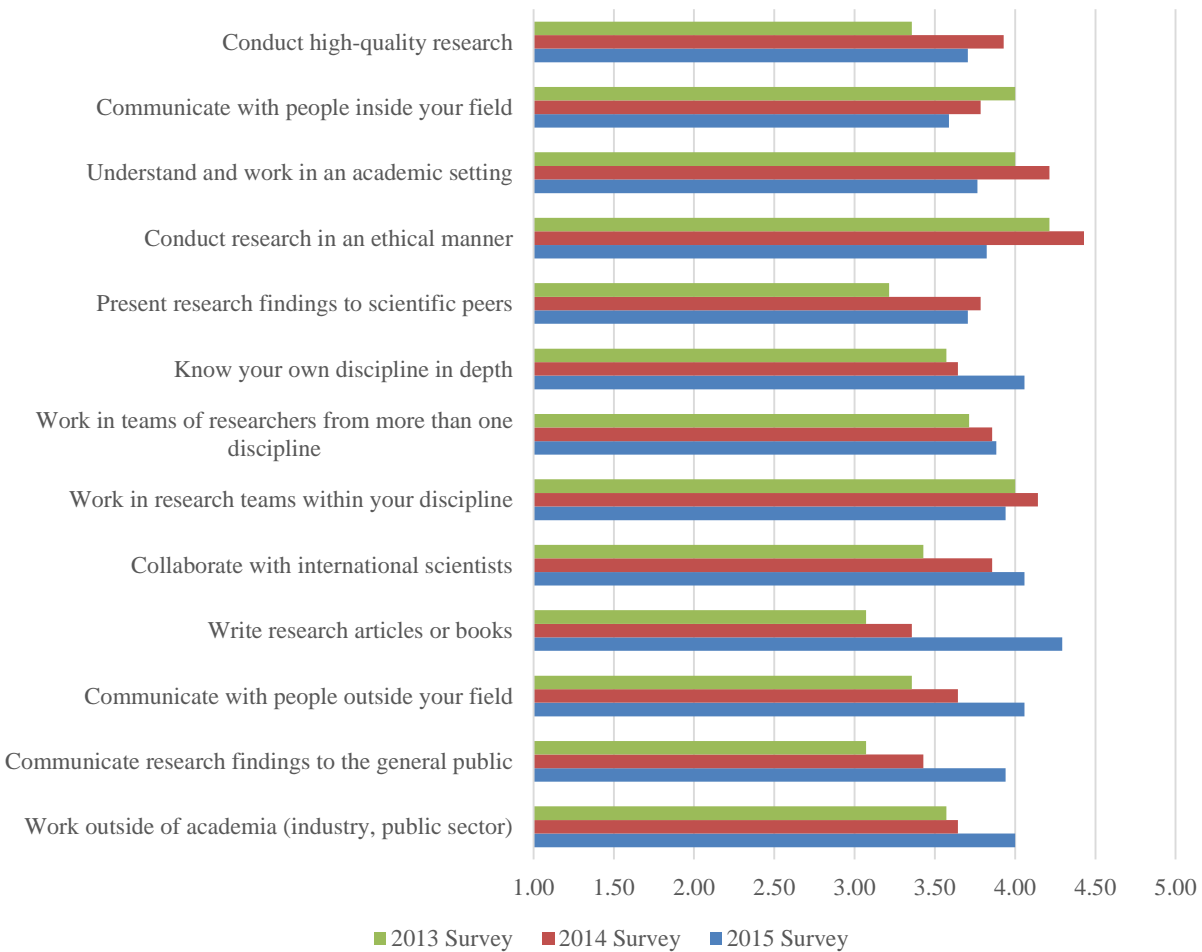


Figure 9. Students' ratings of their preparedness in the 2013-2015 annual surveys. (2013 n = 14, 2014 n = 14, 2015 n = 17). Scale: 1 = Not Prepared, 2 = A Little Prepared, 3 = Somewhat Prepared, 4 = Mostly Prepared, 5 = Very Prepared.

In Table 10 students' perceptions of the IGERT WESEP program are presented. Overall, the majority of students tended to agree with each of the items presented. Students agreed most strongly that they were able to study their field in as much depth as they liked, and they agreed least that they were familiar with research being conducted in their field in foreign countries. Students in the 2014 cohort agreed much less strongly that they were part of a strong student community than did students in any of the other cohorts. As shown in Figure 10, students responded similarly to these items on the 2014 and 2015 annual surveys, though 2015 students were somewhat less likely to agree that they experience high demands on their time from their academic program and that they were part of a strong student community. Students were slightly more likely to agree on the 2015 annual survey that they have been prepared to conduct research outside of their institution than they were on the 2014 annual survey.

**Table 10: Students' Perceptions of their Graduate Program**

	2012 Cohort			2013 Cohort			2014 Cohort			2015 Cohort		
	n	Mean	s.d.	n	Mean	s.d.	n	Mean	s.d.	n	Mean	s.d.
I am able to study my field in as much depth as I like.	3	4.33	1.155	8	4.63	0.518	2	4.50	0.707	4	4.00	0.816
I have developed the ability to communicate and work on research problems with researchers from more than one discipline.	3	4.00	1.000	8	4.38	0.744	2	4.00	0.000	4	3.25	0.500
I experience high demands on my time from my academic program.	3	4.33	0.577	8	4.00	1.069	2	4.00	0.000	4	4.00	0.816
I receive adequate opportunities to network with researchers outside this university.	3	3.67	0.577	8	4.38	0.744	2	3.00	0.000	4	3.25	0.500
I am familiar with current research being conducted in my field in foreign countries.	3	3.33	1.155	8	4.25	1.035	2	3.50	0.707	4	3.00	0.816
I have been prepared to conduct research outside my institution.	3	3.67	0.577	8	4.50	0.756	2	4.00	0.000	4	3.25	0.500
I am being prepared for a wide range of career possibilities.	3	3.67	0.577	8	4.38	0.916	2	3.00	0.000	4	3.75	0.957
I am part of a strong student community.	3	3.67	0.577	8	4.50	0.756	2	2.50	0.707	4	4.00	0.816

Scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Neither Agree nor Disagree, 4 = Agree, 5 = Strongly Agree

## Students' Perceptions of the WESEP IGERT Program on the 2013-2015 Annual Surveys

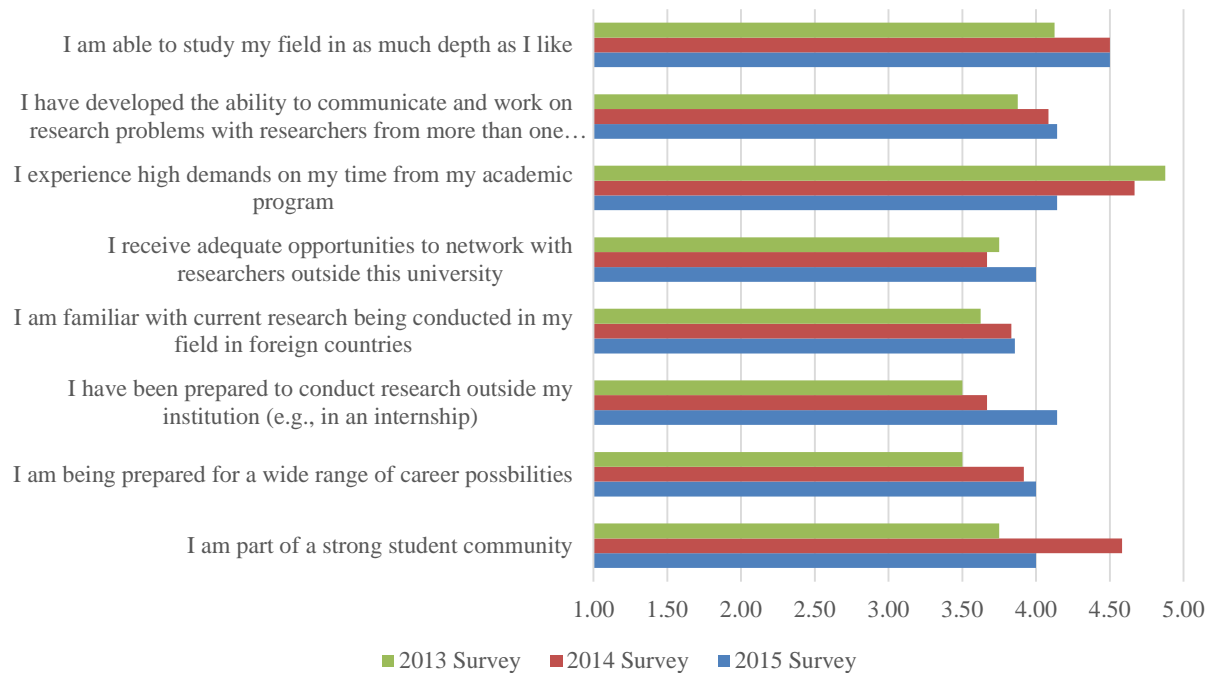


Figure 10. Students' perceptions of the WESEP IGERT program in the 2013-2015 annual surveys. (2013 n = 8, 2014 n = 12, 2015 n = 14). For consistency, incoming students into the program were included in this chart (In the 2013 annual survey, incoming students were not asked to respond to this question. In the 2014 and 2015 surveys, incoming students responded to this question but their responses are not included here.). Scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Neither Agree nor Disagree, 4 = Agree, 5 = Strongly Agree.

Students were asked about the types of careers they would prefer, as well as the extent to which they felt prepared to go into various types of careers (Table 11). Students across cohorts were least interested in careers in academia, and more interested in careers involving research or in industry. Most students also indicated that they felt more prepared for a career in research or industry than they did for a career in academia. This question was new on the 2015 annual survey, and was not posed on the 2013 or 2014 annual surveys; thus, annual results are not pictured. In on-site discussions with the students it was revealed that the consensus amongst the students was that university faculty work long hours doing multiple tasks with little reward versus their counterparts in industry or in federal agency labs; a shared, on the ground perception.

