FINAL SCIENTIFIC REPORT

Southwest United States of America – Distributed Technology Training Consortia (SWUSA-DTTC)

Contract Number: DE-EE0006339

Lead Organization: Electricore, Inc in teaming with:

DOE Project Team:

DOE Field Contracting Officer:	Diana Bobo
DOE Technical Project Officer:	Rosemarie Holsing
Technical Manager:	Christina Nichols

Contractual Point of Contact:
Deborah Jelen
Executive Director
Electricore, Inc.
27943 Smyth Dr. St 105
Valencia, CA 91355
T: (661) 607-0230
jelen@electricore.org

Technical Point of Contact Project Principal Investigator:
Robert Sherick
Southern California Edison
Mr. Robert Sherick
Transmission & Distribution - Advanced Technology
Power System Technologies/Consulting
T: (714) 934-0813
robert.sherick@sce.com

Program Manager:
Kodie Arnold
Electricore, Inc.
27943 Smyth Dr. St 105
Valencia, CA 91355
T: (661) 607-0285
kodie@electricore.org

1.0 EXECUTIVE SUMMARY

The Southwest United States of America – Distributed Technology Training Consortia (SWUSA-DTTC) leveraged the highest concentration of renewable resources in the U.S. as well as operation of the leading independent microgrid installations and other distributed technologies to collect and analyze real-time data streams, advance power system simulations and analysis, identify educational and training gaps and develop solutions-focused curricula. The SWUSA-DTTC consortium posed a unique collaboration between universities and utilities to ensure that classes were focused on subjects and topics of interest to the utilities and ones that had practical benefit related to the preparedness for accommodating high penetration of solar and other distributed energy technologies. This approach to have a close collaboration and shared effort to develop the course content and curriculum is unique and a significant departure from conventional course development. This coursework and training was intended to endure over a long time horizon (10-20 year time frame), and include professionals over the entire Southwest region and the rest of the US, and even outreach into foreign countries.

Project Objectives

In order to support the increase in power systems research, development, and analytical capacity, the SWUSA-DTTC brought together respected professors in Power Systems education, student/professor research and development, and valuable industry and utility experience. Through this program, the partnered universities created and/or modified existing curricula available to students and professionals in the form of university courses, short courses, videos, consortia-led training, and online materials. During this time, the supporting vendors and utilities provided the SWUSA-DTTC with technical advisory roles as well as providing input and feedback in terms of utility and related energy industry needs.

The goals were to create power and energy systems training, curricula, and workforce preparedness through the inclusion of data collection and analysis, power systems expertise, and application-specific training activities which build on fundamental principles, modeling and simulation tools, field-immersed training and methods of performance validation. The outcome of the program was to result in better prepared and greater number of graduates ready to contribute to the field of power systems which depend upon the safe, reliable and efficient generation sources which make up an increasingly diverse mix of renewable power. Additionally, the program was to deliver critical training modules which are intended to support mid-career professionals and be woven into utility training programs used all over the country.

Discontinuation Summary

On September 29, 2014, Electricore received notice of discontinuation of federal funding under subject Award DE-EE0006339. DOE's notice of discontinuation was the first indication provided to Electricore that the work completed against Task 1 - Program Planning and Evaluation during Budget Period 1 was inadequate. Significantly, the discontinuation was based in large part on the erroneous assertion that many of the tasks were incomplete as indicated in the Continuation Application. However, the Continuation Application was submitted July 29, 2014, while the period of performance for this last quarter in Budget Period 1 did not end until September 30, 2014. Accordingly, the performance for this last quarter in Budget Period 1 will be reported in the upcoming Quarterly Report which is not due until October 30, 2014. Nevertheless, in response to DOE's letter and in further support of Electricore's Continuation Application, we are providing a detailed status demonstrating adherence to all program requirements for each Task 1, Budget Period 1 SOPO activity and milestones in response to the DOE review.

Subtasks and Milestones in Budget Period 1 have all been substantially completed. In accordance with the SWUSA-DTTC SOPO, at the end of each Budget Period, DOE will decide whether or not to proceed into the next Budget Period based on the "*successful completion of 85%"* of the Subtasks and Milestones in the previous Budget Period. Electricore demonstrates in the enclosed information that the team successfully met at least 20 out of 22 subtasks and milestones in Budget Period 1 equating to a *successful completion of 91%* of the criteria, exceeding the requirement to move into Budget Period 2.

Electricore respectfully requested DOE objectively review information, correcting incomplete information that drove the decision not to continue funding to this prestigious team. Electricore requested revisiting the decision to fund Budget Period 2 of the program and strongly recommended that this important effort continue.

The SWUSA-DTTC Program is critical to increase U.S. capacity to integrate high penetrations of solar and other distributed technologies. Utilities (Southern California Edison, San Diego Gas & Electric, Maui Electric and Pacific Gas & Electric), and California ISO encountering the highest distributed technologies in the country and the problems associated with their integration have committed support and manpower to drive curricula at key Certified Engineering Universities (University of California San Diego, San Diego State, Arizona State University and University of Hawaii) with the assistance of Lawrence Berkeley National Labs. The resulting changes will improve power system capabilities, promote electric grid security, and create a talent pool of trained specialists through the curricula taught at these key universities and a growing list of others that are interested. This highly qualified team is under contract and actively working toward ground-breaking results.

The work accomplished during Budget Period 1 has already resulted in new course offerings, new degree emphasis and new laboratory investigations. The momentum from these important curricula changes is creating interest in growing the consortium with several universities (Caltech and California Polytechnic University San Luis Obispo and Pomona campuses among others) seeking the opportunity to join. An upcoming California Energy Commission program may offer the occasion to fund expansion to the team and further the goal of SWUSA-DTTC self-sufficiency.

2.0 ACCOMPLISHMENTS

2.1 What are the major goals of the project?

The goals of this program were to create power and energy systems training, curricula, and work force preparedness through the inclusion of data collection and analysis, power systems expertise, and application-specific training activities which build on fundamental principles, modeling and simulation tools, field-immersed training and methods of performance validation.

