

# Impacts on Teaching Practices from a Solar Photovoltaic Institute Faculty Professional Development Program



**MADISON**  
AREA | TECHNICAL  
**COLLEGE**

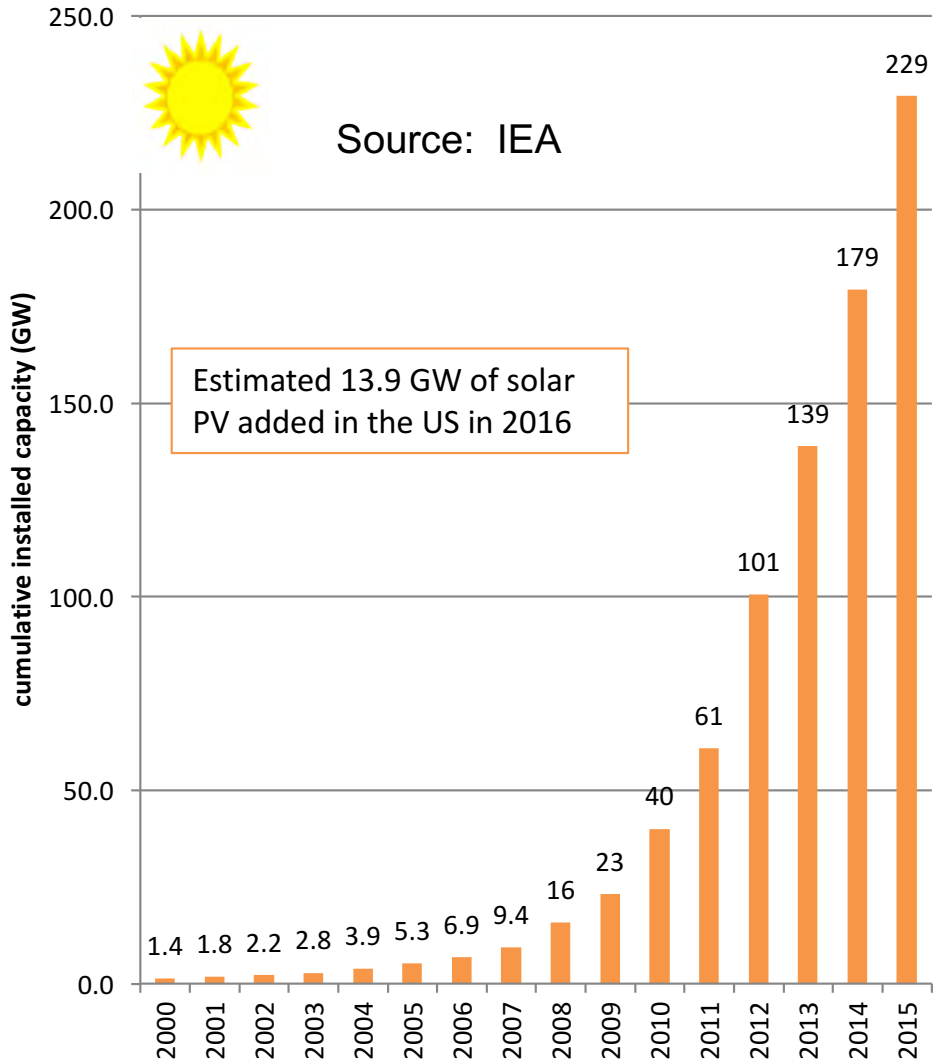
Ken Walz, Joel Shoemaker,  
Scott Liddicoat, and Cris Folk



ASEE, Salt Lake City, UT  
June 25, 2018



# global solar PV energy growth



THINKPROGRESS



## Solar power crushes its own record for cheapest electricity 'ever, anywhere, by any technology'

The lowest price for solar power last year is the highest price now.