**Table 11: Students' Career Plans and Perceptions of Preparedness**

	2012 Cohort			2013 Cohort			2014 Cohort			2015 Cohort		
	n	Mean	s.d.	n	Mean	s.d.	n	Mean	s.d.	n	Mean	s.d.
I would prefer a career in academia.	3	2.33	1.155	8	2.50	0.926	2	2.50	0.707	4	2.50	1.291
I will be well-prepared for a career in academia.	3	2.67	1.528	8	3.38	1.061	2	4.00	0.000	4	4.00	0.816
I would prefer an career in industry	3	4.00	1.732	8	3.50	0.756	2	4.00	0.000	4	4.00	0.816
I will be well-prepared for a career in industry.	3	4.00	1.000	8	3.88	0.835	2	4.00	0.000	4	3.00	1.414
I would prefer a career in government, non-profit agencies, or NGOs.	3	2.67	1.155	8	3.13	0.991	2	4.00	1.414	4	4.50	0.577
I will be well-prepared for a career in government, non-profit agencies, or NGOs.	3	3.00	1.000	8	3.75	0.463	2	3.50	0.707	4	3.50	1.000
I would prefer a career that involves doing research.	3	4.67	0.577	8	4.13	0.641	2	4.00	1.414	4	4.25	0.500
I will be well-prepared for a career that involves doing research.	3	4.33	0.577	8	4.50	0.535	2	3.50	0.707	4	4.25	0.957

Scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Neither Agree nor Disagree, 4 = Agree, 5 = Strongly Agree



### **What suggestions do you have to improve the IGERT program?**

- There was not significant interaction with private industry. Various speakers from industry gave presentations during WESEP 594 which was useful to some degree, but there was not the opportunity to engage with industry such as per a research collaboration.
- I have been very happy with the IGERT program. I know the 594 class gets a lot of grief, but I really like it. I have never once attended any class where I did not learn something new. I understand how others may think that it does not help them in their research, but I think it has helped me to become a better citizen, researcher and engineer. I know it can be hard to find people to talk, but I love listening to industry people. i.e. (GE, Siemens, Old Dominion, MidAmerican). These are opportunities that I do not get elsewhere, and they are well worth the time I put into the class. Now for suggestions, I would say the only problem I have is with the way the required classes are set up. The only reason I came to get a Ph.D. was to advance my engineering skills, and work in renewable energy. I feel I am a smart person, and I would like some more leeway in the classes I take. At this level of education I feel I am the master of my own destiny, and if I feel that taking a EE class on circuits would help me to solve problems in a tower structural systems I feel this should be encouraged. Engineering problems are complex and hard. We (the students) need access to every tool available to solve these problems. At this point I think my main suggestion would be a clear cut process where we could petition a known group of administrators about allowing certain classes to work towards our graduation requirements. I understand that you may not want to add certain classes to a broad list, but there are some individuals who can make a compelling case for certain classes to be added to their program.
- Having a way to actually encourage interdisciplinary research. Currently people chose to partake in it, but it doesn't actually happen all that often.
- Free tacos at WESEP 593. Also, I'd like to hear from more small/start-up companies in the wind industry.
- None.
- I believe the policy/economics/social aspect of the program should be more heavily emphasized through coursework and the research collaborative. The research collaborative presents an opportunity for discussions regarding new developments or obstacles in the wind industry which is currently not being taken advantage of.
- Require a secondary adviser outside of your home department which would allow students to observe other disciplines research in related areas. This interaction could be as little as a few meetings which research is presented or as much as a research project which includes the student and the secondary adviser's students.
- Could have more of a focus on careers for the students involved. If I want to be a faculty member, what should I be doing? If I want to join the wind energy industry, what careers could I be aiming for?
- They way in which WESEP professors are communicated with/kept in the loop could definitely be improved. My major professor, for example, feels like he has no idea what's going on within WESEP/IGERT; this is not ideal from a purely logistical standpoint, but is also not a good way to foster interdisciplinary collaboration (which we don't have too much of).
- None at this time.

- Since I am a new student, I do not have much commentary on the program at this time. It seems well organized and put together.

**Please use this space to discuss any other comments or concerns you may have.**

- The WESEP faculty is to be congratulated for such an outstanding program.
- This note isn't really on the program itself. It is in regards to the application process. The turnaround was extremely quick, but the first initial contact came very late in the application season. The WESEP program was definitively my number one choice, after I knew of its existence. Even prior to it, Iowa State was high on my list, but getting notification late in the application season meant I had to derail certain plans and alter my time schedule for many things. Part of that issue was that I didn't know about the program prior to my home department informing me of WESEP's interest in my application, which is on me. The other aspect of the issue was that WESEP didn't talk to my home department until very late in the season, meaning delayed start time for the quick turnaround. This is possibly inaccurate information as I learned of the opportunity after another call late in the season wherein they told me about it. But I know that notification from WESEP to my home department occurred between March 30th 2015 and April 16th 2015, so late to very late. All of this information is important, because I was about 1 day from accepting a position elsewhere, meaning that not inquiring with possible applicants early enough, and not getting coverage early enough, could lead to viable contenders rejecting simply based on prior obligations. I left this comment in this box, because it felt like a small, but important, logistical issue and does not reflect on the quality of the program whatsoever. Thank you for reading.

The five students who indicated that they planned to graduate with in a year were asked three additional open-ended questions, which are listed below.

**What are your plans after graduation from the program? (e.g., Have you started looking into career opportunities? Do you plan to go into academia or industry? Etc.)**

- I am currently undecided which career path I will take after graduation. I am interested in energy policy and industry research. I plan to apply for the PMF and AAAS fellowships as a path to a career in energy policy. I will also look into industry research jobs.
- I am looking to start my own business.
- My plans are to work at a research center based either at a university or a national laboratory. I don't plan to pursue a faculty position.
- At this point, I do not have a strong preference (e.g., academia, industry, government). My plan is to keep all the options open.
- I am looking at opportunities at National Laboratories, specifically Sandia National Labs. I am also considering an international post-doc through the Japan Society for the Promotion of Science or other international partners.

**What do you view to be the highlight of your experience in the WESEP IGERT program?**

- Through the WESEP 594 Research Collaborative I have had the opportunity to learn a great deal about wind energy from both an industry and policy perspective. This has

strengthened my overall understanding of wind energy and also provided opportunities for networking and internship opportunities.

- The highlight has been the exposure to disciplines and individuals related to wind energy that are outside my own field. The international experience was also a highlight giving me exposure to researchers in another country.
- Overall, it was a good experience. I enjoyed listening to different aspects of wind energy. I also enjoyed working with different individuals with different backgrounds.
- The connections I have made with people in other disciplines of within wind energy.
- 1. Internship experience. 2. Opportunity to engage with fellow graduate students outside of my area. 3. Opportunity to develop my own research plan.

**Were there experiences in the WESEP IGERT program that you felt were lacking or not very useful? Please explain.**

- A lot of WESEP 594 seemed unnecessary and simply time consuming.
- None.

## **2.2 Annual Faculty Survey**

This section of the report details faculty members' responses to the annual faculty survey and is broken down into three subsections: 2.2.1) Research, Publications, and Other Scholarly Activity; 2.2.2) Impact of IGERT on Graduate Students; and 2.2.3) Impact of Participating in IGERT and Suggestions for Program Improvement. Each of these subsections is comprised of similar questions. All 18 of the WESEP IGERT-affiliated faculty members at Iowa State University were sent an e-mail in August 2015 inviting them to complete the faculty survey. Of these 18 faculty, 15 responded to the survey. Not all faculty members responded to every question.

### **Overview**

Faculty participation in the IGERT program is presented in Table 12. Over 90% of the faculty reported that they advised IGERT graduate students, and over half of the faculty indicated that they conducted IGERT-related research. Forty-seven percent of faculty indicated that they served on IGERT dissertation committees, and one-third of the faculty reported teaching IGERT courses. Twenty-seven percent reported attending IGERT workshops or lectures, 20% reported having students that IGERT graduate students worked in their labs. Thirteen percent contributed to IGERT project management.

It is interesting to note that only seven faculty reported serving on dissertation committees, though it is possible that the committees of other faculty were not yet established. It is also possible that faculty interpreted the question to mean "serving on POS committees of students for which I am not the supervisor" since some faculty define "serving on POS committees" in this way – this could be clarified on the 2016 survey. Only eight faculty reported conducting IGERT-related research, this response is strange since a faculty supervising a WESEP student is doing research in wind energy – it is possible that some faculty interpreted this question in terms of their own "hands-on" research activities, which may not have included wind-related research to date. Only three faculty reported having IGERT students working in their research labs, though some faculty don't have labs per-se, particularly those who are focused on software development so do not naturally equate

their desk top computer or lap top computer with what is conventionally considered a laboratory. Only five faculty reported teaching IGERT courses – a total of eight faculty do teach IGERT courses, though several of these faculty may not have responded to the survey.

**Table 12: Participation in the IGERT Project**

	n	%
I advise IGERT graduate students	14	93.3
I serve on IGERT dissertation committees	7	46.7
I conduct IGERT-related research	8	53.3
I attend IGERT workshops or lectures	4	26.7
IGERT graduate students work in my lab	3	20.0
I teach IGERT courses	5	33.3
I contribute to IGERT project management	2	13.3
Other <sup>a</sup>	0	0.0

### 2.2.1 Research, Publications and Other Scholarly Activity

This section provides an overview of four closed-ended questions related to faculty research and publication and other scholarly activity. Faculty members were asked about the numbers of publications which they had authored, coauthored, and/or participated in interdisciplinary research on. They were also asked about interdisciplinary research publications and other scholarly activity.

Faculty responses regarding their research output in WESEP over the past year are displayed in Table 13. On peer-reviewed journal articles related to WESEP, faculty reportedly served as a primary author 13 times, a co-author 11 times, and worked with an interdisciplinary author/co-author four times. On conference presentations or posters related to WESEP, faculty reportedly served as primary author 15 times, co-author 22 times, and worked with an interdisciplinary author/co-author six times. Faculty additionally reported serving as a primary author on a book chapter twice, and one faculty member was the primary author of a book. Faculty reported serving as the primary author on patent applications three times, and worked with interdisciplinary authors/co-authors two times. Five faculty were the primary author of approved patents. On grant applications, faculty served as a primary author 23 times, a coauthor once, and worked with an interdisciplinary author/co-author once. Faculty reported being a primary author on another type of publication twice.

As shown in Figure 11, faculty vastly increased the number of times they reported serving as a primary author on a variety of publications from 2014 to 2015, including journal

articles, conference presentations, books, patent applications, approved patents, grant proposals, and other publications. However, faculty decreased the number of times they reported serving as a co-author on publications, including journal articles, conference presentations, book chapters, and grant proposals. They also decreased the number of times they reported working with interdisciplinary authors/co-authors on publications such as journal articles, conference presentations, and grant proposals – however, this was the first year that faculty reported working with interdisciplinary authors/co-authors on any patent applications.

Taken collectively, the WESEP IGERT faculty have been highly productive in scholarly productivity, which has been of great benefit not only to these faculties, but very importantly to the WESEP IGERT students whom they advise and mentor.