The outcome of the program was intended to result in better prepared and greater numbers of graduates ready to contribute to the field of power systems which depend upon the safe, reliable and efficient generation sources which make up an increasingly diverse mix of renewable power. Additionally, the program planned to deliver critical training modules which were intended to support mid-career professionals and be woven into utility training programs used all over the country.

Budget Period 1 focused on Task 1: Program Planning and Evaluation. Please find the progress below on each task and milestone.

TASK 1: PROGRAM PLANNING AND EVALUATION

- Subtask 1.1 Program Kick-Off: **COMPLETE**
- Subtask 1.2 Evaluation Plan: **COMPLETE**
- Subtask 1.3 Stand up Advisory Boards: **COMPLETE**
- Subtask 1.4 Formative and Summative Evaluations: **COMPLETE**

2.1.1 What was accomplished under these goals?

Subtasks and Milestones in Budget Period 1 have all been substantially completed. Electricore demonstrates in the enclosed information that the team successfully met at least 20 out of 22 subtasks and milestones in Budget Period 1 equating to a *successful completion of 91%* of the criteria, exceeding the requirement to move into Budget Period 2.

TASK 1: PROGRAM PLANNING AND EVALUATION

- Subtask 1.1 Program Kick-Off: **Complete.**
  - Attended DoE Kick Off on November 20, 2013 via teleconference and web.
  - Attended NNA Kick Off on December 11-12, 2014 in Orlando, FL
- Subtask 1.2 Evaluation Plan: **Complete.**
  - The Evaluation Plan Matrix was submitted on July 24, 2014 with the Quarterly Report for April-June 2014 performance. The Evaluation Plan Matrix was also submitted in the Continuation Application on July 29, 2014 and distributed to the National Network Administrator (NNA) and provided in **Appendix A** of this report.
  - The project team has engaged with the identified stakeholders and drafted the Technology to Market Strategy as shown in **Appendix B** of this report. The Technology to Market Strategy was the main agenda topic of the Advisory Board meeting scheduled for October 3, 2014 but cancelled due to the Award discontinuation. This Advisory Board meeting was scheduled for an earlier date in September, but due to heavy travel schedules by and at the request of the Advisory Board Members, it was moved to October 3rd.
- Subtask 1.3 Stand up Advisory Boards: **Complete.**

- The Advisory Board was convened with current members consisting of:
- One member from each SWUSA-DTTC utility:
  - Southern California Edison's Ms. Leanne Swanson, Principal Manager of Distribution Engineering Technologies/Consulting
  - Southern California Edison's Mr. Robert Sherick, Power System Technologies/Consulting
  - Maui Electric Company's Mr. Matt McNeff
  - Maui Electric Company's Mr. Ray Okazaki
  - San Diego Gas & Electric, Mr. John Holmes
  - Pacific Gas & Electric, Mr. Kevin Dasso. The support from Mr. Dasso was received during this reporting period.
- One member from CAISO, Mr. Peter Klauer – The support from Mr. Klauer was received during this reporting period.
- Industry Members
  - Mr. Troy Strand, an Independent Consultant of SDG&E (from the largest solar installer in SDG&E territory)
  - Mr. Bryan Farrens, Eaton Corporation
- Education leadership:
  - Dr. Oner Yurtseven, Retired Dean Emeritus of School of Engineering and Technology, IUPUI
  - Support has also been received by Cal Poly San Luis Obispo's Rakesh K. Goel, Associate Dean, Research, Graduate Programs, and Partnerships.
- At the time of proposal (and the resulting SOPO that borrowed heavily from it), Electricore did not know that EPRI was responding as a Prime to the GEARED program. EPRI has provided a letter of support for our consortium, and we have every intention of including EPRI throughout the duration of our upcoming program activities. John Holmes with SDG&E also attended EPRI's team's kick-off meetings to engage and align perspectives.
- As previously reported, Technology Advisory Board kick off meeting was convened on May 16, 2014. The meeting minutes were provided in the previously submitted Quarterly Report.
- The newly developed programs have been reviewed by several members of the Advisory Board in BP1, including SDG&E - John Holmes, MECO – Matt McNeff and Ray Okazaki and SCE – Robert Sherick.
- With the support of Advisory Board Members from MECO, UHM worked towards development of a high-impact training program on Smart PV Inverters for distribution grid. During this quarter, UHM conducted the following activities with Advisory Board Members support in preparation:
  - Defined real-world data needed for curriculum and worked with Maui Electric Company (MECO) to obtain data.
  - Linked educational activities to research activities by bringing data, modeling, methodologies and outcomes into the classroom.
  - An Advisory Board meeting was rescheduled to October 3, 2014 to align with board members travelling schedules. This meeting was cancelled due to the Award cancellation.

- Subtask 1.4 Formative and Summative Evaluations: **Complete.**
  - PI, Robert Sherick (a Technology Advisory Board Member) and Electricore held individual meetings with SDSU, UCSD and UH Manoa to discuss and critique program and curriculum development. These meetings were held on August 20, August 21 and September 08, 2014. This activity was to be shared with our Advisory

Board in the meeting scheduled for October 3, 2014; this meeting was cancelled due to the Award discontinuation discussions. The meeting notes are provided in **Appendix C** of this response.

- SDG&E Technology Advisory Board Member met directly with faculty and administrators of ASU, SDSU, UCSD, and UH to plan evolution and development of coursework and training curriculum. Joint coursework development is underway.
- With the support of Advisory Board Members from MECO, UHM worked towards development of a high-impact training program on Smart PV Inverters for distribution grid. During this quarter, UHM conducted the following activities with Advisory Board Members support in preparation:
  - Defined real-world data needed for curriculum and worked with Maui Electric Company (MECO) to obtain data.
  - Linked educational activities to research activities by bringing data, modeling, methodologies and outcomes into the classroom.

