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*External Evaluation: Year Three  
Career Education in Renewable  
Energy Technologies*

*NSF-DUE 1205015*

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**June 2015**

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## Introduction

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### **Overview**

Madison Area Technical College (Madison College) is the lead organization on the NSF-DUE ATE 1205015 project, *Career Education in Renewable Energy Technologies*. In NSF-DUE-ATE 0501764, *Partnerships in Educational Resources for Renewable Energy Technologies*, and NSF-DUE-ATE 0903293, *Consortium for Resources in Renewable Energy Technologies (CERET)*, Madison College and consortium partners were highly successful in developing a nationwide network among academic, industry, and government stakeholders to provide renewable energy education for the technician workforce.

The current project expands the scope of work of the previous projects and has as the primary goal: ***To provide renewable energy expertise to two-year college and high school instructors around the country, while creating model career pathways that give students broad skill sets and flexibility in tough and unpredictable labor markets.***

The project includes two main objectives with the following deliverables and activities:

1. Broaden the popular CERET Train the Trainer Academies to serve a larger number of teachers from diverse schools, while increasing the depth of the Academies by including topics such as second and third generation renewable fuels along with battery-based PV systems and NEC code compliance.
2. Evolve Madison College's existing Renewable Energy Certificate into independent academic credentials focusing on solar electricity, wind, and bioenergy in response to national trends and regional needs. These certificates will employ previously successful CERET model for adding renewable energy knowledge and skills to training in traditional disciplines for existing technician-level jobs.

### **Annual External Evaluation**

The annual evaluation of this project is based on the following primary sources of data:

- Phone conversations and in-person meetings with project leaders during the third year of the project
- Analysis of anonymous surveys completed by participants in CERET courses
- Analysis of the applications and pre-post tests for the two Train the Trainer Academies held in summer 2014
- Direct observation and interviews/surveys of Train the Trainer Academy participants
- Follow-up survey to the alumni of the Train the Trainer Academies; phone interviews with selected alumni

- Observation at the Renewable Energy Advisory Committee Meeting on November 20, 2014

Secondary data content analysis of program documents, the website at [www.ceret.us](http://www.ceret.us), recruitment and application materials for the summer 2014 Train the Trainer Academies, and follow-up emails from the Train the Trainer Academy participants to the principal investigators.

The annual external evaluation of NSF ATE DUE 1205015 is based on the Evaluation Plan in Appendix A and answers the following questions:

1. Was the project implemented with fidelity as proposed?
2. Did the Train the Trainer objective lead to enhanced teacher/faculty knowledge and pedagogy, changes in their classroom instructional environments, and enhanced student learning and attitudes towards technical education?
3. Did the project lead to enhanced resources for school districts and colleges especially those that are small, remote, and/or serving minority, economically disadvantages, or other underrepresented groups?
4. Did the implementation of the academic certificates create career pathways based on industry need and standards that lead to increased numbers of students employable in renewable energy?

The remainder of this report addresses each of these four evaluation questions and provides final remarks.

## Evaluation of Implementation and Outcomes

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### 1. Was the project implemented with fidelity as proposed?

**The Career Education in Renewable Energy Technologies began on September 1, 2012, and by the end of June 2015, project leaders had nearly completed the project with the final Train the Trainer Academies scheduled in July and August 2015. They adhered to the project timetable and management plan in the funded proposal.**

### *Train the Trainer Academies – Deliverables*

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- Two Train the Trainer Academies were held in summer 2014.
  - The Biofuels Academy was held on June 23 through 27 in Greensboro, North Carolina and leveraged partnerships with the NSF-funded University of North Carolina A&T BioEnergy Center and Piedmont Biofuels

- The Advanced Solar Electricity (Photovoltaics) Academy was held on July 20 through 25 at Solar Energy International in Paonia, Colorado.
- The final Two Train the Trainer Academies for this NSF project are scheduled, staffed, and participants identified for summer 2015
  - The Biofuels Academy will be held August 17 through 21 and hosted by Shoreline Community College in Seattle, Washington
  - The Photovoltaic Academy will be held in July 20 to 24 at Solar Energy International in Paonia, Colorado

### *Train the Trainer Process*

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The Train the Trainer Academies are consistently rated highly by the participants, with 100% of the summer 2014 participants giving the Academies a grade of “A”. Furthermore, participants use what they learn to improve classroom instruction. In the past year, the summer 2014 participants shared what they learned with over 3,800 students. At this time the estimated total number of high school and college students taught by Academy participants in the current and previous grant is well over 30,000 students.