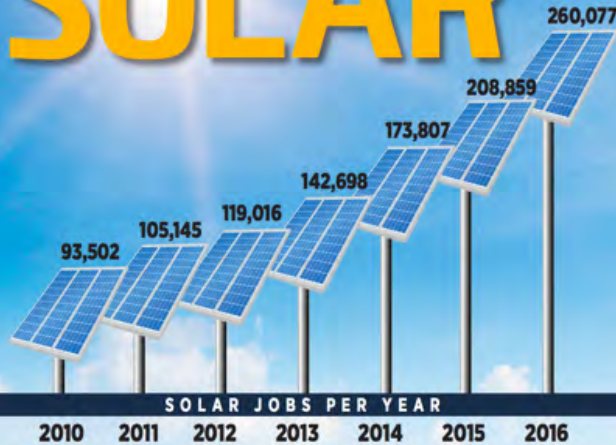
JOE ROMM OCT 20, 2017, 11:24 AM



# Powering American Jobs SOLAR

**In 2016 . . .**

- 260,077 solar workers, a 25% increase over 2015
- Solar jobs have increased at least 20% per year for the past four years
- One in 50 new U.S. jobs were in the solar industry



American Opportunity

## Solar jobs growing 17 times faster than US economy

by Matt Egan @MattEganCNN

May 25, 2017 4:20 PM ET



Inside the U.S. solar jobs boom

Mortgage & Savings

Loan Type	Rate	APR
30-yr fixed	3.63%	3.71%
15-yr fixed	2.88%	3.04%
5/1 ARM	2.5%	3.7%

Loan Amount	APR	Payment
\$225,000 (5/1 ARM)	3.7%	\$889/mo
\$350,000 (5/1 ARM)	3.72%	\$1,499/mo

Get Personalized Rates

President Trump may be focused on saving coal miners, but solar continues to be the hot spot in today's jobs market.

You Can Still Buy This "Millionaire Maker" Stock

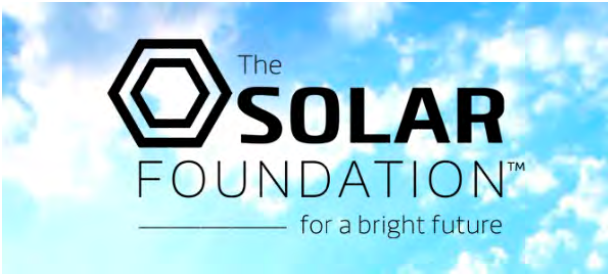
## Renewable Energy Occupation Wages (per hour)



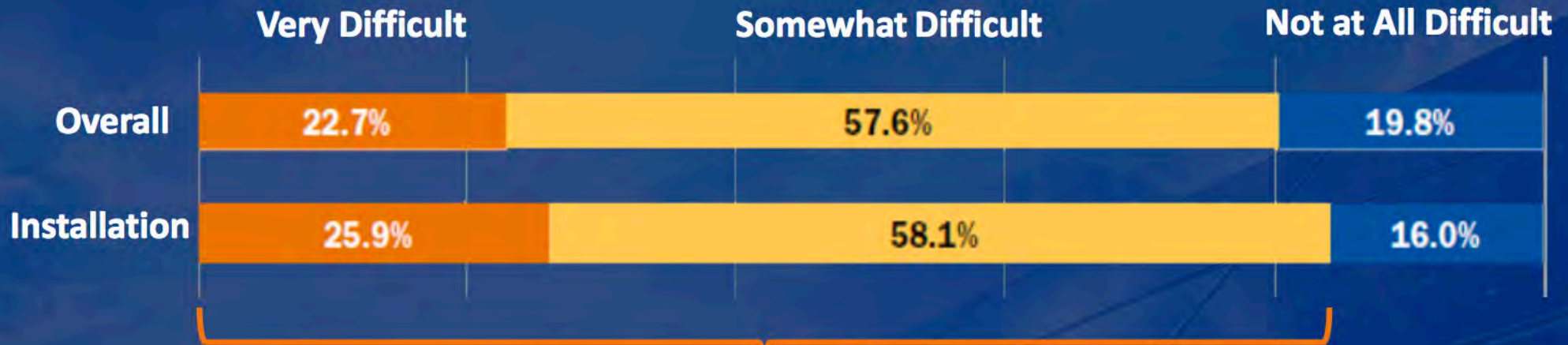
Source: Economic Modeling Specialists (EMS) Int'l data

*These are jobs that:*

- 1) Pay a family supporting wage
- 2) Cannot be outsourced
- 3) Cannot be done by robots
- 4) Benefit society