TASK 1/BP 1 MILESTONES:

Number	Description	Status	Progress Notes
1.1	Program Kick-Off with the DOE	Complete	Attended DoE Kick Off on November 20, 2013 via teleconference and web.
1.2	Meet with NNA provided program and evaluation expert	Complete	Attended NNA Kick Off on December 11-12, 2014 in Orlando, FL
1.3	Prepare Consortium universities to evaluate project according to network-developed metrics via online questionnaires administered by the GEARED NNA	Complete	On August 11, 2014 Electricore provided the NNA's Evaluation Expert, Matt Champagne with the Course Evaluations input for UH, UCSD, and SDSU. Electricore believes this process will be ongoing in future budget periods as additional courses are developed and taught. On August 12, 2014 Electricore provided input to Matt Champagne's Metrics Evaluation Master Matrix which was discussed in the NNA monthly meeting on August 28, 2014 in which Electricore participated in. This activity is provided in **Appendix D** below.
1.4	Participate in brand development and promulgation for the GEARED network	Complete	The SWUSA-DTTC participated in the first student centered conference in Newport Beach, CA April 28-29, 2014. Electricore issued a press release with additional details shown in **Appendix L**. Electricore launched the SWUSA-DTTC site in conjunction with our Electricore website. The link is http://www.electricore.org/swusa_dttc.
1.5	Briefing of the Consortia Organization to the DOE and delivery of the BUDGET PERIOD 1 Evaluation Plan. BUDGET PERIOD 1 Decision Points include DOE	Complete	Electricore presented Budget Period 1 Consortia Organization Activities to the NNA and other GEARED awardees on August 28, 2014. DOE was invited by NNA to Electricore's update. The meeting notes of Electricore's update were submitted to the NNA on August 28, 2014. A copy is provided below in **Appendix E** of this response.

Number	Description	Status	Progress Notes
	recommendations and GO for exit from Subtask 1.2 activities.		As previously reported, the SWUSA-DTTC participated in the required DOE SunShot Summit-Peer Review on May 20-22, 2014. Electricore and SDG&E prepared a poster for the Poster Session and presented our project activities, results and path forward to the review panel selected by the DOE. Results of this Peer Review have not been distributed to Electricore nor any comments received. • On May 20, 2014 Electricore (Deborah Jelen and Kodie Arnold) and SDG&E (John Holmes) met with DOE members (Rose Marie Holsing, Christina Nichols and Fania Gordon) in Anaheim, CA for an internal program review. • Follow up to action items from this meeting were captured in the email dated May 20, 2014 from Deborah Jelen to DOE. • DOE reviewed and approved the requested substitution of SCE for PI SDG&E when SDG&E received substantial R&D funding reductions from their regulatory body (California Public Utility Commission) resulting in their withdrawal from the role. SCE budget, cost share and scope was unchanged from that originally contracted and no other substantial changes are planned.
1.6	Provide space and act as host for training consortia activities, utility laboratory, training, and meeting facilities to be made available to the consortia's programs.	Complete	SDSU developed a new power simulations lab, to be offered for the first time in Spring 2015. The lab will be on power system simulation using ETAP, including transmission network performance in both steady-state and dynamic conditions, optimal power flow (OPF), balanced and unbalanced faults, network equivalent construction, dynamic simulation, and protection coordination. It is hoped that eventually, the lab and any new courses can be taught "virtually", as online courses. The University of Hawaii organized a 2 day training workshop to be held in December 2014 titled "Smart Grid & Renewable Integration in Modern Power Systems". The registration brochure distributed regionally is attached in **Appendix F** below.
1.7	Provide laboratory in the field immersion for case studies correlated with coursework via The Skills Training Center, the Integrated Test Facility, the Operations Centers & a diverse portfolio of assets that can be woven into the training.	Complete	SCE is equipped with a set of laboratories at its Westminster facility that includes a large Real-Time Digital Simulator (RTDS), extensive inverter testing facility, substation and distribution automation test labs, and home area network lab to test communication and control systems behind-the-meter. SCE also has a separate facility in Pomona to test storage devices and electric transportation technologies. These facilities support SCE's ongoing work to thoroughly understand

Number	Description	Status	Progress Notes
			emerging technologies and effectively build the grid of the future. The labs have been instrumental in deploying technologies like IEC-61850 for substation controls, smart circuit switches for the ISGD feeder protection system, and testing smart inverters to identify the characteristics and benefits of these devices as they are interconnected to the grid. This activity was approved by DOE in the contract modification dated August 26, 2014 (after the Continuation Application submittal) and will be reported in the Quarterly Report for July-September performance. During the NNA monthly meeting on August 28, 2014 Electricore announced that The University of Hawaii organized a 2 day training workshop to be held in December 2014 titled "Smart Grid & Renewable Integration in Modern Power Systems". The registration brochure distributed regionally is attached in **Appendix F** below. ASU provided development of the Virtual laboratory for Smart Distribution Grid. It has been transferred to the latest edition of MATLAB. ASU developed the short course: "Smart Transmission and Smart Distribution Grid with renewables. USCD is providing a power systems lab with the Integrated Test Facility. UCSD is providing advanced training courses coordinating the content with SDSU. SDSU developed a new power simulations lab, to be offered for the first time in Spring 2015 or Fall 2015 (latest). The lab and any new courses can be taught "virtually", as online courses. The originally planned work to test at SDG&E's skills training center and Integrated Test Facility was shifted to Southern California Edison (SCE) Advanced Technology Center when SCE was contracted as PI. The training activities planned for this activity would have occurred as planned in future years, as identified in Task 2.2.3.
1.8	Provide public outreach through communication through major broadcast networks and public media.	Complete	During Budget Period 1 there were no major DOE events which warranted major media outreach. If BP2 and BP3 proceed, University accomplishments and planned DOE conferences will allow for greater media exposure and the budget to create this exposure will be expended.