Alumni of the Train the Trainer Academies are most likely to use what they learned to help educate or bring others “on board” such as colleagues, administrators, community (85%), enhance classroom lessons and/or labs (80%), modify course curriculum and/or labs (79%), create new lab activities (77%), and improve or modify existing lab activities (76%).

The project continues to involve a diverse group of high school and college instructors as well as a mix of rural, suburban, and urban communities across the US. Three Native American Tribal Colleges and several Hispanic Serving institutions have participated in the project.

High school and college instructors were recruited for the Train the Trainer Academies through the CERET website, direct e-mail to contacts, distribution through other NSF projects, and various listservs. Those accepted into the academies were required to complete content pre-tests. For the Beginning Photovoltaics Academy, participants with low pre-test scores are asked to complete Solar Energy International’s online course before the academy to ensure they have the background knowledge needed to take full advantage of the academy.

At the end of each Train the Trainer Academy, data is collected through the following: content post-test, satisfaction survey, and a survey to collect baseline data on their instructional practices and planned use of the materials learned in the Academy. Past participants are contacted during the year by the external evaluator to determine the impact the academy has had on their instruction and students.

The biofuels academy curriculum was enhanced to include cellulosic ethanol, algae-based fuels, and biogas for transportation fuel. The Advanced PV curriculum was developed for previous PV Academy completers. The curriculum includes battery-based off-grid and backup systems, electrical inspection, code compliance, system maintenance and troubleshooting.

Train the Trainer Academy participants are able to receive 2 credits for the Biofuel Academy and 2 credits for the Photovoltaic Academy through the Colorado School of Mines Teacher Enhancement Program.

### *2014 Biofuel Train the Trainer Academy*

The Biofuel Train the Trainer Academy was held on June 23 through 27 in Greensboro, North Carolina and leveraged partnerships with the NSF-funded University of North Carolina A&T BioEnergy Center and Piedmont Biofuels. The hands-on academy included 21 participants: 6 females and 15 males. Participants were from California, Florida, Kansas, North Carolina (9), Oregon (2), Pennsylvania, Tennessee, Washington (2), and Wisconsin (3). The participants included 9 high school teachers, 11 instructors from two-year colleges, and one faculty member from a two/four year college.

The sessions included the following classroom topics:

- Overview of Biochemistry, Energy, and Classification of Biofuels
- Cellulosic Ethanol Technology
- Biodiesel Transesterification and Gravimetric Separation
- Compression and Spark Ignition Engine Basics
- Biodiesel Safety
- Overview of Petroleum and Biofuel Properties
- Biodiesel Use and Performance
- Ethanol Fuel and Fermentation Chemistry
- Biodiesel and Ethanol Emissions and Environment
- Participant Sharing: Ways they teach the material, their programs, and resources
- Peak Oil and Energy Balance of Biofuels

The hands-on labs included the following:

- Biodiesel Feedstock Titration
- Biodiesel Transesterification and Gravimetric Separation
- Biodiesel Transesterification Chemistry
- ASTM QA/QC Testing
- Water Washing Biodiesel Fuel
- Ion Exchange Polishing Biodiesel Fuel
- Cellulosic Ethanol Processing
- Biofuel Blending and Emissions Testing

The participants completed tours of Piedmont Biofuels, Central Carolina Community College, and CREST Bioenergy Center of UNC A&T. James Croonenberghs, Cellulosic Development Manager, Novozymes, was a guest speaker.

The academy organizers and lead instructors were PI Ken Walz and Paul Morschauser, program director and senior diesel tech instructor at Madison College and Certified Master Truck Technician who is the Wisconsin State Manager for SkillsUSA and certified to teach by the National Alternative Fuel Training Consortium.

### *Biofuels Participants*

#### *Feedback from Participants about Biofuels Train the Trainer Academy:*

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At the end of the academy, participants completed an academy evaluation to provide anonymous feedback on the quality and usefulness of the presentations, labs, and materials. The external evaluator tabulated the results.