# Solar Training and Hiring Insights

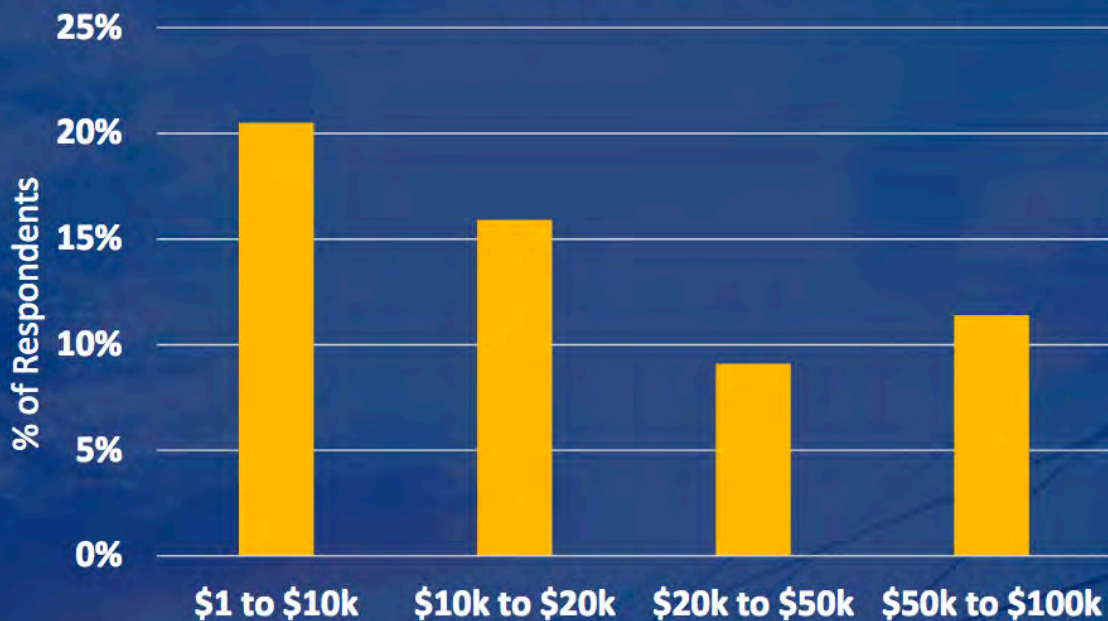


**84%** of solar installers report difficulty hiring qualified workers



# Solar Training and Hiring Insights

## Difficulty Hiring Costs Firms Money

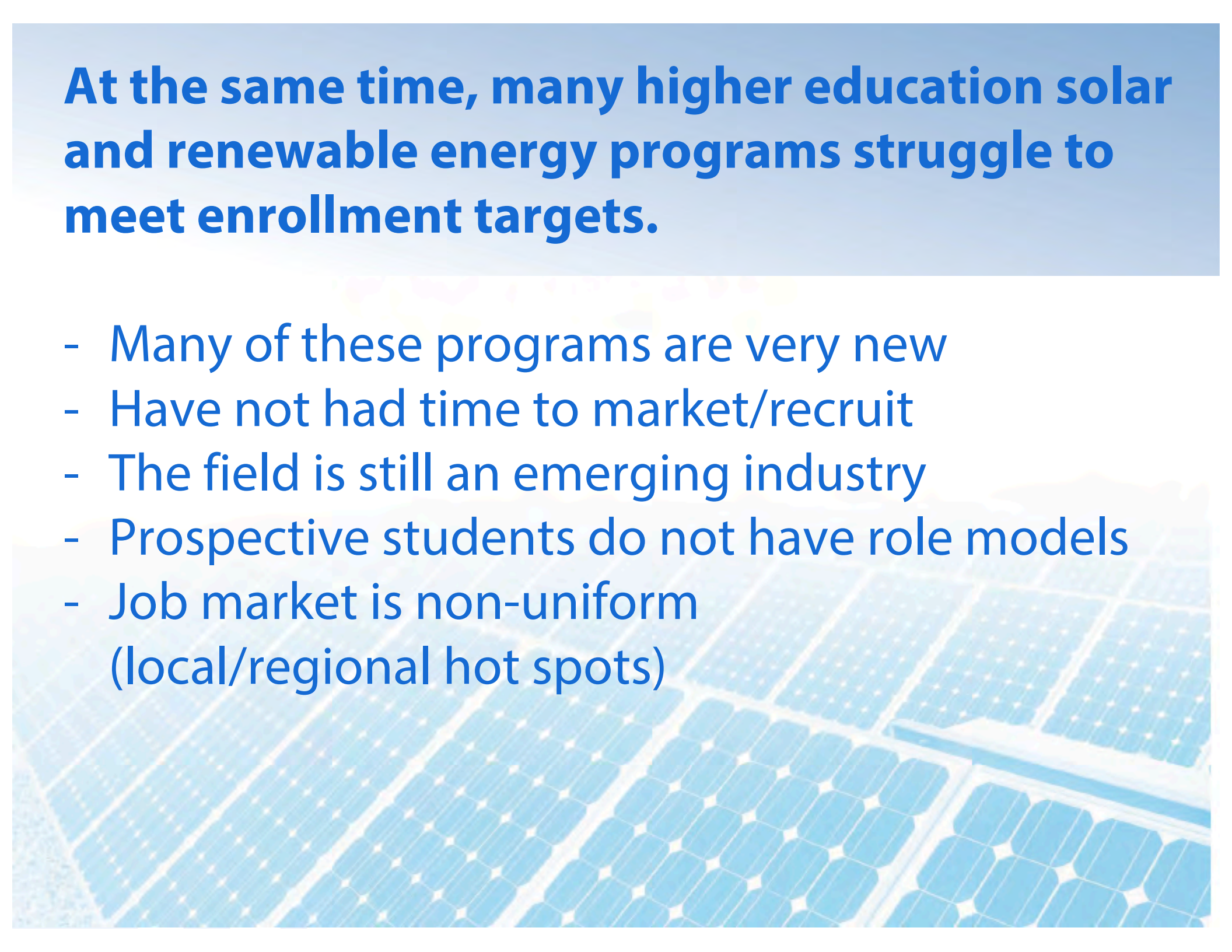


Per position cost due to difficulty hiring for your firm in both recruitment costs and opportunity costs of delayed hiring

- **67%** of employers report difficult hiring has impacted their ability to grow
- **65.1%** of employers report difficulty hiring has cost their firm money

# **At the same time, many higher education solar and renewable energy programs struggle to meet enrollment targets.**

- Many of these programs are very new
- Have not had time to market/recruit
- The field is still an emerging industry
- Prospective students do not have role models
- Job market is non-uniform  
(local/regional hot spots)





**Center for  
Renewable  
Energy  
Advanced  
Technological  
Education**

**The goal of the CREATE Center is to advance the field of renewable energy by supporting two-year college renewable energy programs. This goal will be accomplished through five key objectives:**

- 1) Providing support for faculty
- 2) Establishing industry, business and academic partnerships.
- 3) Promoting technician careers
- 4) Addressing technician knowledge, skills, and competencies
- 5) Screening, validating, updating, and broadly distributing exemplary renewable energy instructional materials



# Faculty Needs Survey

<b>Priority for resources for Solar PV</b>	<b>Normalized Priority</b>
Model Hands-on Student Activities	100
Lab Manuals/Lab Experiments	79
Problem/Project Based Learning Activities	78
Textbooks	68
Video Clips or Narrated Slide Presentations to Support Online or Hybrid Instruction	50
Model Course Syllabi	34
Test Banks, Sample Exams, & Sample Quizzes	33
Homework Problems and Exercises	28
Model Facilities and/or Instructional Laboratory Design Specifications and Plans	26



# Faculty Needs Survey

<b>Would you be interested in participating in the following professional development opportunities? (mark all that apply)</b>	<b>%</b>
<b>participating in 3-5 day summer RE workshops</b>	<b>75</b>
receiving a CREATE newsletter and RE communications	59
participating in online webinars on RE topics/technologies	53
accessing and/or contributing to a showcase of RE teaching materials	48
participating in an online community of RE faculty	46
participating in 1-2 day workshops before or after a conference	35