Number	Description	Status	Progress Notes
			Although Budget Period 1 outreach was not picked up through major broadcast networks, our consortium did conduct outreach through other forms of communication and public media. During this reporting period, the following activities were conducted: • Creation and dissemination of a SWUSA-DTTC Program Summary brief to interested parties while attending multiple California Energy Commission (CEC) workshops and meetings related to the upcoming EPIC 2012-2014 Triennial Investment Plan. During these workshops and meetings, Electricore promoted the SWUSA-DTTC efforts with CEC workshop attendees, CEC Program Managers and the Supervisor for Renewable Energy R&D, Erik Stokes. The Program Summary Brief is below in **Appendix G.** ○ PI, Robert Sherick held discussions with UC Riverside and UC Irvine on forecasting demanding response and solar adoption and promoting the SWUSA-DTTC consortium activities and distributing the SWUSA-DTTC Program Summary brief. • On August 28th, during the briefing to the NNA and GEARED network, Electricore announced that the University of Hawaii was organizing a 2 day Training Workshop in December 2014 titled "Smart Grid & Renewable Integration in Modern Power Systems". UH conducted regional outreach to receive a large attendance to this training workshop. The brochure was distributed regionally and is attached in **Appendix F** below and also will be reported in the Quarterly Report for July-September. • Electricore launched the SWUSA-DTTC site in conjunction with our Electricore website. The link is http://www.electricore.org/swusa_dttc; this was reported in the Quarterly Reports and Continuation Application and also distributed to the NNA.
1.9	Develop materials and course content relevant to the dispatch of stored energy which incorporates resource awareness and weather forecasting.	Complete	Utility partners met directly with faculty and administrators of ASU, SDSU, UCSD, and UH to plan evolution and development of coursework and training curriculum. Joint coursework development is underway. UCSD is developing course content on solar forecasting and its impacts on optimal energy storage discharge. UCSD's update can be found in **Appendix M: UCSD Short Course Description.**

Number	Description	Status	Progress Notes
			The SDSU department is offering a new undergraduate/graduate course in Fall 2014 as a special topics class EE596 - Advanced Electrical Engineering Topics: Renewable Energy Systems and the Smart Grid. The course is on the effects of changes in the structure of the electric utility system caused by distributed generation or co-generation involving deployment of renewable energy sources such as wind and solar. Topics covered include photovoltaic and wind-energy conversion systems, power converters and energy storage, and load flow analysis of power grids and microgrids. An update on development of materials and course content relevant to the dispatch of stored energy which incorporates resource awareness and weather forecasting is shown in Appendix A: Deliverable And Evaluation Matrix. A completed syllabus for SDSU's newly created class can be found in Appendix H: SDSU EE596 Syllabus An update of development materials is included in the Evaluation Plan Matrix, **Appendix A.** Utility partners met directly with faculty and administrators of ASU, SDSU, UCSD, and UH to plan evolution and development of coursework and training curriculum. Joint coursework development is underway. UCSD was developing course material on the integration of energy storage with solar forecasting. The course was scheduled to be taught for the first time in January 2015. UCSD developed new short courses on • Solar energy forecasting & solar energy performance monitoring and modeling • Advanced applications of interfacing renewables to power system • Power system simulation: fundamentals and applications UCSD modified and extended course offering to incorporate Power Systems Engineering: • Solar Energy Meteorology • Radiation for Energy Applications • Added content on microgrid data integration • Introduction to Power Electronics • Power Electronics II • Introduction to Embedded Systems • Introduction to Smart Grid

Number	Description	Status	Progress Notes
			• Power systems lab in coordination with SDG&E and/or SCE UH Manoa prepared slides for 10 hour graduate level course on power conversion for PV and Wind - Coordinated with SDSU and organized a 2 day workshop in Dec 2014 on embedded control of inverters for PV, Wind and EV. Expected: 50 participants from utilities and universities. The SDSU department is offering a new undergraduate/graduate course in Fall 2014 as a special topics class EE596 - Advanced Electrical Engineering Topics: Renewable Energy Systems and the Smart Grid. The course is on the effects of changes in the structure of the electric utility system caused by distributed generation or co-generation involving deployment of renewable energy sources such as wind and solar. Topics covered include photovoltaic and wind-energy conversion systems, power converters and energy storage, and load flow analysis of power grids and microgrids. An update on development of materials and course content relevant to the dispatch of stored energy which incorporates resource awareness and weather forecasting is shown in **Appendix A.** A completed syllabus for SDSU's newly created class can be found in **Appendix H.**
1.10	Assist with identifying the challenges faced when adding distributed generation to the grid, potential solutions to those challenges, methods to evaluate and prioritize potential solutions, and skills needed to implement those solutions by participating in planning discussions with the team, review and provide feedback on curriculum, highlight priorities for new curriculum development, and share findings from research and utility experience	Complete	Electricore held collaboration meetings this quarter with our SWUSA-DTTC to identify challenges faced, evaluate and prioritize solutions and provide feedback to curriculum on the following dates below. Meeting minutes were captured and distributed to the SWUSA-DTTC and below in **Appendix I**. ✓ 03-27-14 ✓ 04-17-14 ✓ 05-15-14 ✓ 06-19-14 ✓ 07-17-14 ✓ 08-21-14 ✓ 09-19-14 Our PI, Robert Sherick and Electricore held individual meetings with SDSU, UCSD and UH Manoa to also discuss identified challenges and solutions. These meetings were held on August 20, August 21 and September 08, 2014. The meeting notes are provided in **Appendix C** of this response. Technical Advisory Board Member, John Holmes was invited to two national appointments: the UL Renewable Energy Council and the Board of Directors of the Energy Storage Council in which SWUSA-DTTC findings from research and utility experience gained from participation will be represented and publicized.