**Table 13: Faculty, Publications and Other Scholarly Activity Related to WESEP**

	<b>n</b>	<b>Mean</b>	<b>s.d.</b>
Journal articles in refereed journals			
Primary Author	13	0.87	2.560
Co-author	11	0.73	1.223
Interdisciplinary author/co-authors	4	0.27	0.594
Conference paper or poster presentations			
Primary Author	15	1.00	2.563
Co-author	22	1.47	1.552
Interdisciplinary author/co-authors	6	0.40	0.737
Book chapters			
Primary Author	2	0.13	0.516
Co-author	0	0.00	0.000
Interdisciplinary author/co-authors	0	0.00	0.000
Books			
Primary Author	1	0.07	0.258
Co-author	0	0.00	0.000
Interdisciplinary author/co-authors	0	0.00	0.000
Patent applications			
Primary Author	3	0.20	0.414
Co-author	0	0.00	0.000
Interdisciplinary author/co-authors	2	0.13	0.516
Approved patents			
Primary Author	5	0.33	0.900
Co-author	0	0.00	0.000
Interdisciplinary author/co-authors	0	0.00	0.000
Grant proposals			
Primary Author	23	1.53	3.159
Co-author	1	0.07	0.258
Interdisciplinary author/co-authors	1	0.07	0.258
All other publications			
Primary Author	2	0.13	0.516
Co-author	0	0.00	0.000
Interdisciplinary author/co-authors	0	0.00	0.000

### Number of Times Faculty Reported Working on Research Projects on the 2013-2015 Annual Surveys

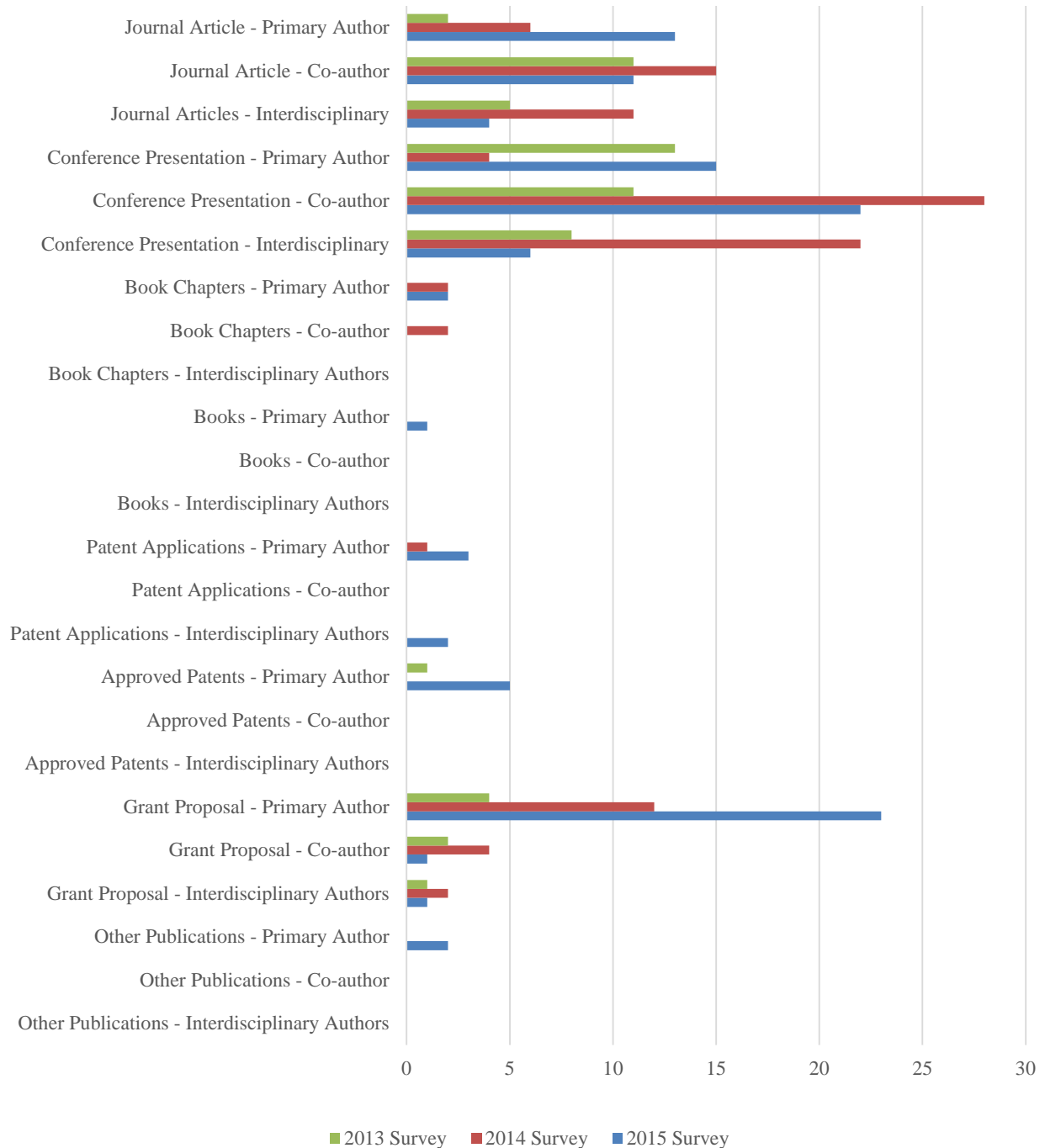


Figure 11. Number of times faculty reported working on research projects in 2013-2015 annual surveys. (2013 n = 17, 2014 n = 18, 2015 n = 15).

As shown in Table 14, faculty were asked to indicate whether they had published research findings in a journal, or presented research findings at a conference, outside their home discipline within the last year. Eight of the 15 faculty respondents indicated that they had presented research findings at a conference outside their home discipline, and seven faculty reported that they had published research findings in a journal outside their home discipline.

The percentage of faculty reporting that they had published research findings in a journal outside their home discipline or presented research findings at a conference outside their home discipline within the last year remained fairly stable on the 2013, 2014, and 2015 surveys (Figure 12). However, a slightly smaller percentage of faculty reported publishing research findings in a journal outside of their home discipline in 2015, and a somewhat larger percentage of faculty reported presenting findings at a conference outside of their home discipline in 2015.

**Table 14: Research Publications and Professional Conference Talks/Posters Outside of the Faculty Home Discipline**

	n	%
Published research findings in a journal outside your home discipline.	7	46.7
Presented research findings at a conference outside your home discipline.	8	53.3

Percentage of Faculty Members Reporting Publications and Presentations Outside their Home Discipline on the 2013-2015 Annual Surveys

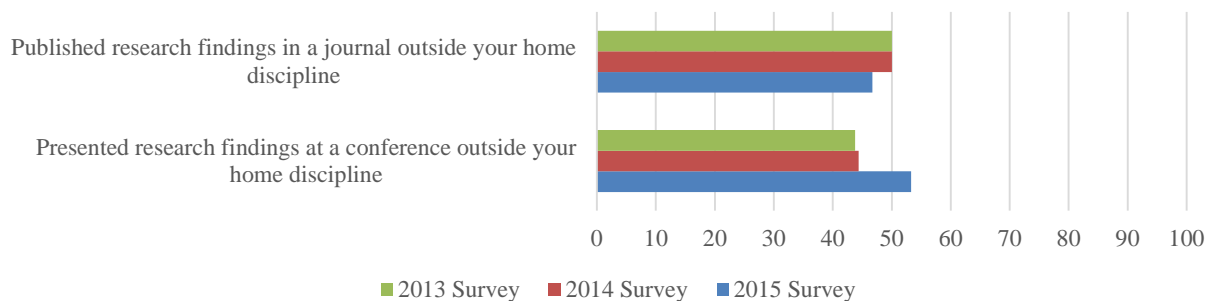


Figure 12. Percentage of faculty members reporting publications and presentations outside their home discipline on the 2013-2015 annual surveys (2013 n = 16, 2014 n = 18, 2015 n = 15).

### 2.2.2 Impact of IGERT on Graduate Students

Faculty members were asked to respond to an open-ended question about departmental recruiting of graduate students and three closed-ended questions related to the impact of IGERT on graduate admissions, the preparation of graduate students, and the usefulness of the WESEP 594: the RTRC.



**What strategies were used to attract a highly qualified, diverse pool of applicants for the IGERT program?**

Five faculty members responded to this question. Several faculty mentioned trying to interest undergraduate students in the field of wind energy and recruit those students to the program. One faculty member mentioned dissemination of program information, increased student participation at national and international meetings, and engagement with students at other universities. Faculty responses are listed below.

- Wider dissemination of program descriptions, more student and postdoc participation at national and international meetings, more interactions with students from other universities.
- We try to pay special attention to very good quality undergrads in our program and make sure they are aware of the IGERT program.
- I had one IGERT funded grad student - he dropped out at the MS level (\*) - he never really did much on his research project. He lacked the dedication to spend the time needed to be successful on research -- liked to socialize more than work on research. (\*We note however, this observation/statement is not quite correct as all of the IGERT students are by definition PhD students. In checking further we found that there was a student who dropped out but he was a “direct entry” [direct from UG to PhD] and so the major professor may have considered this student to have been on the level of an MS student)
- Selecting students early on in their career and promoting their interest in Wind Energy.
- Educating students with the benefit of an IGERT fellow.

WESEP faculty were asked to respond to a series of questions on the impact of IGERT on their home department admissions, as shown in Table 15. Faculty agreed most strongly that they have attracted more students who are U.S. citizens, with ten faculty agreeing to this item and one faculty disagreeing. Eight faculty agreed that they had attracted students with different career goals, and seven reported that they had inter/multidisciplinary backgrounds. Six faculty agreed that they had attracted students from a more varied disciplinary background, six indicated that they had attracted better qualified students, and six agreed that they had attracted more students. No faculty agreed that they had attracted more international students, and only one faculty member agreed that they had attracted more underrepresented minority students.

As shown in Figure 13, faculty members agreed slightly more on each item related to the impact of IGERT on departmental missions on the 2015 annual survey than they did on the 2014 annual survey.