# Building Student Pathways



## STEM Educator Solar Institute

Sponsored by the

Center for  
Renewable  
Energy  
Advanced  
Technological  
Education

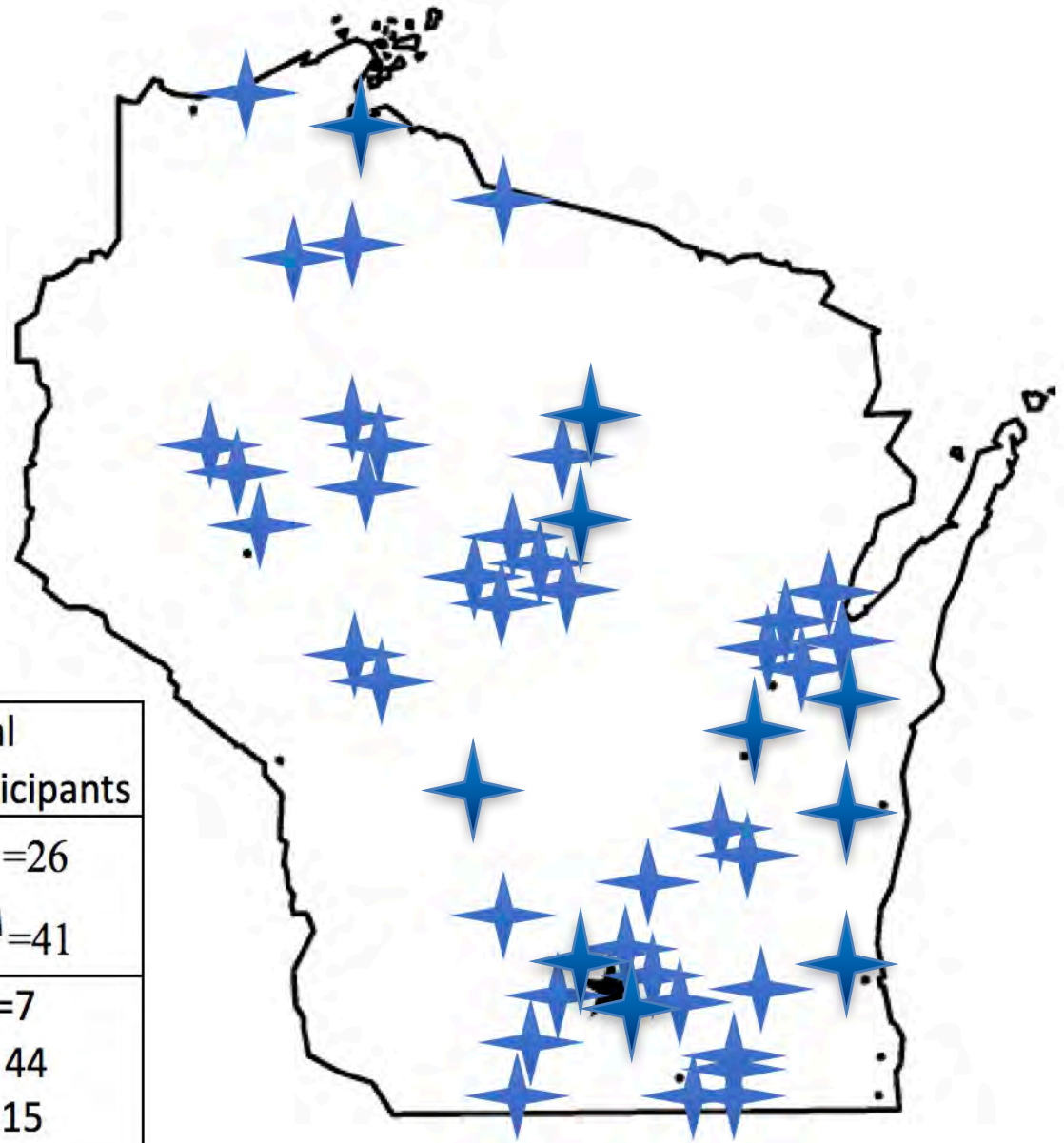


# PV Institute Agenda

- Three days
- Install a full-size PV system
- Small group workshops
  - Solar pathfinder
  - Generating an IV curve
  - PV Watts
  - Small, battery based system
- Student lessons and activities
- Discuss implementation within science and technical education curricula