Number	Description	Status	Progress Notes
1.11	Evaluation of training materials by leveraging ongoing research on distributed generation and participation in industry workgroups	Complete	• UCSD conducted a study on distribution feeder impacts of high PV penetration. • Utility partners are involved in advancing evolution of California interconnection practices, assessing IEEE evolution of IEEE 1547 and UL 1741. • Technical Advisory Board Member, John Holmes was invited to two national appointments: the UL Renewable Energy Council and the Board of Directors of the Energy Storage Council in which SWUSA-DTTC findings from research and utility experience gained from participation will be represented and publicized. • The newly developed programs have been reviewed by several members of the Advisory Board in BP1, including SDG&E - John Holmes, MECO – Matt McNeff and Ray Okazaki and SCE – Robert Sherick. • With the support of Advisory Board Members from MECO, UHM worked towards development of a high-impact training program on Smart PV Inverters for distribution grid. During this quarter, UHM conducted the following activities with Advisory Board Members support in preparation: o Defined real-world data needed for curriculum and worked with Maui Electric Company (MECO) to obtain data. o Linked educational activities to research activities by bringing data, modeling, methodologies and outcomes into the classroom.
1.12	Assist with evaluation of training outcomes by assisting with developing methods to evaluate the training outcomes and proposing modifications to the training materials where outcomes could be improved	Complete	On August 11, 2014 Electricore provided the NNA's Evaluation Expert, Matt Champagne with the Course Evaluations input for UH, UCSD, and SDSU. Electricore believes this process will be ongoing in future budget periods as additional courses are developed and taught. On August 12, 2014 Electricore provided input to Matt Champagne's Metrics Evaluation Master Matrix which was discussed in the NNA monthly meeting on August 28, 2014 in which Electricore participated in. This activity is provided in **Appendix D** below.
1.13	Provide a high-level mapping between the previously identified challenges and solutions into functions within utilities/industry.	Complete	• The high level mapping is complete and was reported in the Quarterly Report for July-September 2014 period of performance and is provided in **Appendix J below.** o The high level mapping was planned to be discussed in the Advisory Board meeting scheduled for October 3, 2014 which was cancelled due to the Award discontinuation. • PI, Robert Sherick and Electricore held individual meetings with SDSU, UCSD and UH Manoa to also discuss identified challenges and solutions. These meetings were held on August 20, August 21 and

Number	Description	Status	Progress Notes
			September 08, 2014. The meeting notes are provided in **Appendix C** of this response. o The outcome of these discussions was planned to be discussed in the Advisory Board meeting scheduled for October 3, 2014 which was cancelled due to the Award discontinuation.
1.14	Technical Advisors / High level technical support	Complete	The Advisory Board was convened with current members consisting of: • One member from each SWUSA-DTTC utility: o Southern California Edison's Ms. Leanne Swanson, Principal Manager of Distribution Engineering Technologies/Consulting o Southern California Edison's Mr. Robert Sherick, Power System Technologies/Consulting o Maui Electric Company's Mr. Matt McNeff o Maui Electric Company's Mr. Ray Okazaki o San Diego Gas & Electric, Mr. John Holmes o Pacific Gas & Electric; Mr. Kevin Dasso. The support from Mr. Dasso was received during this reporting period. • One member from CAISO, Mr. Peter Klauer – The support from Mr. Klauer was received during this reporting period. • Industry Members o Mr. Troy Strand, an Independent Consultant of SDG&E (from the largest solar installer in SDG&E territory) o Mr. Bryan Farrens, Eaton Corporation • Education leadership: o Dr. Oner Yurtseven; Retired Dean Emeritus of School of Engineering and Technology, IUPUI o Support has also been received by Cal Poly San Luis Obispo's Rakesh K. Goel, Associate Dean, Research, Graduate Programs, and Partnerships. • At the time of proposal (and the resulting SOPO that borrowed heavily from it), Electricore did not know that EPRI was responding as a Prime to the GEARED program. EPRI has provided a letter of support for our consortium, and we have every intention of including EPRI throughout the duration of our upcoming program activities. John Holmes with SDG&E also attended EPRI's team's kick-off meetings to engage and align perspectives. • As previously reported, Technology Advisory Board kick off meeting was convened on May

Number	Description	Status	Progress Notes
			16, 2014. The meeting minutes were provided in the previously submitted Quarterly Report. • The newly developed programs have been reviewed by several members of the Advisory Board in BP1, including SDG&E - John Holmes, MECO – Matt McNeff and Ray Okazaki and SCE – Robert Sherick. • With the support of Advisory Board Members from MECO, UHM worked towards development of a high-impact training program on Smart PV Inverters for distribution grid. During this quarter, UHM conducted the following activities with Advisory Board Members support in preparation: o Defined real-world data needed for curriculum and worked with Maui Electric Company (MECO) to obtain data. o Linked educational activities to research activities by bringing data, modeling, methodologies and outcomes into the classroom. • An Advisory Board meeting was rescheduled to October 3, 2014 to align with board members travelling schedules. This meeting was cancelled due to the Award cancellation.

2.3 What opportunities for training and development has the project provided?

During the first budget period, SDSU made an offer to hire SDG&E, Dr. Hassan Ghoudjehbaklou for three years beginning Spring Semester, January 2015. Dr. Hassan Ghoudjehbaklou was to teach a graduate course on power systems planning and reliability.

Having industry experts teach courses part time was the model that many universities follow, and students provided feedback that they find it valuable having industry teach advanced topics.

With the shutdown described in the executive summary, SDSU cancelled the course in Spring, discontinuing Dr. Hassan Ghoudjehbaklou's efforts and also postponed establishing the graduate specialization area in energy systems.

During the first budget period, ASU's Jicheng Yu, PhD student worked on the Virtual laboratory for Smart Distribution Grid. This program allows that utility technician practice on the use of smart meters and smart appliances using a computer without interfering with the actual operation of the system. This effort will be shut down by the cancellation of the SWUSA-DTTC consortium.

UHM offered a position to Dr. Sasidharan Sreedharan who joined UHM August 18th and will prepare and teach course modules. Dr. Sreedharan's position was cancelled due to the DOE cancellation of this award.

2.4 How have the results been disseminated to communities of interest?

Please see Milestone 1.8 above for further details.

3.0 PROJECT ACTIVITIES SUMMARY

Subtasks and Milestones in Budget Period 1 have all been substantially completed. Electricore demonstrates in the enclosed information that the team successfully met at least 20 out of 22 subtasks and milestones in Budget Period 1 equating to a *successful completion of 91%* of the criteria, exceeding the requirement to move into Budget Period 2.