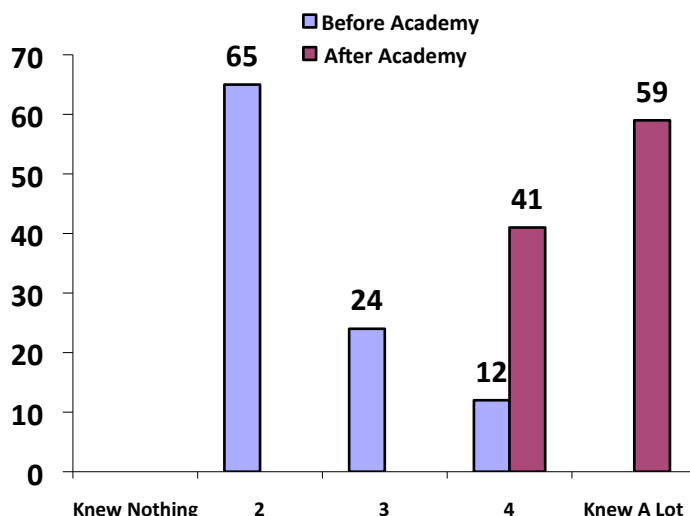
All respondents (n=17) indicated the application and registration process was clear and efficient. The percentages of participants giving the 2014 biofuels academy an “A” were as follows for meeting the objective:

- 100% - learn or review fundamental biofuels, concepts
- 94% - increase awareness of biofuels issues
- 94% - gain hands-on experience in biofuels
- 94% - appreciate the need for biofuels education
- 77% - become familiar with biofuels education materials
- 71% - integrate biofuels concepts into your curriculum
- 59% - join a nationwide network of educators

In addition, 94% of respondents agreed that the training materials were more useful than those received through other activities in the last two years and all (100%) rated the academy as an “A” and would recommend the academy to a friend.

The participants self-reported large increases in their knowledge of biofuels from the academy as shown in the graph below. The 5-point rating scale ranged from “Knew Nothing” to “Knew a Lot”. At the beginning, the median rating was a “2” and at the end the median was a 5. The percentage of participants who felt they knew “a lot” about biofuels had increased from 0% to 59%.

Participants' Ratings of Their Biofuels Knowledge Before and After the Academy  
 Scale 1= Knew Nothing to 5 Knew a Lot  
 Percentage of Respondents (n=17)



All (100%) of the respondents indicated “Agree” or “Strongly Agree” to each of the following statements:

- Addressed the concepts I thought it would
- Was a good way to learn this information
- Had a reasonable workload for the credits
- Had a good mix of hands-on and academic material.

The majority of respondents indicated that the right amount of time was allocated to work with laboratory equipment and instrumentation, to share ideas with other teachers, to interact with instructor(s), and for the entire training.

All respondents agreed that the instructors expressed subject matter clearly, were well prepared for the course, and welcomed questions and encouraged discussion, and 94% thought the instructors covered the subject matter completely.

The majority of respondents indicated that they had made significant or moderate gains in their knowledge of the following:

- Biofuel teaching strategies (100%)
- How biodiesel fuel is produced and used (100%)
- Safety of biofuel production and use (100%)
- Storage and handling of biofuels (100%)
- Spark and compression ignition engines (100%)
- Environmental benefits of biofuels (100%)
- How ethanol fuel is produced and used (88%)
- Fuel quality control tests (88%)



All indicated that as a result of the academy they were interested in discussing biofuels with colleagues, students, friends or family; interested in taking additional classes on biofuels or renewable energy topics, and were most likely to include the discussion of biofuels in the classes they teach.

Comments from Biofuel Academy participants included the following:

Excellent program! Thanks!
I learned more about air pollution than anticipated which I will teach my students.
I thank Ken and Paul for an excellent class and informative field trip.
It was a great academy. I really learned a lot and am very excited to pass this along to my students
Outstanding teachers and outstanding program.
Overall this class was very informal, I really enjoyed the hands on portion, although I wished the class was longer in length. The instructors were all very knowledgeable in their subject matter, which made the classes very interesting. This was my first time doing anything like this and my interest has been peaked to wanting to learn more about biofuels and chemistry. Thank you.
Overall, this was a great program, well thought-out and coordinated. Good job by Ken and Paul!
Thank you Dr. K for making this possible and for arranging and taking care of the logistics! I look forward to learning from you in the future!
The teaching style was very helpful for this course, allowing questions and addressing the essential issues at a level that was appropriate for a class of diverse backgrounds. It was a positive learning environment.
I have never honestly had a more valuable course/seminar in all my professional teaching career of 15+ years. The fact that the application process was not overwhelming, the cost for travel and hotel and other miscellaneous expenses that were covered and furthermore reimbursed, the instructors, the host and all others involved in carrying out the mission along with their knowledge base and personalities made for a "perfect storm". The entire week was so fulfilling and my only hopes are without a doubt that I can attend another seminar in alternative energies and fuels. <i>In other words it was simply and awesome experience.</i> Thanks you so much to everyone for making a dream and future endeavors in my professional career a reality. I can't help but think of the song sung by Metallica and the lyrics from the song Fuel. ....Give me fuel, give me fire, give me that which I desire. It just pumps me up like the seminar when I reminisce. Thanks again.