# Participant Demographics



2015	2016	2017	2018	Total Participants
♀ = 3	♀ = 8	♀ = 7	♀ = 8	♀ = 26
♂ = 11	♂ = 9	♂ = 9	♂ = 12	♂ = 41
HS - 13 2Y - 1	MS = 5 HS = 9 2Y = 3	MS = 1 HS = 12 2Y = 2 4Y = 1	MS = 1 HS = 10 2Y = 9	MS = 7 HS = 44 2Y = 15 4Y = 1
WI (13) KY	<u>WI</u> (15) CO, WA	<u>WI</u> (14) ME Curacao	WI (12) CA, DE, <u>FL</u> (2), IL, LA, NC, OR	

# Teachers Install Solar PV

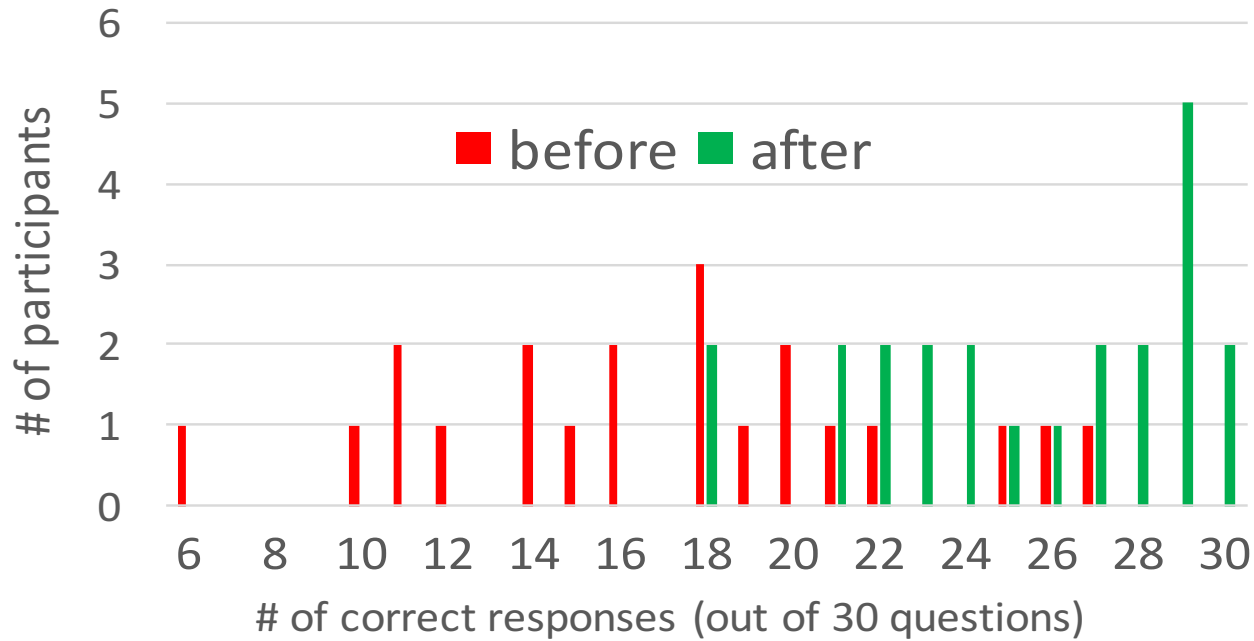
# Systems



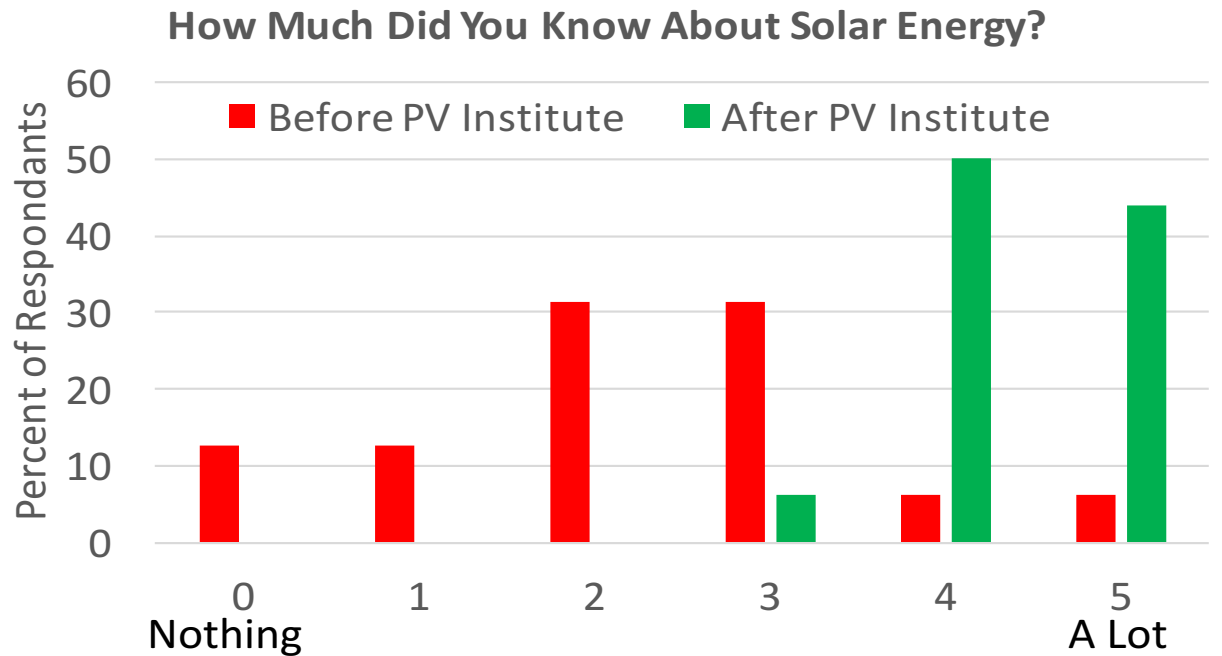
# Classroom Activities



# Measuring Learning Gains



	Before	After
<b>Low Score</b>	20.0%	60.0%
<b>High Score</b>	90.0%	100.0%
<b>Median Score</b>	60.0%	86.7%
<b>Mean Score</b>	49.9%	84.4%
<b>St Dev</b>	25.7%	12.3%