TASK 1: PROGRAM PLANNING AND EVALUATION

- Subtask 1.1 Program Kick-Off: **COMPLETE**
- Subtask 1.2 Evaluation Plan: **COMPLETE**
- Subtask 1.3 Stand up Advisory Boards: **COMPLETE**
- Subtask 1.4 Formative and Summative Evaluations: **COMPLETE**

During the first budget period, Electricore and the project team focused on completion of the Task 1 Milestones described in Section 2 above. In addition, the following activities were completed:

- Finalized contract negotiations with project partners.
- The Electricore team participated in a Project Review Meeting with DoE and NNA on April 24th and May 29th, 2014.
- The SWUSA-DTTC held monthly meetings to discuss subcontract agreements, program evaluation and planning on April 17th, May 15th, June 19th, 2014 and July 17, 2014. The meeting minutes are included in Appendix I to this application.
- The following students attended and presented at the first annual Student Centered Conference in conjunction with the SEPA Utility Solar Conference in Newport Beach, CA on April 28-29, 2014.

Table 1: Student Centered Conference Posters

University	Professor	Student	Poster Title
UCSD	Jan Kleissl	Andu Dung Nguyen	Powering the Future with Solar Energy: Forecasting and Integration Strategies
ASU	Dr. George Karady	Jicheng Yu	Development of the Virtual Laboratory for Electric Machines and Power Electronics
SDSU	Dr. Sridhar Seshagiri	Ethan Block	Extremum Seeking for Wind and Solar Energy Applications
UHM	Reza Ghorbani	Ehsan Reihani	Voltage and Reactive Power Control in Distribution System

- The SWUSA-DTTC coordinated an additional fourteen (14) students from UCSD and SDSU to attend the Student Centered Conference with the donation from Pacific Gas & Electric.
- The Electricore team worked with our University partners to select students for the Student Innovation Board being directed by the NNA. The following students were selected:

Table 2: SWUSA-DTTC Student Innovation Board

School	Staff	Student	Notes
UCSD	Jan Kleissl	Andu Nguyen	UCSD is looking for an undergraduate student as a 2nd candidate
ASU	George Karady	Jicheng Yu	PhD student working on the Virtual laboratory for Smart Distribution Grid with renewables on-line course
ASU	George Karady	Meenakshi Saravanan	MS graduate student working on the Transmission System short course and on the Distribution system with Renewables short course
SDSU	Sridhar Seshagiri	Miranda Turner	power systems students
SDSU	Sridhar Seshagiri	Joe Saldana	power systems students
UH	Reza Ghorbani	Ehsan Reihani	PhD student working on the optimal power distribution with very high penetration of renewables.
UH	Reza Ghorbani	Alireza Eshragi	MS graduate student working on the transient response and control of PV inverter. Assisting in preparing slides for 10 hours short course on smart grid with high penetration of renewable energy.

- The SWUSA-DTTC advisory board was established and the first Advisory Board Meeting was held May 19, 2014. The advisory board consisted of the following members:
  - One member from each SWUSA-DTTC utility:
    - Southern California Edison's Ms. Leanne Swanson, Principal Manager of Distribution Engineering Technologies/Consulting
    - Southern California Edison's Mr. Robert Sherick, Power System Technologies/Consulting
    - Maui Electric Company's Mr. Matt McNeff
    - Maui Electric Company's Mr. Ray Okazaki

        - San Diego Gas & Electric, Mr. John Holmes
        - Pacific Gas & Electric, Mr. Kevin Dasso. The support from Mr. Dasso was received during this reporting period.
    - One member from CAISO, Mr. Peter Klauer – The support from Mr. Klauer was received during this reporting period.
    - Industry Members
        - Mr. Troy Strand, an Independent Consultant of SDG&E (from the largest solar installer in SDG&E territory)
        - Mr. Bryan Farrens, Eaton Corporation
    - Education leadership:
        - Dr. Oner Yurtseven, Retired Dean Emeritus of School of Engineering and Technology, IUPUI
        - Support has also been received by Cal Poly San Luis Obispo's Rakesh K. Goel, Associate Dean, Research, Graduate Programs, and Partnerships.
- During the first budget period, San Diego Gas & Electric (SDG&E) withdrew from the Principle Investigator (PI) role on this program due to issues which have dramatically changed their organization's research and development budgets. SDG&E's leadership on this important program and good faith efforts per the past year have been critical to the success of the development and launching the program. SDG&E was committed to remain on the Technical Advisory Committee to ensure program continuity and a seamless transition as the Team adjusted to the replacement Principal Investigator (PI).
- During the Sunshot Program Review in Anaheim, Electricore and SDG&E participated in a meeting with DOE Program Directors to discuss potential alternatives for technical leadership, budget and scope of work. Building on a shared vision, Southern California Edison's (SCE) Mr. Robert Sherick has agreed to assume the PI role along with the associated scope of work, budget and cost share commitment. Electricore presented DOE with a request for contract modification to replace SDG&E's John Holmes with SCE, Robert Sherick as the PI along with the requested contractual documentation; this request was approved by DOE. All schedule, scope of work and budget items are expected to remain unchanged. The SWUSA-DTTC program is currently on schedule with the university partners actively engaged in their tasks. The program is on budget and has exceeded the cost share percentages required to date. No changes to schedule, budget or scope are expected except for the assignment of SDG&E tasks to SCE.

3.1 UNIVERSITY SUMMARY

SWUSA-DTTC University Partners focused effort on the following activities during the first budget period:

University California, San Diego

- UCSD held internal meetings to discuss the courses and curriculum provided in the statement of work.
    - Curricula for short courses, advanced training courses, and upgrades of existing courses were compiled this budget period.
- UCSD assigned coursework and faculty participation for each course
    - On account of their physical proximity, and with the idea of not duplicating efforts, UCSD and SDSU will plan on course sharing. This will be done at the level of the Dept. Chairs/Deans through the Open University Enrollment mechanism that both universities allow.
- USCD finished modifying courses to incorporate Power Systems Engineering, including MAE255 Solar Energy Meteorology, MAE256 Radiation for Energy Applications, MAE280A, EE180 Power Electronics II, and EE188 Introduction to Power Electronics.
    - CSE "Introduction to Embedded Systems" and CSE291 Smart Grid should be complete by the beginning of the fall semester.
- UCSD was working to develop two to eight hour short courses. The topics include: solar energy forecasting & solar energy performance monitoring and modeling, advanced applications of interfacing renewables to power system, and power system simulation. These are expected to be complete by the end of July 2014.
- The group developed advanced training courses, including power system engineering and system planning & operation. Both these courses were scheduled to be complete by the beginning of the fall 2014 semester.
- Teaching was scheduled to begin this fall 2014 and continue through the end of the program.
- UCSD offered to hold courses for large meetings in San Diego in 2015-2018.
- The group was open to obtaining training needs from human resources divisions of industry affiliates.
- Developed new 2 to 8 hour short courses in the following areas:
    - Solar energy forecasting & solar energy performance monitoring and modeling
    - Advanced applications of interfacing renewables to power system
    - Power system simulation: fundamentals and applications
- Started development of Advanced Training Courses and coordinated content with SDSU in Advanced Training Courses to fill niches. These courses could be added to a Master of Advanced Studies.
    - UCSD conducting outreach to recruit non UCSD students as well.
    - Courses include:
        - Solar Grid Integration course: broad focus on solar forecasting and power electronics. Utility professionals are encouraged to take these courses through the UC extension
        - Power System Engineering: combination of power electronics and power engineering
        - System Planning and Operation
        - Combine advanced training and short courses into jointly taught, 4 unit 'Advanced Topics' MAE207 in Advanced Power Systems Technology

- UCSD was working towards modifying and extending the course offering at UCSD to incorporate Power Systems Engineering. These courses could become the core of a Master of Advanced Studies in Renewable Energy and Power Systems. Courses include:
    - MAE255 Solar Energy Meteorology
    - MAE256 Radiation for Energy Applications
    - MAE280A: Added content on microgrid data integration, synchrophasors
    - EE180 Power Electronics II
    - EE188 Introduction to Power Electronics
    - CSE "Introduction to Embedded Systems" (4 units) will cover the basics of power systems. It will also discuss details of embedded sensors/actuators needed to manage SmartGrid interfaces
    - CSE291 Smart Grid (1 unit): Introduction to Smart Grid; Basics of Power Systems; Smart Grid Communication, Measurement, and Control; Renewable Energy & Energy Storage; System Reliability & Ancillary Services; Microgrids;
    - Power systems lab in coordination with SDG&E

Arizona State University

- ASU's major task was the development of a virtual laboratory on Smart Grid components. ASU, in the last semester, developed a virtual laboratory for the EEE 360 Energy Systems and Power Electronics (4) course.
- Based on this experience, ASU started the development of a virtual laboratory which permits the WEB based testing of Domestic Smart Meters of the student without attending actual laboratory.
    - ASU determined all function of the meter and started computer simulation of the meter operation. This will be followed by the development of the WEB based testing procedure and the student note to perform the testing.
    - This procedure will be repeated for each of the smart grid components.
    - The virtual laboratory development is a lengthy procedure, which requires significant amount of graduate student work.
    - The existing virtual laboratory programming method has been updated for the latest version of MATLAB.
    - The virtual laboratory requires smart equipment, which must be provided by participating utilities. ASU is currently working with regional utilities to rent applicable equipment.
- ASU started the development of undergraduate Power engineering on-line education. This effort developed a procedure which significantly improves on- line courses efficiency. Dr Karady is presently working on the development the online version of EEE360.
    - Based on this experience we can apply this technique for the courses selected for this project.
- ASU hired Meenakshi Saravanan, an MS student. Ms. Saravanan began upgrading existing draft lectures for the short courses "Smart Transmission System" and "Smart Distribution Grid with Renewables." These short courses will each cover ten hours of lecture time with 450-500 slides.
- Jicheng Yu, a PhD student, developed two short courses concerning distribution systems with renewable energy. Each was to span 150-200 slides.
- ASU found that audio for short courses must be recorded in a studio, for which no funding has been allocated.

- Jiazi Zhang, an MS student, developed open-source software for modeling energy management system functionalities. This was planned to be used to evaluate computational units such as state estimation, security constrained economic dispatch, and topology processors. It will also be used to evaluate the effects of cyber-attacks and test new algorithms & their effects on system behavior.
    - Mr. Zhang was testing a time-progressive computational model including DC and/or AC state estimation and optimal power flow and was also developing a topology processing unit.
- Developed EEE598: Cyber-security and privacy in the Smart Grid. This was a graduate course concerning computational components of energy management systems. It was previously taught in Spring 2014 using slides and lectures. An online version will be introduced after the next course offering in Spring 2015, which will have an expected class size of 40.
- ASU developed the virtual laboratory for Smart Grid Components
    - The existing virtual laboratory for EEE 360 Energy Systems and Power Electronics (4) course has been updated and transferred to the latest edition of MATLAB.
    - PhD Student Jicheng Yu (jichengy@asu.edu) has continued efforts on this project.
- ASU continued the development of two required short courses.
    - Continued development of the Smart Transmission System
    - Continued development of the Distribution Grid with Renewables.
        - Ms. Meenakshi Saravanan reviewed the literature and produced about 50 slides for this short course.
        - MS Student Meenakshi Saravanan (msaravan@asu.edu) works on this project
    - The enrollment of EEE 360 Energy System and Power Electronics in the next semester string in August is 64 students
    - The enrollment of EEE 571 Power System Transients in the next semester string in August is 51 on-campus students and 15 online students

San Diego State University

- The energy systems group presented their plans for new course offerings to the faculty at large in the department.
- Based on faculty inputs, and what is standard procedure in the department, new courses and labs will have to be offered on an experimental basis before becoming regular course offerings.
- The university discussed offering a new class for undergraduate and graduate students in the fall called "Energy Systems" as a special topic. With enough participation over the next three years, it will become a full class.
- SDSU also created a new lab called "Power Simulations."
- SDSU finalized development of a new undergraduate/graduate course as a special topics course in Renewable Energy Systems and the Smart Grid. This course is currently being offered in Fall 2014.
- SDSU continued efforts working towards developing a new power simulations lab, to be offered for the first time in Spring 2015 or Fall 2015 (latest). The lab and any new courses can be taught "virtually", as online courses.