### *PV Train the Trainer Academy*

The PV Train the Trainer Academy was held from July 20 through 25, 2014 in Paonia, Colorado at the facility of Solar Energy International, a sub-award partner. Based on requests from prior attendees, this academy included advanced topics such as battery based off-grid and backup systems, electrical code compliance and inspection, system maintenance, and troubleshooting.

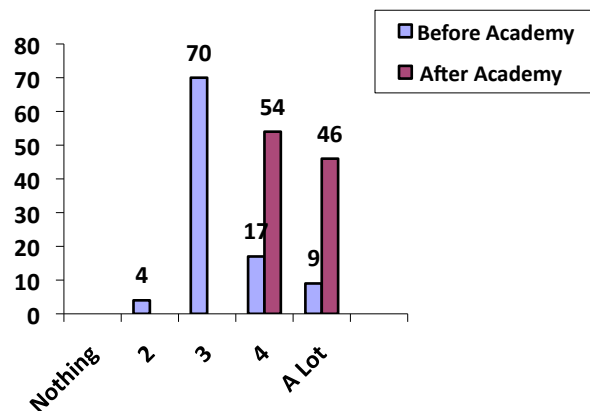
Twenty-six participants attended the academy including 21 males and 5 females from Arizona, Colorado, Delaware, Illinois, Maine (3), Michigan (2), Minnesota, North Carolina, New Mexico, South Carolina (2), Virginia (2), and Wisconsin (8).

All survey respondents (n=24) awarded the 2014 PV Academy an “A”. They perceived the following benefits to them:

- 92% - gain hands on experience in PV
- 83% - appreciate the need for PV education
- 79% - learn or review fundamental PV concepts
- 75% - increase your awareness of PV issues
- 71% - join a nationwide network of educators
- 67% - integrate PV concepts into your curriculum
- 63% - become familiar with PV education materials

The participants self-reported large increases in their knowledge of PV from the academy as shown in the graph below. By the end of the academy, the percentage of participants who felt they knew “a lot” about PV had increased from 9% to 46%.

Percentages of Participants’ Ratings of Their PV Knowledge



The majority of respondents indicated “Agree” or “Strongly Agree” to each of the following statements:

- Addressed the concepts I thought it would (100%)
- Provided more information than I expected (92%)
- Was a good way to learn this information (100%)
- Had a reasonable workload for the credits (88%)
- Had a good mix of hands-on and academic material. (100%)

In general, the respondents indicated the right amount of time was allowed to work with equipment and instrumentation, to share ideas with other teachers, to interact with instructor(s), and for the entire training.

Over 90% of the respondents agreed that the instructors expressed subject matter clearly, were well prepared for the course, and welcomed questions and encouraged discussion. In addition, nearly 80% agreed that the training materials were more useful than those received through other activities in the last two years and 100% rated the academy as an “A”.

The majority of respondents indicated that they had made significant or moderate gains in their knowledge of the following:

- How to properly wire, inspect, and test lead-acid storage batteries (92%)
- How batter charge controllers work (83%)
- Battery-based PV safety and risk management (92%)
- How to commission a battery-based PV system (100%)
- How to measure and interpret PV panel and I-V curves (100%)
- How to inspect a PV system and diagnose possible equipment failures (96%)
- PV teaching strategies (96%)

All indicated that as a result of the academy they were interested in discussing PV with colleagues, students, friends or family; interested in taking additional classes on PV or renewable energy topics, and were most likely to include the discussion of PV in the classes they teach.