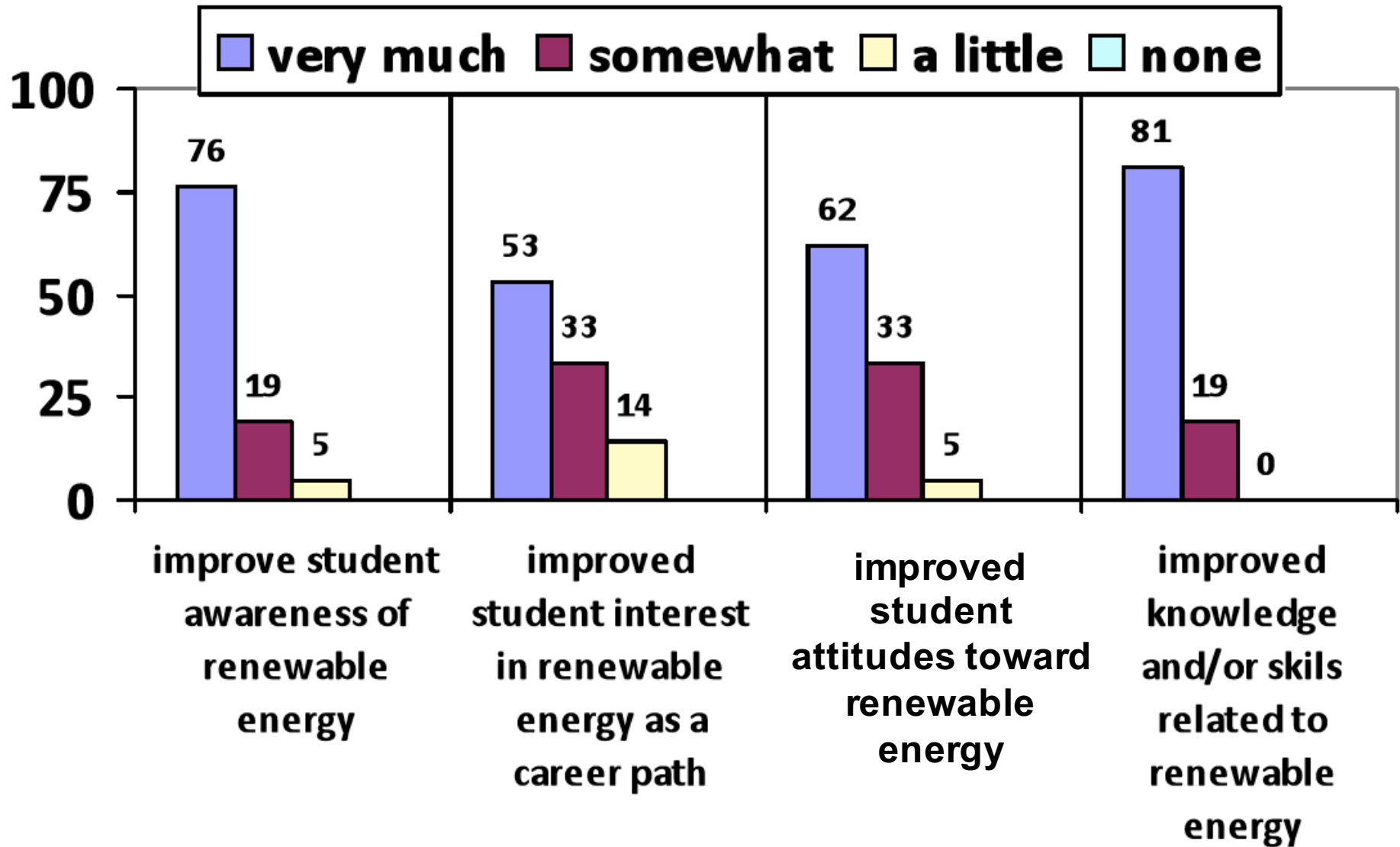
# Impacts on teaching practice

**Q: Have you used information gained in the Solar Institute to:  
(mark all that apply )**

<b>Answer Choices</b>	<b>Responses</b>
Educate other staff at your school (colleagues, administrators, etc)	<b>86.1%</b>
Enhance classroom lessons	<b>81.0%</b>
Modify course curriculum	<b>79.8%</b>
Create new lab activities	<b>78.5%</b>
Improve or modify existing lab activities	<b>77.2%</b>
Add more hands-on learning to the curriculum	<b>57.0%</b>
Improve safety procedures and protocols	<b>55.7%</b>
Create new course curriculum	<b>51.9%</b>
Acquired new lab equipment, supplies, or materials	<b>48.1%</b>
Participate in other professional development activities	<b>39.2%</b>



# Impacts on student learning



# Testimonials

- “A wonderful experience that will benefit my students. I plan to purchase solar equipment to use in my classroom this year.”
- “Really appreciate this opportunity, the material and activities. PV commissioning was a great experience that I can now safely perform in my class.”



# What is next?

<b>Priority for prof development in energy topics/technologies</b>	<b>Normalized Priority</b>
Photovoltaics	100
Energy Storage (i.e. Batteries)	79