**Table 15: Impact of IGERT on Departmental Admissions**

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	n	Mean	s.d.
We have attracted better qualified students	0	1	8	5	1	15	3.40	0.737
We have attracted more students	0	0	9	6	0	15	3.40	0.507
We have attracted more students who are U.S. citizens	0	1	4	8	2	15	3.73	0.799
We have attracted students who have inter/multidisciplinary backgrounds	0	1	7	6	1	15	3.47	0.743
We have experienced increased admissions inquiries into our program	0	1	12	2	0	15	3.07	0.458
We have attracted students from a collectively more varied disciplinary background	0	0	9	5	1	15	3.47	0.640
We have attracted students with different career goals	0	0	7	7	1	15	3.60	0.632
We have attracted more underrepresented minority students	0	4	10	1	0	15	2.80	0.561
We have attracted more female students	1	3	8	2	1	15	2.93	0.961
We have attracted more international students	2	2	11	0	0	15	2.60	0.737

Scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Neither Agree nor Disagree, 4 = Agree, 5 = Strongly Agree

### Mean Faculty Responses Regarding Departmental Admissions on the 2013-2015 Annual Surveys

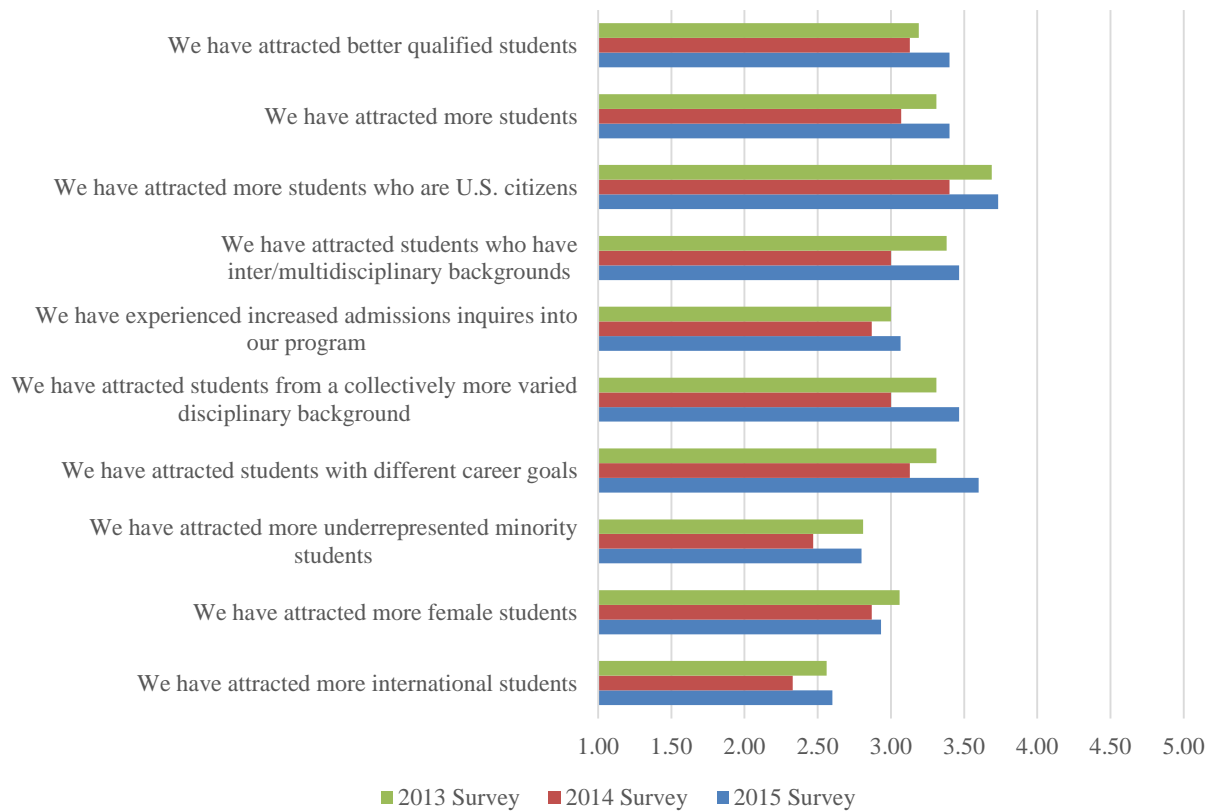


Figure 13. Mean faculty responses regarding departmental admissions on the 2013-2015 annual surveys (2013 n = 16, 2014 n = 15, 2015 n = 15). Scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Neither Agree nor Disagree, 4 = Agree, 5 = Strongly Agree.

IGERT faculty were asked to compare IGERT and Non-IGERT graduate students in their respective home departments, as detailed in the responses in Table 16. Notably, on average the IGERT students were rated as being better prepared than their Non-IGERT peers on all of the items. IGERT students were rated the highest in their preparedness to communicate with people inside and outside of their field, work on research teams within their discipline, understand and work in an academic setting, conduct research in an ethical manner, and work on teams of researchers from more than one discipline. The disparity between the ratings received by IGERT and non-IGERT students was over a full scale point on items related to preparedness to communicate with people outside of their field and work in teams of researchers from more than one discipline. Additionally, disparities between the ratings received by IGERT and non-IGERT students exceeded half a point for five items related to students’ preparedness to work in research teams within their disciplines, understand and work in an academic setting, work outside of academia, collaborate with international scientists, and communicate research findings to the general public.

As shown in Figure 14, faculty tended to rate IGERT students higher than Non-IGERT students on the 2013, 2014, and 2015 surveys. Faculty did tend to rate IGERT students as slightly more prepared on the 2015 survey than they did on the 2014 survey.

**Table 16: Preparation of Graduate Students**

	Not prepared	A little prepared	Somewhat prepared	Mostly prepared	Very prepared	Not sure/ not applicable	n	Mean	s.d.
Conduct high-quality research									
IGERT Graduate Students	1	0	1	6	7	0	15	4.20	1.082
Non-IGERT Graduate Students	0	0	3	10	2	0	15	3.93	0.594
Present research findings to scientific peers									
IGERT Graduate Students	0	1	0	6	8	0	15	4.40	0.828
Non-IGERT Graduate Students	0	0	2	12	1	0	15	3.93	0.458
Know their own discipline in depth									
IGERT Graduate Students	1	1	0	4	9	0	15	4.27	1.223
Non-IGERT Graduate Students	0	0	3	9	3	0	15	4.00	0.655
Communicate with people inside their field									
IGERT Graduate Students	0	1	1	2	11	0	15	4.53	0.915
Non-IGERT Graduate Students	0	0	4	6	5	0	15	4.07	0.799
Work in research teams within their discipline									
IGERT Graduate Students	0	1	0	4	10	0	15	4.53	0.834
Non-IGERT Graduate Students	0	0	4	8	3	0	15	3.93	0.704
Understand and work in an academic setting									
IGERT Graduate Students	1	0	1	1	12	0	15	4.53	1.125
Non-IGERT Graduate Students	0	0	3	10	2	0	15	3.93	0.594
Write research articles or books									
IGERT Graduate Students	1	0	3	4	7	0	15	4.07	1.163
Non-IGERT Graduate Students	0	0	2	11	2	0	15	4.00	0.535
Conduct research in an ethical manner									
IGERT Graduate Students	0	0	1	5	9	0	15	4.53	0.640
Non-IGERT Graduate Students	0	0	3	8	4	0	15	4.07	0.704
Communicate with people outside their field									
IGERT Graduate Students	0	0	1	5	9	0	15	4.53	0.640
Non-IGERT Graduate Students	0	3	5	6	1	0	15	3.33	0.900

Scale: 1 = Not Prepared, 2 = A Little Prepared, 3 = Somewhat Prepared, 4 = Mostly Prepared, 5 = Very Prepared  
 Not Sure/Not Applicable responses are not included in the calculation of the n, mean, or standard deviation.

**Table 16: Preparation of Graduate Students (con't)**

	Not prepared	A little prepared	Somewhat prepared	Mostly prepared	Very prepared	Not sure/ not applicable	n	Mean	s.d.
Work in teams of researchers from more than one discipline									
IGERT Graduate Students	0	0	1	5	9	0	15	4.53	0.640
Non-IGERT Graduate Students	0	4	6	4	1	0	15	3.13	0.915
Work outside of academia, (industry, public sector)									
IGERT Graduate Students	0	1	2	6	6	0	15	4.13	0.915
Non-IGERT Graduate Students	0	1	8	5	1	0	15	3.40	0.737
Collaborate with international scientists									
IGERT Graduate Students	0	1	5	3	6	0	15	3.93	1.033
Non-IGERT Graduate Students	1	1	6	6	1	0	15	3.33	0.976
Communicate research findings to the general public									
IGERT Graduate Students	1	1	2	4	7	0	15	4.00	1.254
Non-IGERT Graduate Students	2	1	5	6	1	0	15	3.20	1.146

Scale: 1 = Not Prepared, 2 = A Little Prepared, 3 = Somewhat Prepared, 4 = Mostly Prepared, 5 = Very Prepared  
 Not Sure/Not Applicable responses are not included in the calculation of the n, mean, or standard deviation.