The respondents offered the following comments:

Course was great, looking to pursue more training
Fantastic professional development opportunity, I am really grateful to have gone and I learned so much.
Give more opportunity like this to more teachers and give them some material funding (up to \$5,000) to go with it so we can easily apply this knowledge and put it to good use right away. Our schools, at least at the high school level, in WI right now is going to the bottom with funding and the UW system is also suffering the budget cuts but at least in the tech ed they might have more support from the industries that promotes their products and are looking for good educated workers.
Great job to all the coordinators and teachers.
Great job!!! I learned a lot more with this second academy. This is absolutely the best and most effective hands on training I have ever been to.
Great training and learning experience.
Great workshop! However, the lack of shade and heat got the most out of me. Mornings were great, afternoons I was run down.
I am also the renewable energy education coordinator for the service territory of our electric utility. In this capacity I teach teachers about solar PV and how they may teach about it in their high school classrooms so I am able to leverage what I learned to a very high degree.
For the next round, perhaps students can be purposefully reassigned to different instructors to ensure a well-rounded learning experience.
Thank you for simply the best workshop/training I have ever had.

Thank You for this great opportunity.
Thanks for the great experience.
The Advanced PV Academy was an interesting and informative experience. It has given me information that I will use to set up the new Renewable Energy Lab at my school, as well as outfit a barge with a battery-based system to use as a renewable energy lab platform. The hands-on part of the course is what makes it so great.
The on-line class prior to the training was a great way to get up to speed with the lab. Definitely a great route for future classes. Appreciated the "pre" class to familiarize myself with some areas that I am not as familiar or is new to me.
This has been an invaluable experience. The workshop is very well organized, the staff at SEI is top-notch, the training facility and access to testing equipment and instrumentation is excellent, and the training materials are first-rate. Having an opportunity to meet with peers across the country to share ideas for training is wonderful.
This is an amazing experience that more teachers should take advantage of.
Would love to see this program continue. A recommendation would be to focus on integration of PV projects into the classroom; building small systems to use in teaching the many PV concepts; perhaps writing collaborative grant proposals that include CERET and SEI with schools and university.

**2. Did the Train the Trainer objective lead to enhanced teacher/faculty knowledge and pedagogy, changes in their classroom instructional environments, and enhanced student learning and attitudes towards technical education?**

*Participant Learning*

Train the Trainer Academy participants completed a content-knowledge pre-test before their attendance at the academy and a post-test at the end of the academy. Both were administered by the external evaluator.

**Summer 2014 participants had statistically significant increases in their content knowledge as measured by the difference in their pre- and post-test scores (Biofuel paired t-test = 6.411 (df 14),  $p < .000$  and PV paired t-test = 2.33 (df 25)  $p = .007$ ).**

The biofuels test had a reliability of 0.73. The median effect-size for the participants was 0.98, indicating a large increase in content-knowledge.

The PV test had reliability of 0.69. The median effect-size for the PV test was 1.44 indicating a large increase in content-knowledge. See table for additional information.

Pre- and Post-Tests for Content Knowledge in  
Summer 2014 Train the Trainer Academies

	Biofuel Academy	Photovoltaic Academy
Test Alpha Reliability	0.73	0.69
Mean Pre Test	20.13	13.84
Mean Post Test	25.47	17.36
Effect Size Minimum	0.00	0.00
Effect Size Maximum	2.93	3.35
Median Effect Size	0.98	1.44

*Classroom Impact – Summer 2014 Academy Participants*

The Train the Trainer Academy participants took back to their classrooms what they learned in the Academies. The summer 2014 Academy participants impacted a total of 3,882 students in school year 2014-2015.

The summer 2014 Biofuels Academy participants informally impacted 998 students and provided direct instruction with materials and/or content from the Academy to 476 during the 2014-15 school year.

The summer 2014 PV Academy participants reported the following impact on their students. Total Impacted includes those who were made aware of the solar electric topics in an informal way. Total Intensive Impact is the subgroup of the total impact that was taught via content, curriculum, and resources from the Academy via direct and hands-on instruction.

**Impact of 2014 Summer PV Train the Trainer Academies  
on High School and College Students**

	High School		College		Total Students	
	Total Impacted	Total with Intensive Impact	Total Impacted	Total with Intensive Impact	Total Impacted	Total with Intensive Impact
<b>Number of Students</b>	1,294	917	1,590	947	2,884	1,864 (55%)

### *Continuing Impact of the NSF CERET Project*

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In spring 2015, an online, follow-up survey was sent to past participants in the Train the Trainer Academies. A total of 79 responded with a completed survey; a response rate of 45%. The numbers of respondents by year and Academy are in the table. Some participants attended both the biofuel and PV Academies. All respondents completed the survey once. The 2014 PV Academy was an advanced academy for PV Academy alumni.

