

Design-oriented Education and Hands-on Training with Wide Bandgap Power Electronics for the Next-Generation Power Engineering Workforce

DE-EE0007304

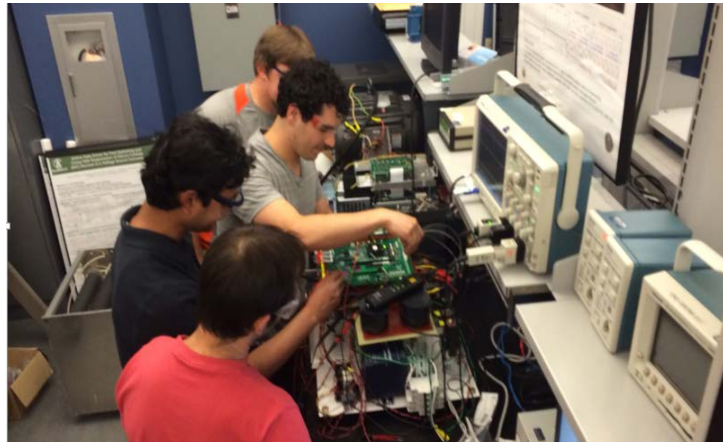
The University of Tennessee / Oak Ridge National Laboratory
Period 1: January 2016 – June 2017

Leon M. Tolbert, The University of Tennessee

U.S. DOE Advanced Manufacturing Office Program Review Meeting
Washington, D.C.
June 13-14, 2017

Project Objective

- Provide design-oriented education and hands-on training with WBG power electronics
- In 5-year period, recruit 30 M.S. or Ph.D. U.S. citizens for traineeship.
- Students will also have opportunities for research experiences and internships at nearby Oak Ridge National Laboratory and/or partner U.S. companies.



Technical Innovation – Curriculum Revision to Add more WBG and Hands-On Content

- Seven senior level and graduate courses will have more WBG content
- Developing four new courses with main focus on WBG power electronics and hands-on experiences
- New WBG Graduate Certificate offered to students completing 4 WBG courses and 1 professional development course in entrepreneurship, engineering economics, or project management.



Year 1 Trainee Cohort



- 11 U.S. citizen graduate students started program in August 2016

Technical Innovation - Student Projects 16-17

1. Intermediate bus GaN converter for data centers
2. 6.78MHz GaN rectifier for wireless power
3. Point of load power converter optimization with GaN
4. 110 MHz integrated battery charger with SiC
5. High density solar inverter with GaN devices
6. Online conditioning monitoring of SiC-based phase-leg modules
7. SiC-based power module for EV applications
8. Controller for SiC-based variable reactor
9. GaN-based Class D audio amplifier
10. Intelligent gate drive for paralleled SiC devices for medium voltage motor drives
11. Low-cost GaN-based solar inverter

Approach - Professional Development Seminars

- Research skills / attitudes
- Technical writing
- Giving effective technical presentations
- Poster presentation tips
- Ethics in engineering
- Entrepreneurship and innovation in engineering
- Importance of diversity / cultural perceptions
- Women in power engineering
- Laboratory safety
- Careers in academia



Approach - Training at ORNL / Companies

- All trainees have ORNL issued badges so that they can attend seminars and other events at the ORNL main campus and NTRC.
- Trainees will have opportunity to see advanced manufacturing techniques (mostly for packaging and thermal management).
- Some student projects have company or ORNL mentors to provide monthly feedback.
- Students have internship opportunities at ORNL and industry partners.