### Faculty Ratings of IGERT and Non-IGERT Students on the 2013-2015 Annual Surveys

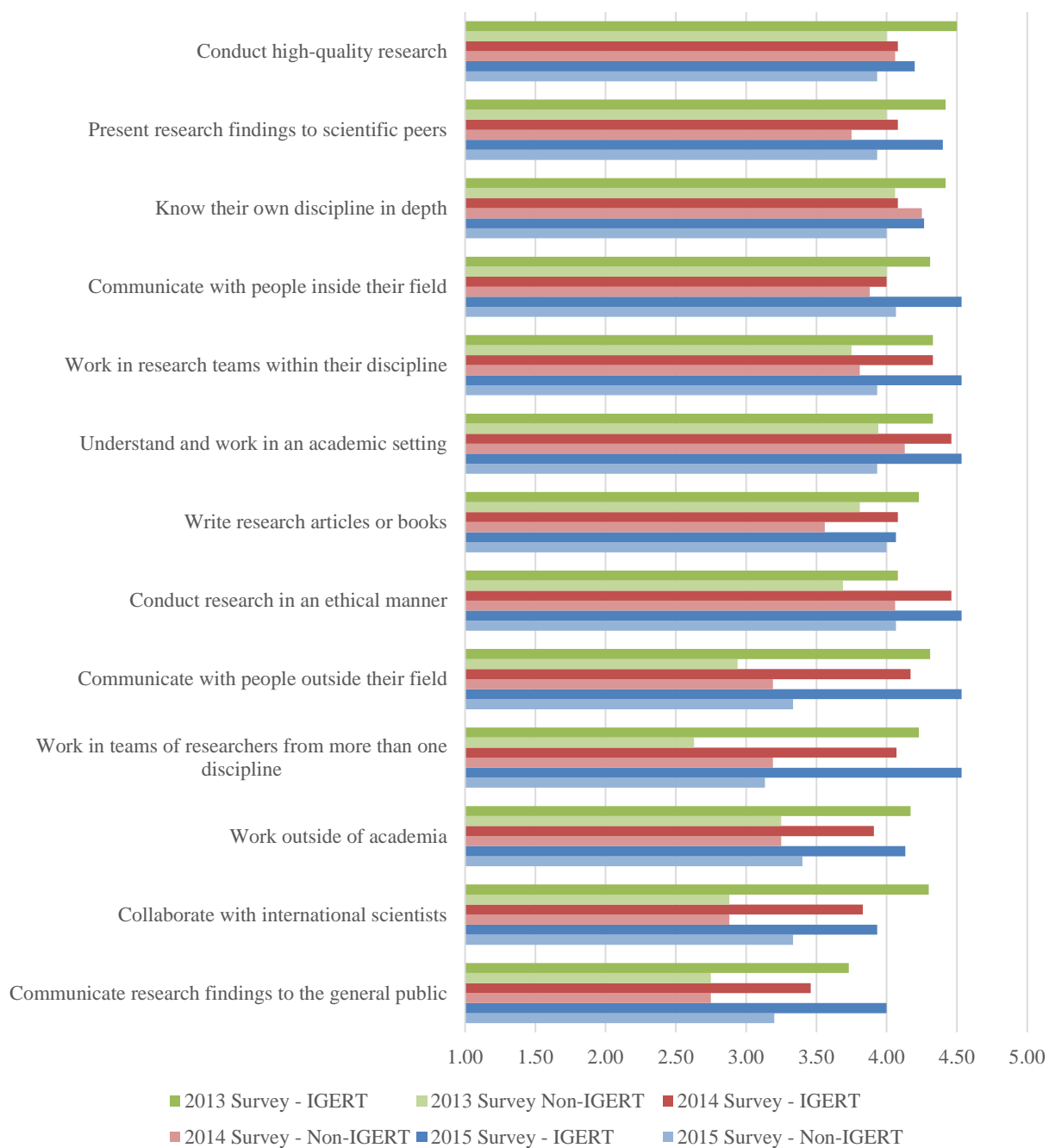


Figure 14. Faculty ratings of IGERT and Non-IGERT students on the 2013-2015 annual surveys (2013 IGERT n = 12, 2013 Non-IGERT n = 16, 2014 IGERT n = 13, 2014 Non-IGERT n = 16, 2015 IGERT n = 15, 2015 Non-IGERT n = 15). Scale: 1 = Not Prepared, 2 = A Little Prepared, 3 = Somewhat Prepared, 4 = Mostly Prepared, 5 = Very Prepared.

Faculty members were asked a series of questions about WESEP 594: the RTRC. Their responses are given in Table 17. All responding faculty agreed that the RTRC was somewhat to very useful in each of the areas listed. They indicated that the RTRC was most

useful for teaching students how to do research, stimulating and enhancing students' research productivity, facilitating students' interdisciplinary work, and enhancing students' communication skills. The lowest rated item was related to teaching students about environmental and policy issues, although all responding faculty still indicated that the RTRC was somewhat or very useful in this area.

As shown in Figure 15, faculty rated WESEP 594: the Real Time Research Collaborative slightly higher on four items on the 2015 survey than they did on the 2014 survey, and slightly lower on three items on the 2015 survey than they did on the 2014 survey.

**Table 17: Usefulness of WESEP 594: the Real Time Research Collaborative**

	Not at all useful	A little useful	Somewhat useful	Very useful	Not sure/ not applicable	n	Mean	s.d.
Teaching students how to do research	0	0	1	6	8	7	3.86	0.378
Stimulating and enhancing students' research productivity	0	0	1	6	8	7	3.86	0.378
Facilitating students' interdisciplinary work	0	0	1	6	8	7	3.86	0.378
Enhancing students' communication skills	0	0	1	6	8	7	3.86	0.378
Enhancing students' awareness of and ability to respond to ethical issues	0	0	4	2	9	6	3.33	0.516
Learning about environmental and policy issues	0	0	5	2	8	7	3.29	0.488
Making industry connections	0	0	2	4	8	6	3.67	0.516

Scale: 1 = Not at all Useful, 2 = A Little Useful, 3 = Somewhat Useful, 4 = Very Useful

Not Sure/Not Applicable responses are not included in the calculation of the n, mean, or standard deviation.

### Faculty Ratings of WESEP 594: the Real Time Research Collaborative on the 2013-2015 Annual Surveys

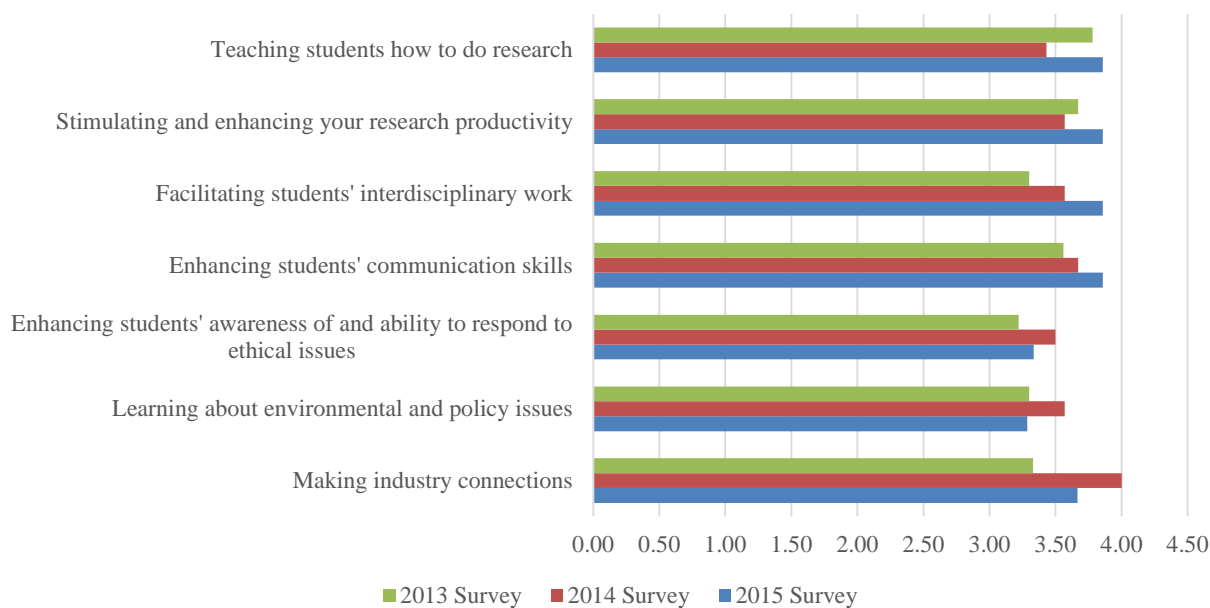


Figure 15. Faculty ratings of WESEP 594: the Real Time Research Collaborative on the 2013 and 2014 annual surveys (2013 n = 9, 2014 n = 7, 2015 n = 7). Scale: 1 = Not at all Useful, 2 = A Little Useful, 3 = Somewhat Useful, 4 = Very Useful.

### 2.2.3 Impact of Participating in IGERT and Suggestions for Program Improvement

Faculty members were asked to respond to three closed-ended questions related to the impact of participating in the IGERT program, including the amount of time they spent on activities in their home department, the impact of IGERT on their professional lives, and the impact of IGERT on their home departments. They were also asked for suggestions on how to improve the IGERT program.

Faculty responses to the question of how involvement in IGERT has affected their time spent in their home departments are summarized in Table 18. Thirteen faculty said they spent equal time teaching department courses, while one spent less time and another spent more time. Fourteen spent equal time advising departmental students, while one faculty member spent more time doing this. Twelve spent equal time engaging in department leadership activities, while three faculty members indicated spending less time on this. All 15 faculty indicated that they spent the same amount of time conducting research with other departmental faculty.

Results from the question about how IGERT has affected faculty members' time spent in their home departments from the 2013 and 2014 surveys are not pictured. However, results from the 2013 and 2014 surveys were similar, with most faculty suggesting that they spent an equal amount of time in their home department on each activity.



**Table 18: Time Spent in Home Department**

	Less time		Equal time		More time	
	n	%	n	%	n	%
Teaching department courses	1	6.7	13	86.7	1	6.7
Advising department students	0	0.0	14	93.3	1	6.7
Engaging in department leadership activities	3	20.0	12	80.0	0	0.0
Conducting research with other departmental faculty	0	0.0	15	100.0	0	0.0

Faculty were asked to indicate how IGERT influenced their professional lives (Table 19). On average, faculty agreed most strongly that they had been exposed to new ideas outside of their area of knowledge, with 11 faculty agreeing to this item and no faculty disagreeing. Faculty also agreed strongly, on average, that they met faculty in other departments who they would not otherwise have met, that they were able to work with a greater variety of students, that they were more likely to conduct research with colleagues in disciplines outside of their own, and they could explore research topics that would not otherwise have been funded. Faculty were least likely to agree that they had less time to conduct their own research, with only one faculty member agreeing to this item.

Figure 16 displays the comparison of faculty members' responses regarding the impact of IGERT on their professional lives on the 2013-2015 annual surveys. Faculty tended to agree less overall on the 2014 annual survey than they did on the 2013 survey. In 2015, responses tended to be higher than 2014 responses, though responses were still lower than 2013 responses on most items. Faculty reported less agreement on the 2015 survey than they had on the 2014 survey on two items – *I am in a better position to obtain new research grants* and *I have less time to conduct my own research*.