**Number of Survey Respondents by Year and Academies Attended**

	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>
<b>Biofuel</b>	5	14	6	13	9
<b>PV</b>	6	12	12	16	11

### *How Academy Participants Used What They Learned*

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Survey respondents indicated the following use of the information gained in the Train the Trainer Academy:

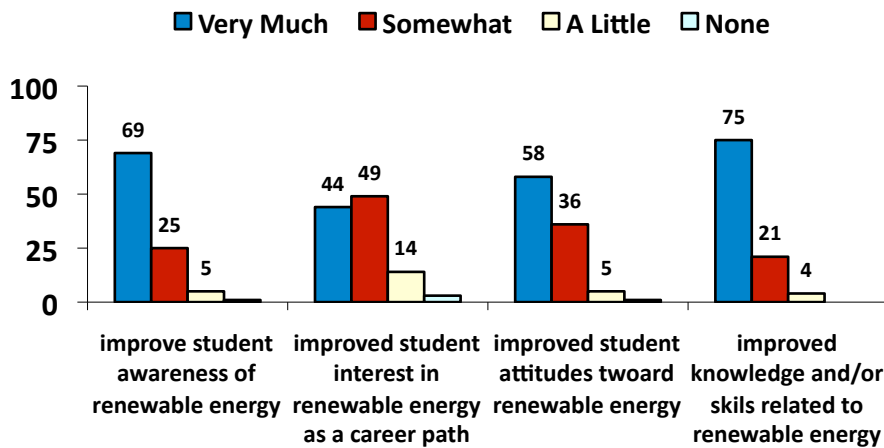
- 85% - Help educate or bring others “on board” (colleagues, administrators, community)
- 80% - Enhance classroom lessons and/or labs
- 79% - Modify course curriculum and/or labs
- 77% - Create new lab activities
- 76% - Improve or modify existing lab activities
- 56% - Add more hands-on and authentic learning to the curriculum
- 54% - Improve safety procedures and protocols
- 52% - Create new course curriculum
- 47% - Acquire new equipment, modifications to equipment, supplies, and materials
- 38% - Led to your participation in other activities such as grants, research
- 37% - Deliver outreach or recruiting events such as presentations, meetings, publications, radio shows, etc.
- 33% - Scale up our program
- 28% - Redesign an instructional space
- 28% - Promote cooperation between you institution and another institution
- 28% - Improve your campus or community
- 23% - Help you procure funding
- 11% - Develop a new certificate program
- 9% - Develop a new degree program

The 79 respondents by themselves had shared Academy materials with 855 faculty, staff, and administrators, provided instruction using the materials to 1,314 middle school

students, 6,760 high school students, and 5,367 college students. The overall collective impact of all of the Academy alumni has now reached over 30,000 high school and college students.

The respondents reported that the changes in their classrooms based on the Academy information and resources led to student changes including increasing their knowledge and skills as well as their awareness and attitudes towards renewable energy.

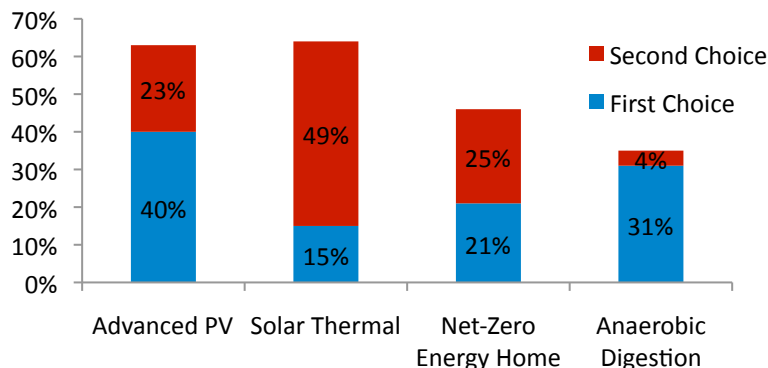
Percentages of Train the Trainer Participants Reporting Changes in Their Students



The alumni feel grateful for working with the project leaders and partners, an esteemed group of highly respected individuals and organizations. Ken Walz, PI, was recently named the 2015 Higher Education Energy Educator of the Year by the Wisconsin K-12 Energy Education Program of the University of Wisconsin – Stevens Point. In addition, he was 2010 Wisconsin Professor of the Year through the Carnegie Foundation for the Advancement of Teaching and the Council for Advancement and Support of Education. Solar Energy International, the sub-awardee, brings industry credibility and expertise to the project.