Industry Partners



**United Technologies
Research Center**

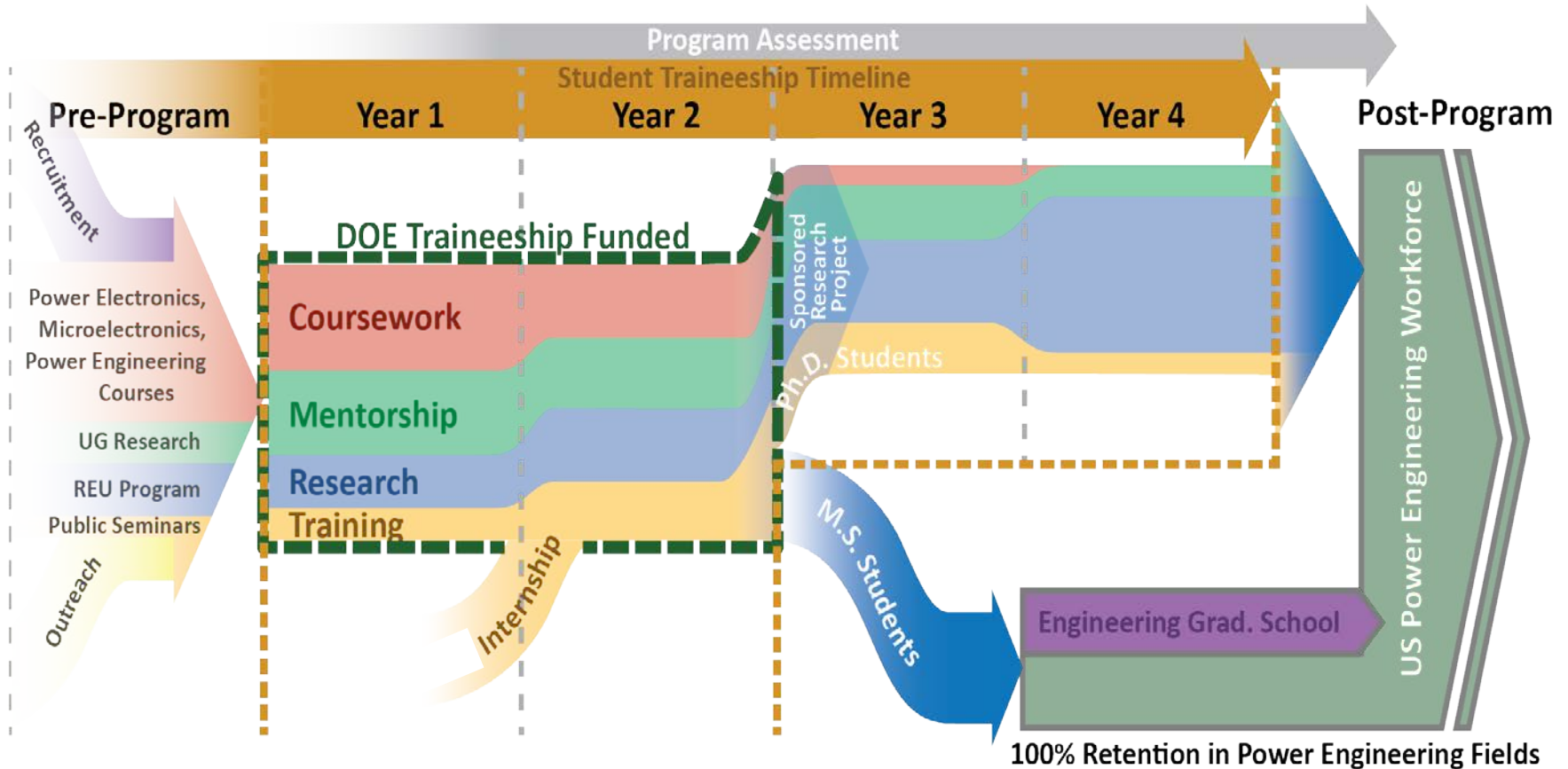


Approach – Website Development



- <http://Potenntial.eecs.utk.edu>
- Basic tutorials on
 - Power electronics
 - Power semiconductors
 - Wide bandgap semiconductors
- Research areas and projects at UTK
- Program information and applications
- Future space for course modules