Energy Management and Building Design	61
Solar Thermal	56
Wind	52
Special Topics	48
Biomass/Biogas	24
Energy Policy	24
Energy/Water Nexus	22
Liquid Bio Fuels (e.g. ethanol & biodiesel)	22
Hydropower	19
International Perspective On Renewable Energy (Study Abroad & Global Literacy)	18
Geothermal	18

**CREATE Energy Storage Project – NSF Award # 1800893**  
**(July 1, 2018 - June 30, 2021)**

# Please Join Us! See our webpage...

[www.CreateEnergy.org](http://www.CreateEnergy.org)



 Join Our Mailing List

[ABOUT](#)

[TEAM](#)

[PUBLICATIONS](#)

[WORKSHOPS](#)

[CALENDAR](#)

[BLOG](#)



*Center For Renewable Energy Advanced Technological Education*

[PARTNER SCHOOLS](#)

# Take Home Points

- Ask teachers what they need
- Content knowledge is easy to acquire, but teachers need hands-on professional development
- Sharing pedagogy is important
- Thoughtful selection of participants builds professional networks and amplifies impact
- Provide recognition of efforts (graduate credits, certificate of achievement, press release)
- Assessment of impact is invaluable

**Thank you for  
your attention!**

***Questions?***

This work was supported in part by National Science Foundation Awards #1205015 and 1600934.

Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