**Table 19: Impact of IGERT on Professional Life**

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	n	Mean	s.d.
I have been exposed to new ideas outside my area of knowledge.	0	0	4	9	2	15	3.87	0.640
I have met faculty in other departments whom I would not otherwise have met.	0	2	2	9	2	15	3.73	0.884
I am able to work with a greater variety of students.	0	1	5	6	3	15	3.73	0.884
I am more likely to conduct research with colleagues in disciplines outside my own.	0	0	6	7	2	15	3.73	0.704
My teaching has become more interdisciplinary.	0	0	8	7	0	15	3.47	0.516
I am more likely to consider team-teaching with a faculty member outside my department.	0	1	7	6	1	15	3.47	0.743
I am in a better position to obtain new research grants.	0	0	10	5	0	15	3.33	0.488
I have learned new research techniques.	0	1	9	3	2	15	3.40	0.828
I can explore research topics that would not otherwise be funded.	0	1	3	10	1	15	3.73	0.704
I am able to work with students who are better qualified than non-IGERT students in my department.	1	2	9	2	1	15	3.00	0.926
I have less time to conduct my own research.	2	5	7	1	0	15	2.47	0.834

Scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Neither Agree nor Disagree, 4 = Agree, 5 = Strongly Agree

### The Impact of IGERT on Faculty's Professional Lives on the 2013-2015 Annual Surveys

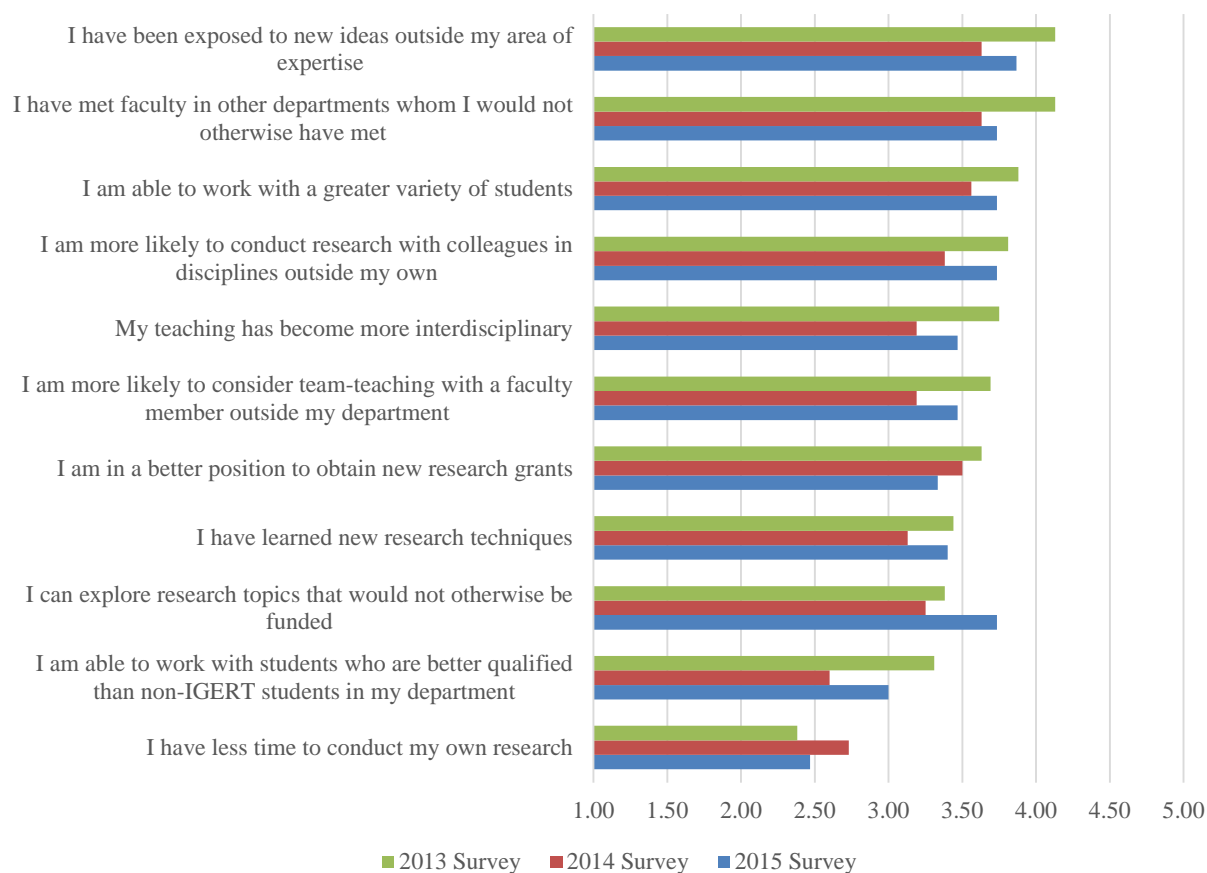


Figure 16. The impact of IGERT on faculty’s professional lives on the 2013-2015 annual surveys (2013 n = 16, 2014 n = 16, 2015 n = 15). Scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Neither Agree nor Disagree, 4 = Agree, 5 = Strongly Agree.

The impacts of the IGERT program on faculty members’ home departments are summarized in Table 20. All fifteen of the responding faculty believed that the program altered the research scope of faculty involved in the program, while two reported it did not. Fourteen of the faculty reported that the program improved faculty mentoring of students in their home departments, while one faculty member indicated that it had not. Thirteen faculty said that the IGERT program did improve the quality of faculty research in their home department, while two faculty indicated that IGERT did not improve the quality of faculty research in their home department.

Survey responses from the 2013-2015 annual surveys regarding the impact of IGERT on faculty members’ home departments are displayed in Figure 17. Faculty members’ responses were consistent in indicating a moderate impact in each area, and responses were the same on both surveys regarding the impact of IGERT on improving the quality of faculty research. Faculty reported an increased impact of the IGERT program in all three areas on the 2015 survey compared to the 2013 and 2014 surveys.

**Table 20: Impact of IGERT on Faculty's Home Department**

	Not at all - 1	2	3	4	Extensively - 5	n	Mean	s.d.
Improved the quality of faculty research	2	2	7	4	0	15	2.87	0.990
Altered the research scope of involved faculty	0	3	5	7	0	15	3.27	0.799
Improved faculty mentoring of students	1	1	9	4	0	15	3.07	0.799

The Impact of IGERT on Faculty Members' Home Departments on the 2013-2015 Annual Surveys

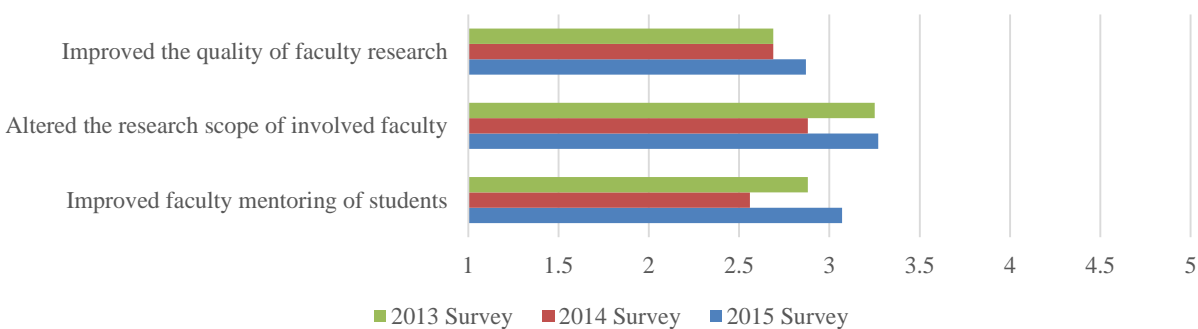


Figure 17. The impact of IGERT on faculty members' home departments on the 2013-2015 annual surveys (2013 n = 16, 2014 n = 16, 2015 n = 15). Scale: 1 = Not at all, 5 = Extensively.

**What suggestions do you have to improve the IGERT program?**

Several faculty suggestions related to intensifying efforts to recruit quality students to the program. Faculty responses are listed below as they were provided.

- Continue and intensify recruitment efforts.
- Guarantee some funding for all four years instead of just two.
- Get a company like Push Marketing to define the WESEP "brand" and design media content to recruit students.
- I had a bad experience with a weak and under-motivated student who had little research aptitude, who was not willing to put the needed hours into classes or his research.
- Have periodic meetings (once or twice the year) with all the faculty involved to discuss possible improvements to the IGERT program at ISU.

**Please use this space to discuss any other comments or concerns you may have.**

Faculty responses are listed below as they were provided.

- Faculty participation in classroom teaching is a challenge.

- Needs to be better screening of students and the qualifier process needs to be more demanding.
- Very well organized program. Glad to be part of it.

### **3. Student Focus Groups and Interviews**

The evaluation team, led by Len Pietrafesa, with support from Brandi Geisinger and Mari Kemis, conducted WESEP IGERT student interviews in two formats. The first format was a focus group in which all current WESEP IGERT students were invited to participate. Twelve students participated in the focus group, and all participating students consented to be audio-recorded. The second format consisted of individual interviews, which were conducted with 15 of the WESEP IGERT students, for which extensive notes were taken during and immediately after the interviews. A total of 17 students participated in the on-campus interviews and/or focus group. The analysis of the student focus group and individual interviews below was conducted on the extensive notes from individual student interviews and the focus group. Due to the fact that the focus group and interview topics and conversations tended to be similar, results of the focus group and interview conversations are presented together and not distinguished.

In the focus group and individual interviews, students discussed a variety of topics, noting things that they particularly liked about the program and suggestions for program improvement. The topic areas discussed included: coursework, internships, graduate student climate, student community outreach and recruitment efforts, industry connections and employment, research and publications, and the WESEP IGERT program sustainability. Overall, students were pleased with their experiences in the WESEP IGERT program.

#### **Coursework - Updates**

##### ***WESEP 594: The Real-Time Research Collaborative***

The WESEP IGERT students mentioned their experiences in the WESEP course 594; the Real-Time Research Collaborative (RTRC). Overall, students found the Fall 2015 594 to have been a highly useful experience and found the changes made in the past few years to be very helpful. Most students indicated that there was a good balance between student presentations, faculty presentations, and industry presentations, though one student mentioned wanting to make sure that there was still space for student presentations. Students appreciated that the “how to do research” lecture was repeated regularly, both to teach incoming students and to serve as a reminder for more advanced students. Students reported that 594 helped increase their awareness of current research and advances in wind energy, as well as helping them to think about and form their own research projects. Students also found that 594 helped them connect and network with other students in the program, in addition to faculty and industry representatives. Students were very impressed by the quality of most of the faculty and industry guest speakers. There is a complete series

of the Fall 2015 lectures, with slides, available at: [home.eng.iastate.edu/~jdm/WESEP594](http://home.eng.iastate.edu/~jdm/WESEP594). Several representative seminars are: Alex King on “Critical Materials”; Cristina Archer on “Wake Losses”; James McCalley on “Doing Research”; and Kayt Wahlert on “Legislative Affairs”.

Students expressed remaining concerns regarding the ways in which WESEP 594 has been assigned credit and appears on their transcripts. Students indicated that, although the problems with the course credits assigned each semester had been fixed going forward, their transcripts continued to appear as though they had re-taken the course multiple times for only one course credit prior to the issue being fixed. Several students indicated that this overall lack of assigned credits was causing delays with their POS, as well as potentially causing issues with their transcripts. Discussions held last year with the University Administration rectified this issue going forward from Fall 2015 now inserting the word “repeatable”. Additionally, the Graduate College has requested that a request from WESEP leadership be made as soon as possible, such that the credit for 594 is made “retroactive”. On this latter matter, University administration has indicated that this problem could be rectified and all WESEP students will receive one credit for each time that they had taken 594. This will correct the students’ POSs and also rectify the false impressions left in the students’ transcripts by prior repeats of the same course with no accumulating credit hours, as they need to reach a total of 72 credit hours for their PhD.