The respondents were interested in additional Train the Trainer Academies and ranked them as their 1<sup>st</sup> through 4<sup>th</sup> choices. The first and second choice rankings are provided in the figure.

First and Second Choices for Additional Train the Trainer Academies



**3. Did the project lead to enhanced resources for school districts and colleges especially those that are small, remote, and/or serving minority, economically disadvantages, or other underrepresented groups?**

The participants were given access to numerous resources through Drop Box and e-mail. As shown in their feedback reported previously in the report, they are using these resources. The resources included materials created through other NSF projects, Department of Labor grants, from the National Renewable Energy Lab, Workforce Development projects, etc.

The respondents to the Train the Trainer Alumni survey provided examples of how this project helped them and their institutions. Other examples were e-mailed directly to the PI.

Examples in 2014 include:

- Big Sky High School received a grant for a 3.3kW solar array –“this awesome addition to the school would never have happened without the knowledge and inspiration I received last summer in Paonia”.
- Another school created a new certificate program and secured a \$13.5K grant to help fund a grid tied 3K ground mount array that students can install.
- A Train the Trainer alum completed a Biodiesel Guide and presented it at a SUNY sustainability conference as well as present at NYS Fire Marshal’s Conference regarding biodiesel safety.

The summative report will provide a more complete listing of examples of ways the project made a difference in the renewable energy workforce and education.



#### **4. Did the implementation of the academic certificates create career pathways based on industry need and standards that lead to increased numbers of students employable in renewable energy?**

The colleges in Wisconsin are under severe budget constraints at this time. However, the PI and Co-PI are diligent in assuring the certificates, including the original CERET certificate, remain aligned to industry standards.

The project team involves industry throughout the project and has successfully engaged the largest companies as well as medium and small businesses. In 2014, the Biofuel Academy was done in partnership with Piedmont Biofuels and the NSF-funded BioEnergy Center of the University of North Carolina. The August 2015 Biofuel Academy will partner with the largest biodiesel facility in the US, General Biodiesel and Imperium Renewables. The PV Academies are in partnership with sub-award recipient Solar Energy International.

Since 2006, over 570 students have enrolled in the CERET courses; they represent 45 different states, the District of Columbia, Canada, Egypt, Estonia, Grand Cayman, Haiti, Israel, the Philippines, South Africa, St. Lucia, Trinidad, the United Arab Emirates, and the Virgin Islands. A total of 55 students earned an academic certificate in renewable energy. As of May 2015, a total of 88 students are pursuing one or more of the credentials. Approximately 20% are female. The racial diversity of the group is approximately 73% white students, 4% black students, 2% Asian students, and 19% multiracial students. Approximately 2% are of Hispanic ethnicity.

### **Final Remarks**

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The *Career Education in Renewable Energy Technologies* is led by highly capable professionals. This project is a model ATE project in the focus on education, workforce, and new technologies.

- The project is consistently implementing its funded proposal with fidelity. The activities and courses are of the highest quality and usefulness to the participants and students. The project team and members of the advisory board include individuals and organizations that are nationally and internationally recognized as leaders in renewable energy.
- A significant number of students are engaged in the CERET certificate program and the new Madison College certificates are approved. The CERET certificate has been highly successful. Difficult decisions are being made by Wisconsin colleges due to fiscal constraints.

- A broad-based team from academia and industry worked collaboratively to continually improve the program to meet the needs of education and industry.
- Participants in the Train the Trainer Academies are using what they learned to impact their students and are applying for and receiving funding to make the changes needed to their programs.
- Planning has been completed to hold the final two Train the Trainer Academies and finish the closeout procedures for this NSF project in the coming year.

## Appendix A: Overview of Evaluation Plan

*Career Education in Renewable Energy Technologies  
NSF-DUE 1205015*

The annual external evaluation of the project focuses on five questions:

1. Was the project implemented with fidelity as proposed?
  - Review of project artifacts, interview and/or survey of project leaders
  - Assessment of Output Indicators in Table 1
2. Did the Train the Trainer objective lead to enhanced teacher/faculty knowledge and pedagogy, changes in their classroom instructional environments, and enhanced student learning and attitudes towards technical education?
  - Pre-post content knowledge tests for each Train the Trainer Academy
  - Pre-post assessments of participants' instructional environment
  - Report by each participant for follow-up year
3. Did the implementation of the academic certificates create career pathways based on industry need and standards that lead to increased numbers of students employable in renewable energy?
  - Enrollment data by demographic and geographic characteristics
  - Post-class survey of participants
  - Assessment of alignment of credential to industry standards and workforce needs
4. Did the project lead to enhanced resources for school districts and colleges especially those that are small, remote, and/or serving minority, economically disadvantages, or other underrepresented groups? (See question 5)
5. Was the process used by Madison College to cultivate renewable energy education replicated by other campuses?
  - Interviews and/or surveys to school and college contacts on how the materials were used, facilitating factors/challenges to use, and outcomes realized, including population served