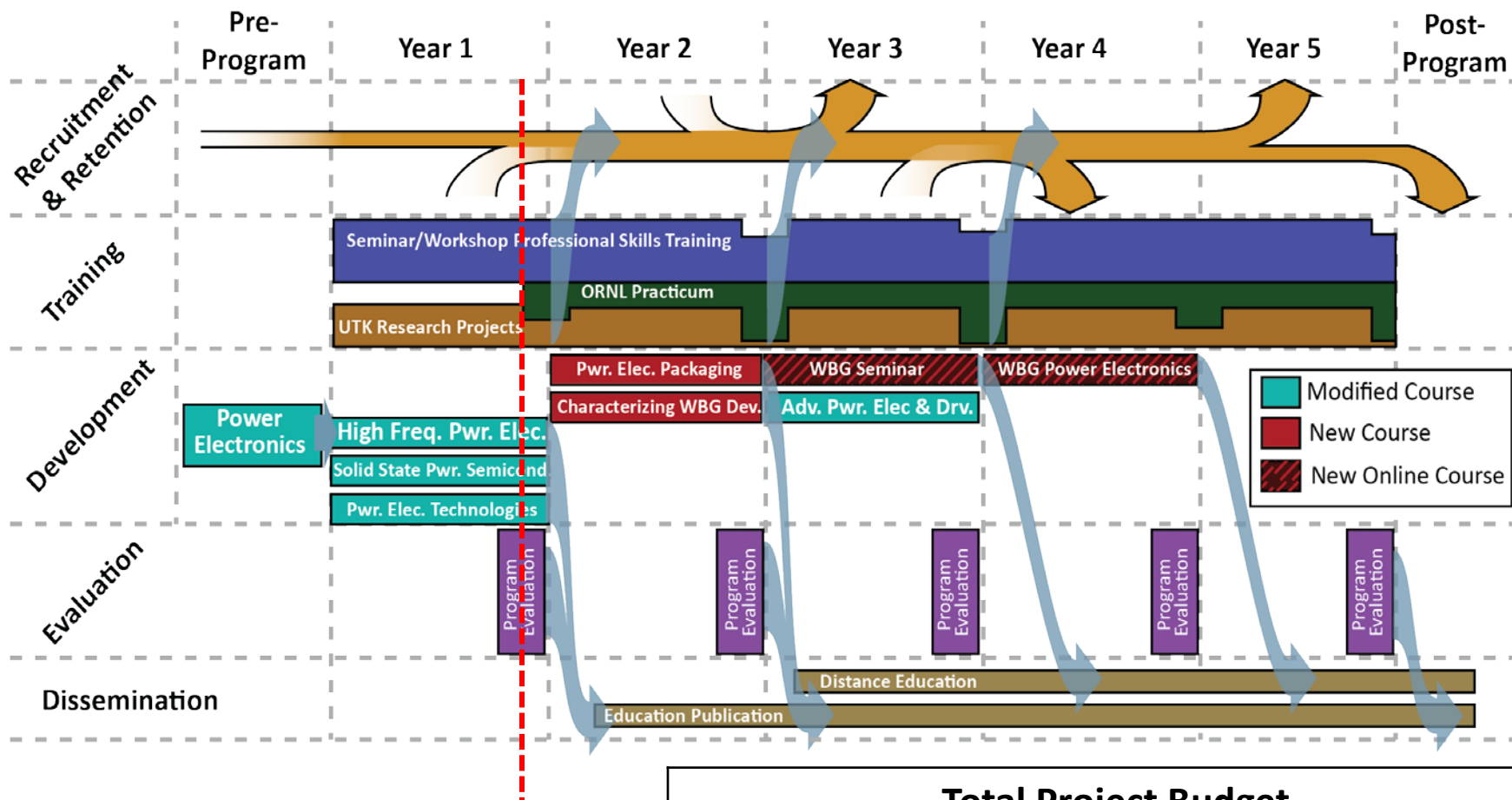
Student Timeline



Transition (beyond DOE assistance)

- Trained U.S. citizen graduate students for employment by U.S. industry that have unique skills in the application of WBG power electronics
- All students will do thesis or dissertation that has an experimental component.
- Information disseminated through traditional publications (including education journals) and also web-based modules.
- Exit and 1-year follow up surveys of students and industry will be performed to assess effectiveness of traineeship (skills learned).
- Will present results to PoTENNTial Industry Advisory Board for feedback on program.

Project Management and Budget



Total Project Budget	
DOE Investment	\$2,905,708

Accomplishments in First Year

- 11 U.S. graduate students started program in August 2017.
- WBG graduate certificate approved by university for 2017-18 academic year.
- Five power electronics graduate courses taught in 2016-2017 that had modified content to include emphasis on WBG devices. (Enrollment ranged from 15 to 26).
- PoTENNTial website developed to feature information on WBG power electronics.
- CURENT Seminar Series during 2016-17 provided several talks on entrepreneurship, technical writing, intellectual property, and laboratory safety.

Questions?



This work is supported by DOE Award DE-EE0007304.

Other US government and industrial sponsors are also gratefully acknowledged.