### ***WESEP 502***

A couple of students were concerned about WESEP 502, reporting that it felt very disjointed and that they were “not able to connect the dots.” They indicated that they were unable to discern the overall themes in the class and how the different sections of the course fit together. One student touted the class as, “The worst class I’ve ever taken in my college career,” indicating that if he were forced to re-take the class, he may choose, instead, to drop out of the program. He felt that it was a waste of his time and that he wasn’t learning from many of the faculty teaching the course.

The evaluator notes that one could consider 502 lectures to fall under the general umbrella of “Wind Energy”, so are thus connected. Perhaps on the first day of the first fall class, a list of the upcoming lectures could be provided to the students accompanied by a quick explanation of how the lectures connect to each other could be provided as well. This type of survey course is a challenge when each lecture is presented by a different faculty member. In the evaluator’s view, WESEP 502 provides a very useful broad overview of the many facets of wind energy.

### ***WESEP 512***

This is a new, upper-level course in the WESEP program. Dr. J. McCalley presented approximately half of the lectures and the WESEP students presented four lectures each. Lectures related to: 1) the basics of wind energy as relates to the individual student's area of interest; 2) the research objectives of wind energy in the student's area of interest; 3), a continuation of the previous lecture; and 4) an outline of a research proposal in wind energy in the student's area of interest that intends to push the envelope beyond the student's dissertation content. This course was very well received by the students and is constructed to catapult the student into his/her professional presentations and to address the question of "where do I go from here?"

### ***The Wind Energy Systems Laboratory (WESL)***

This laboratory has had upgrades and has made significant progress in being integrated into the WESEP instruction and research. WESL has been integrated with classroom activities in both WESEP 502 and 512. Laboratory scale wind turbines and tower turbines have been acquired and are up and running for demonstrations and as learning and research tools. There are now several WESEP research projects using WESL facilities. This has become an integral facility for WESEP IGERT student instruction and research. The Laboratory Director, Mr. Nick Davis is perceived to be a hands-on, user friendly facilitator who works well with the students and faculty, though his appointment could be at risk due to salary and benefits funding concerns. Discussions were held with leadership of COE and LAS, along with WESEP-IGERT leadership, and a permanent solution for full time support of the lab director position is a possibility in the future.

### ***POS and Faculty Committees***

Several students expressed frustration because there was not a lot of overlap between the degree requirements in their home department and the degree requirements for WESEP. In several situations, completing both programs of study, that is, WESEP plus their respective majors, required extra coursework on the part of the students; a challenge for double majors. COE appears to have accomplished a great deal in this regards but LAS, particularly for the statistics majors, is still addressing the issue. However the students clearly understand that the rewards for double majoring can be great and lead to new future professional opportunities. One student noted that he would like to have a clear process and timeline for adding new courses to the WESEP curriculum.

Several students expressed confusion about their graduate faculty committees, and were uncertain which faculty were actually WESEP faculty members. They indicated that it would be helpful to have an up-to-date list of current WESEP faculty. In addition, they reported that WESEP faculty should be provided with some basic information about the program, since some WESEP faculty might not be as involved and have less information

about requirements of the program for their graduate advisees. A one to two page hand-out and a clear and concise description of this on the WESEP website would resolve this.

### **Internships**

Students greatly appreciated having the opportunity to travel internationally and participate in internships through the WESEP IGERT program. Several students indicated that the international internship component was an integral part of what attracted them to the program to begin with. Several students wondered when the best time to complete an internship would be – whether they should plan one earlier in their program, or later in their program, after completing coursework. Students who had already participated in internships reported that their internships had been good experiences which were helpful for their research and for building wind energy knowledge. Students were often unable to use the work they did as part of their internships as part of their thesis or dissertation, however, because the information they were collecting or analyzing was typically considered proprietary. One student did remain hopeful that he would be able to use a ‘cleansed’ version of the work he did for his internship for his thesis. Overall, this is a very positive component of the WESEP IGERT program.

### **Graduate Student Climate**

Students reported a good sense of community with other graduate students in the program, and students who chose to reside and work in the shared office space indicated that it was a good environment to learn from and share ideas with other WESEP students. Nonetheless, approximately half of the WESEP students indicated that they either did not have space in the shared office or chose not to use it, preferring to spend their time in their home departments with their disciplinary “majors” colleagues.

### **Student Community Outreach and Recruitment Efforts**

Two students, both female, have formed a new student organization, formally associated with WESEP – the Wind Energy Student Organization (WESO). In this laudable undertaking, they have partnered with ISU undergraduate students in creating WESO, and hope to promote research and collaboration through community outreach efforts and bringing in guest lecturers to speak about wind energy. Students reported that the lectures were very well attended by ISU undergraduate students. WESO has developed two committees, one in STEM Outreach and the other in Collaborative Research engagements. The community outreach efforts have been highly appreciated, with WESO being sought after to deliver presentations to new groups, both internal and external to ISU. WESO students hope that this will become a positive way to promote wind energy within the community and also a way to recruit undergraduates to the WESEP IGERT graduate program. Presently WESO is working to construct a 1 KWT wind turbine on the ISU campus as a demonstration model. Hopefully WESO will continue to prosper as an integral



WESEP student initiated activity. WESO has received funding in support of its activities from the ISU WESEP Program Office.

Several students noted that they had been recruited to the WESEP IGERT program after applying to a related graduate degree program at ISU. While this was a successful way to recruit these students to the program, they noted that they were not notified of this option until mid-April and reported that the program may have missed out on recruiting other students because of the late notice and information about the program, since other students may have already accepted other offers by this time. Students felt that pushing these notifications out much earlier would help recruit more students to the program. However, it is noted that this process can be challenging, since WESEP IGERT student fellowship resources are sometimes pre-committed and then not acted upon in a timely manner by potential new IGERT fellows, and then quick, admittedly late, decisions have to be made by the WESEP Program Office.

### **Industry Connections and Employment**

Some students believed that the WESEP IGERT program could be improved by increasing the number of opportunities available for engagement with industry, and creating stronger ties to industry. Most students reported a desire to pursue a career in industry after graduation, and students viewed industry connections as valuable resources for future employment prospects. Several students noted that the Wind Energy Symposium was well attended and was a good way to connect with industry members.

### **Research and Publications**

Several students indicated that they were working on large research projects, and many were pleased that they were able to conduct interdisciplinary research within the program. Students' research topics were varied, ranging from new tower structure designs to turbine farm turbine-to-turbine interactions, turbine icing, improvements in wind boundary layer numerical modeling, and predicting gearbox failures deterministically and statistically, and so on. Many students reported giving professional conference presentations, both oral and poster, and one student noted that discussing potential conference options in WESEP 594 improves the quality of students' conference presentations. Many students have now published in the peer reviewed literature and are working on peer-reviewed publications on their research. One student noted that a WESEP writing group was being formed to help students work on their academic writing and prepare manuscripts for publication. Several students noted that they were limited in being able to publish all of their research findings because of prior proprietary agreements with industry. Some students indicated that they were not pursuing patent applications, but were encouraged to do so by the program evaluator. One student had reportedly been advised by his major professor, who is new to the WESEP IGERT mentoring program and process, to not begin research until later in his

program. At a following discussion with a professor colleague of the latter new professor, the colleague said that he would confer with the new professor about the process.

### **WESEP IGERT Program Sustainability**

Many students expressed concern about the sustainability of the WESEP IGERT program and whether the program would continue after the first five years. Some students worried that the value of their WESEP IGERT degrees might be diminished if the program were to dissipate. WESEP leadership should discuss this concern with all of the IGERT Fellows.

## **4. Faculty Interviews**

Individual interviews were completed with nine ISU faculty members, two of whom are department heads/chairs, all associated with the IGERT program, in addition to meetings with the program PI. Extensive notes were taken during and immediately after the interviews, and the analysis of the faculty interviews is based on these notes.

Faculty discussed a variety of topics, noting things that they particularly liked about the program and also made suggestions for program improvement. Overall, faculty expressed a high level of support for the WESEP IGERT program, and deemed it a valuable asset to the university and the field. They offered that the IGERT student fellows were of exceptional quality, and felt the program was very well-managed by the IGERT PI. Faculty responses regarding things that they liked about the program and suggestions for program improvement are discussed in more detail below.

### **Program Positives**

Faculty appreciated the high quality of students they were able to recruit to the program, and several faculty indicated that they would not have been able to recruit the same caliber of students to ISU were it not for the WESEP IGERT program. They also noted that they were able to recruit more U.S. students due to the program's requirements. In addition, they found it useful to have two years of funding from the program to support graduate students, and they also commented that it was a benefit to be able to attract domestic students to ISU and to their respective home departments.

A few faculty mentioned that they occasionally attended the WESEP 594 seminar when a guest speaker was presenting, and these faculty found this to be very informative. Other faculty seemingly had not considered attending. This could potentially be a way to help new WESEP faculty learn more about the program and the field of wind energy.

Overall, faculty felt that the WESEP IGERT was a strong program that was creating future leaders in the field of wind energy. They felt that it allowed them to spend more time focusing on their research, and to do research projects that they would not have otherwise had time or funding to pursue. They also felt that it was a very unique program that was not being replicated elsewhere.

### **Challenges and Suggestions for Program Improvement**

Several faculty members mentioned funding challenges, reporting that the Department of Energy was no longer providing funding for the types of projects they were working on. One newer WESEP faculty member mentioned that he was not exactly sure how to find funding opportunities for wind energy, though he reported that he was planning to talk to other WESEP faculty to learn more about wind energy opportunities.

Faculty spoke of trying to increase collaborations with industry, but noted challenges with doing research on an academic timeline rather than at the fast-pace of industry, which is quarterly. They also noted that it could be challenging to work with industry due to limitations for faculty and their students and post-docs not being able to publish all of their findings when working with what is often considered to be proprietary information by industry.

Overall, faculty reported few challenges or suggestions for program improvement, noting that they were very happy with the program. One faculty member hoped that the program would continue to grow, while other faculty expressed some concern about how the program would be sustained at the end of the present 5-year grant cycle.

## **5. Administration Interviews**

Individual interviews were completed with three ISU deans. Extensive notes were taken during and immediately after the interviews, and the analysis of the faculty interviews is based on these notes.