*Table A.1. Evaluation Matrix for Outputs for Goals and Objectives*

<b>Goal: To provide renewable energy expertise to two-year college and high school instructors around the country, while creating model career pathways that give students broad skill sets and flexibility in tough and unpredictable labor markets.</b>			
Objective 1	Broaden the popular CERET Train the Trainer Academies to serve a larger number of teachers from diverse schools, while increasing the depth of the Academies by including topics such as second and third generation renewable fuels along with battery-based PV systems and NEC code compliance.		
1.a	Were the academies implemented as proposed	Description of what was done, number and	Direct observation of the Train the

	and of quality? Did those who applied and those selected represent a diverse group from a variety of schools Were the academies modified for advanced topics?	demographic and geographic characteristics of those involved Perceptions of trainers and trainees	Trainer Academies Content analysis of curricula for academies Descriptive analysis of survey of trainers and trainees Review of applications of participants
1.b	Was sufficient academic support provided for participants?	Description of support and those who completed the pre-academy instruction (SEI's PV 101)	Descriptive analysis of course enrollment and completion
1.c	Was the regional Train the Trainer class in PV implemented for teachers in Madison College's region?	Description of what was done, number and demographic and geographic characteristics of those involved Perceptions of trainers and trainees	Direct observation of the Train the Trainer Academies Content analysis of curricula for academies Descriptive analysis of survey of trainers and trainees
1.d	How were faculty recruited for the academies and did faculty teams apply?	Description of recruit strategies and applications	Review of websites, interview with project leaders, and review of applications
1.e	What follow-up for Train the Trainer participants was provided, how many were engaged in the follow-up, and what were the outcomes of the follow-up?	Description of what was done, number and demographic and geographic characteristics of those involved Perceptions of participants and SEED	Interview/survey with Debra Rowe of SEED Analysis of participant survey
Follow-up Outcome	Were the lesson plans of quality and implemented by the trainees? Did this lead to the integration of the materials into classrooms? If not, why?	Quality of lessons as rated by rubric Quality of implementation of content into classroom lessons Pre-post content tests, as possible	Analysis of lesson plans posted on website using rubric Content analysis of annual report by trainee
Objective 2	Evolve Madison College's existing Renewable Energy Certificate into independent academic credentials focusing on solar electricity, wind, and bioenergy in response to national trends and regional needs. These certificates		

	will employ previously successful CERET model for adding renewable energy knowledge and skills to training in traditional disciplines for existing technician-level jobs.		
2.a	Was the original Renewable Energy Certificate retained or did it evolve into another academic certificate?	Description of status of the original certificate, enrollment and completions by demographic and geographic characteristics	Interview with project leaders and course information Content analysis of Madison College's curriculum/catalog
	Were the other academic certificates (PV and BioEnergy Technician) implemented?	Description of status of certificates, Enrollment by zip code of students. Location of institutions, faculty, and professionals involved. Perceptions of students and faculty.	Interview with project leaders and course information Content analysis of Madison College's curriculum/catalog Descriptive analysis of course records. Survey of participants Interview/survey of faculty
	Do the courses reflect industry standards? How are the courses updated as industry changes?	Course/materials evaluation by industry professionals Involvement of employers in the program and advisory committee	Attendance at and content analysis of advisory meeting notes
	Do the materials lead to student learning and changes in employment?	Course surveys for knowledge and attitude of students, perceptions of usefulness of the content and delivery, and impact on employment	Descriptive analysis of student surveys administered by external evaluator annually

The **Annual Evaluation Report** will address the appropriate questions for the year completed and provide recommendations to the project leaders. The **Final Report** will address 1) the degree to which each objective was met; 2) the feasibility, effectiveness, and costs of processes used in attaining the goal; 3) lessons learned and unexpected outcomes; 4) sustainability of the classroom instructional changes, Train the Trainer Academies, and the new academic credentials.