The College Deans were uniformly enthusiastic about the WESEP IGERT program. However, several issues and suggestions for program improvement were shared. One was that the total number of students in the program still appears to be an apparent issue. While the present full time enrollment of 18 is a laudable number, the target at this apparent stage was more like 6 to 8 per year or nominally 24 – 32 to date. However, here it must be noted that NSF made the formal award to ISU in September of 2011, which was far too late for the WESEP IGERT leadership team to recruit students for the 2011 – 2012 academic year. Thus, the first WESEP IGERT cohort of Fellows was really the 2012 – 2013 group. As such the 2015 – 2016 cohort is now the 4<sup>th</sup> group.

Notably, two of the 2012 first cohort of incoming students left almost immediately as one of the WESEP students followed his major professor to another university and a second student decided that she really did not aspire to pursue a PhD but rather wanted a terminal MS degree in a mathematical science program that did not require a thesis; which she was able to transfer into. Those losses would have made the total number to date at 20 or 5/year. A suggestion was made that WESEP take advantage of a professional communications videographer in COE, Bill Beach, and produce a glitzy two minute WESEP recruitment video that would be available online at ISU.

It was revealed that the university is in the process of creating a “Student Innovation Center” (SIC), an \$80 M five story building. This building could well house the Wind Energy

Systems Lab, the Wind Manufacturing Lab and the Student Innovation Center; in effect a three-legged stool for student research and technology innovation within WESEP.

The deans were also quite pleased with the WESEP summer to fall conferences that have been held previously as they greatly helped facilitate faculty interactions and were well received by the ISU administration hierarchy. They suggested holding these conferences/workshops routinely. These could be held at the venues as they have in the past but would move to the new SIC complex in the future. It was noted the Iowa public is believed to be strongly in favor of renewable energy, particularly wind related, versus other sources of energy.

## Appendix A. Annual Student Survey

## WESEP IGERT Student Survey 2015

You have been selected to participate in this study because of your involvement as a graduate student in the Iowa State University Wind Energy Science, Policy, and Engineering IGERT program. We are trying to learn more about the IGERT program and its impact on graduate students and faculty members. In order to do this, we are asking you to complete this short survey, which should take about 10 minutes of your time. Your responses are extremely valuable in helping us to improve the program.

Your responses to the survey are confidential. All individual responses will be aggregated and reported as a group. If you have any questions, please feel free to contact Brandi Geisinger, brandige@iastate.edu, at 294-9622.

Throughout this survey, we use the term 'home discipline' to describe your primary field or department outside of WESEP.

When did you first start the wind energy graduate program?

- Fall 2012
- Spring 2013
- Summer 2013
- Fall 2013
- Spring 2014
- Summer 2014
- Fall 2014
- Spring 2015
- Summer 2015
- Fall 2015

Have you received formal training or taken courses in the following areas? 'Training' includes workshops, seminars, retreats, special sessions within a course, etc. Check all that apply.

- Responsible conduct of research (ethics)
- Statistics
- "Bridge" courses to learn background content knowledge outside your field
- Research methods
- State-of-the-art instrumentation
- Professional speaking/ presentation skills
- Communicating to people outside your home discipline
- Professional writing
- Communicating to the general public
- Working on a team research project

How well prepared do you feel to do each of the following tasks?					
	Not Prepared	At Little Prepared	Somewhat Prepared	Mostly Prepared	Very Prepared
Conduct high-quality research	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Communicate with people inside your field	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Understand and work in an academic setting	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Conduct research in an ethical manner	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Present research findings to scientific peers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Know your own discipline in depth	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Work in teams of researchers from more than one discipline	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Work in research teams within your discipline	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Collaborate with international scientists	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Write research articles or books	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Communicate with people outside your field	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Communicate research findings to the general public	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Work outside of academia (industry, public sector)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please indicate the extent to which you agree or disagree with the following statements about your program.					
	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I am able to study my field in as much depth as I like	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have developed the ability to communicate and work on research problems with researchers from more than one discipline	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I experience high demands on my time from my academic program	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I receive adequate opportunities to network with researchers outside this university	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am familiar with current research being conducted in my field in foreign countries	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have been prepared to conduct research outside my institution (e.g., in an internship)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am being prepared for a wide range of career possibilities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am part of a strong student community	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

With which of the following types of people have you worked on research projects while in your current graduate program? Check all that apply.

- Faculty at my institution in my home department
- Faculty at my institution in other departments
- Faculty at other universities in the United States
- International faculty members
- Industrial scientists in Iowa
- Industrial scientists in the United States (outside of Iowa)
- International industrial scientists
- Government laboratory scientists on the ISU campus
- Public/government laboratory scientists in the United States
- International public/government laboratory scientists
- Policymakers or planners
- Other scholars or consultants









How many of each of the following are you currently in the process of authoring or coauthoring?

	0	1	2	3	4	5	6	7	8	9	10
Journal articles in refereed journals											
Conference paper or poster presentations											
Book chapters											
Books											
Patent applications											
Approved patents											
Grant proposals											
All other publications											

Have you engaged in any of the following research activities in the last year? Check all that apply.

- Published research findings in a journal outside your home discipline
- Presented research findings at a conference outside your home discipline

Please provide the following information for conferences or workshops you have attended.

	Attended a Conference	Presented a Poster	Presented a Paper
At home institution	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Within the U.S. (outside the home institution)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Outside the U.S.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

How useful was WESEP 594 (the Real Time Research Collaboratives (RTRC)s) in each of the following areas?				
	Not At All Useful	A Little Useful	Somewhat Useful	Very Useful
Learning how to do research	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Stimulating and enhancing your research productivity	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Facilitating your interdisciplinary work	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Enhancing your communication skills	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Enhancing your awareness of and ability to respond to ethical issues	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Learning about environmental and policy issues	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Making industry connections	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please indicate the extent to which you disagree or agree with each of the following statements.					
After I graduate from graduate school...					
	Strongly Disagree	Disagree	Neither Disagree nor Agree	Agree	Strongly Agree
I would prefer a career in academia.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I will be well-prepared for a career in academia.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would prefer an career in industry	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I will be well-prepared for a career in industry.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would prefer a career in government, non-profit agencies, or NGOs.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I will be well-prepared for a career in government, non-profit agencies, or NGOs.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would prefer a career that involves doing research.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I will be well-prepared for a career that involves doing research.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Do you plan to graduate within the next year (Fall 2015, Spring 2016, or Summer 2016)?
<input type="radio"/> Yes
<input type="radio"/> No

What are your plans after graduation from the program? (e.g., Have you started looking into career opportunities? Do you plan to go into academia or industry? Etc.)

What do you view to be the highlight of your experience in the WESEP IGERT program?

Were there experiences in the WESEP IGERT program that you felt were lacking or not very useful? Please explain.

What suggestions do you have to improve the IGERT program?

Please use this space to discuss any other comments or concerns you may have.

Thank you for completing the survey. Please click >> to submit.

## Appendix B. Annual Faculty Survey

## 2015 WESEP IGERT Faculty Survey

You have been selected to participate in this study because of your involvement as a faculty member in the Iowa State University Wind Energy Science, Policy, and Engineering IGERT program. We are trying to learn more about the IGERT program and its impact on graduate students and faculty members. In order to do this, we are asking you to complete this short survey, which should take about 10 minutes of your time. Your responses are extremely valuable in helping us to improve the program.

Your responses to the survey are confidential. All individual responses will be aggregated and reported as a group. If you have any questions, please feel free to contact Brandi Geisinger, brandige@iastate.edu, at 294-9622.

Throughout this survey, we use the term 'home discipline' to describe your primary field or department outside of WESEP.

In what ways do you participate in the IGERT project?

- I advise IGERT graduate students
- I serve on IGERT dissertation committees
- I conduct IGERT-related research
- I attend IGERT workshops or lectures
- IGERT graduate students work in my lab
- I teach IGERT courses
- I contribute to IGERT project management
- Other (please specify):

Please indicate whether your IGERT participation has resulted in your spending less time, equal time, or more time on each of the non-IGERT responsibilities listed below.

	Less Time	Equal Time	More Time
Teaching department courses	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Advising department students	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Engaging in department leadership activities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Conducting research with other departmental faculty	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>







Of the professional publications related to wind energy you listed in the two previous questions, how many of them included students or faculty from a home discipline other than your own, industrial scientists, public or governmental employees or international scientists as either the primary author or a co-author?

	0	1	2	3	4	5	6	7	8	9	10
Journal articles in refereed journals											
Conference paper or poster presentations											
Book chapters											
Books											
Patent applications											
Approved patents											
Grant proposals											
All other publications											

Have you engaged in any of the following research activities in the last year? Check all that apply.

- Published research findings in a journal outside your home discipline
- Presented research findings at a conference outside your home discipline

To what extent do you agree or disagree with the following statements about the impact that participating in the IGERT project has had on your professional life?

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I have been exposed to new ideas outside my area of knowledge	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have met faculty in other departments whom I would not otherwise have met	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am able to work with a greater variety of students	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am more likely to conduct research with colleagues in disciplines outside my own	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My teaching has become more interdisciplinary	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am more likely to consider team-teaching with a faculty member outside my department	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am in a better position to obtain new research grants	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have learned new research techniques	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I can explore research topics that would not otherwise be funded	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am able to work with students who are better qualified than non-IGERT students in my department	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have less time to conduct my own research	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

What strategies were used to attract a highly qualified, diverse pool of applicants for the IGERT program?



How well do you think your graduate students <b>who are not IGERT students</b> are being prepared for the following tasks?					
	Not Prepared	A Little Prepared	Somewhat Prepared	Mostly Prepared	Very Prepared
Conduct high-quality research	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Present research findings to scientific peers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Know their own discipline in depth	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Communicate with people inside their field	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Work in research teams within their discipline	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Understand and work in an academic setting	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Write research articles or books	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Conduct research in an ethical manner	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Communicate with people outside their field	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Work in teams of researchers from more than one discipline	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Work outside of academia (industry, public sector)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Collaborate with international scientists	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Communicate research findings to the general public	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

To what extent has the IGERT grant affected your department in the following ways?					
	Not At All - 1	2	3	4	Extensively - 5
Improved the quality of faculty research	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Altered the research scope of involved faculty	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Improved faculty mentoring of students	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

How useful was WESEP 594: the Real Time Research Collaborative (RTRC) in each of the following areas?					
	Not At All Useful	A Little Useful	Somewhat Useful	Very Useful	Not Sure / Not Applicable
Teaching students how to do research	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Stimulating and enhancing students' research productivity	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Facilitating students' interdisciplinary work	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Enhancing students' communication skills	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Enhancing students' awareness of and ability to respond to ethical issues	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Teaching students about environmental and policy issues	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Making industry connections	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

What suggestions do you have to improve the IGERT program?

Please use this space to discuss any other comments or concerns you may have.

Thank you for completing the survey. Please click >> to submit.