University Hawaii at Manoa

- UHM held discussions to develop additional courses in collaboration with the SWUSA-DTTC utilities.
- UHM held discussions regarding possibility of renewable energy crossing into college of engineering and developing ideas for increased student involvement.
- UHM planned on holding a short course on the Smart Grid, which it will revise after the summer and offer as an online course.
- UHM is working with the College of Engineering to facilitate the preparation of media modules for short courses.
- Permission from copyright owners needs to be obtained before posting course material online.
- Dr. Ghorbani continued preparation of a 10-hour graduate level course concerning power conversion for photovoltaic and wind energy. This work is being coordination with Dr. Seshagiri at SDSU.
- Dr. Ghorbani also continued preparation with Myway Plus Inc. to organize a 3-day workshop being held in 2014 on embedded control of inverters for PV, Wind, and EV for utilities.
    - There are 30-50 participants from utilities and universities from the United States and Japan that are expected to attend.
    - The registration brochure distributed regionally is attached in **Appendix F** below.
- UHM offered a position to Dr. Sasidharan Sreedharan who joined UHM August 18th and will prepare and teach course modules. Dr. Sreedharan's position was cancelled due to the discontinuation of this award.
- UHM worked towards development of a high-impact training program on Smart PV Inverters for distribution grid, with creation of new research activity and attendant PhD program that focuses on model-based control of smart grid with high penetration of PV. During this quarter, UHM conducted the following activities in preparation:
    - Defined real-world data needed for curriculum and worked with Maui Electric Company (MECO) to obtain data.
    - Linked educational activities to research activities by bringing data, modeling, methodologies and outcomes into the classroom.
    - Developed "laboratory"/hands-on activities related to lecture materials
- UHM worked towards development and implementation of new short courses in the following areas 1) Power System Distribution, 2) Smart Grid: Smart power grid operation and control, 3) Power delivery management for communities, 4) Solar Power Systems.
    - The current plan for the Smart Grid course involves the steps listed below. As of the current Fall Semester, we are at Step 3 below. Based on the experience with this first course, the plan will be modified as appropriate for the three subsequent courses.
        1. Create curriculum outline.
        2. Work with current/former utility experts (e.g. at HNEI) to identify real-world experiences & information that might be integrated into course material.
        3. Initially for university classes at UHM, sequentially develop materials over the course of a semester**, Appendix K**.
        4. Receive course feedback from Advisory Board and make improvements

5. Modify course material into a focused multi-day workshop for participants from utilities and universities. Relative to the online short courses (see next item below), the emphasis will be on more advanced content. Therefore, once the online short courses are developed, students attending subsequent workshops will be asked – as a prerequisite before attending the workshop – to complete the introductory online module. The in-person workshop will also emphasize "laboratory"/hands-on activities. Roughly, the workshop is envisioned to be a total of 7 hours of lecture and 7 hours of lab/hands-on activities.
6. UHM modified course material into an online short course for utility personnel consisting of five 1-hour introductory lectures and five 1-hour advanced lectures.

4.0 FINAL PRODUCTS

4.1 What has the project produced?

The SWUSA-DTTC participated in the first student centered conference in Newport Beach, CA April 28-29, 2014. Electricore issued a press release with additional details shown in **Appendix L.**

Electricore presented Budget Period 1 Consortia Organization Activities to the NNA and other GEARED awardees on August 28, 2014. DOE was invited by NNA to Electricore's update. The meeting notes of Electricore's update were submitted to the NNA on August 28, 2014. A copy is provided below in **Appendix E** of this response.

The SWUSA-DTTC participated in the required DOE SunShot Summit-Peer Review on May 20-22, 2014. Electricore and SDG&E prepared a poster for the Poster Session and presented our project activities, results and path forward to the review panel selected by the DOE. Results of this Peer Review have not been distributed to Electricore nor any comments received.

- On May 20, 2014 Electricore (Deborah Jelen and Kodie Arnold) and SDG&E (John Holmes) met with DOE members (Rose Marie Holsing, Christina Nichols and Fania Gordon) in Anaheim, CA for an internal program review.
- Follow up to action items from this meeting were captured in the email dated May 20, 2014 from Deborah Jelen to DOE.

During Budget Period 1 there were no major DOE events which warranted major media outreach. If BP2 and BP3 proceed, University accomplishments and planned DOE conferences will allow for greater media exposure and the budget to create this exposure will be expended.

Although Budget Period 1 outreach was not picked up through major broadcast networks, our consortium did conduct outreach through other forms of communication and public media. During this reporting period, the following activities were conducted:

- Creation and dissemination of a SWUSA-DTTC Program Summary brief to interested parties while attending multiple California Energy Commission (CEC) workshops and meetings related to the upcoming EPIC 2012-2014 Triennial Investment Plan. During these workshops and meetings, Electricore promoted the SWUSA-DTTC efforts with CEC workshop attendees, CEC Program Managers and the Supervisor for Renewable Energy R&D, Erik Stokes. The Program Summary Brief is below in **Appendix G.**
- PI, Robert Sherick held discussions with UC Riverside and UC Irvine on forecasting demanding response and solar adoption and promoting the SWUSA-DTTC consortium activities and distributing the SWUSA-DTTC Program Summary brief.
- On August 28th, during the briefing to the NNA and GEARED network, Electricore announced that the University of Hawaii was organizing a 2 day Training Workshop in December 2014 titled "Smart Grid & Renewable Integration in Modern Power Systems". UH conducted regional outreach to receive a large attendance to this training workshop.

The brochure was distributed regionally and is attached in **Appendix F** below and also will be reported in the Quarterly Report for July-September.

- Electricore launched the SWUSA-DTTC site in conjunction with our Electricore website. The link is http://www.electricore.org/swusa_dttc; this was reported in the Quarterly Reports and Continuation Application and also distributed to the NNA.
- An update of development materials is included in the Evaluation Plan Matrix, **Appendix A.**

5.0 PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS

The following individuals were major contributors to this Budget Period 1 effort:

- Principal Investigator: Mr. Robert Sherick, Southern California Edison
- Program Director: Deborah Jelen, Executive Director, Electricore, Inc.
- Program Manager: Kodie Arnold, Electricore, Inc.
- Program Associate: Brandon Yauch, Electricore, Inc.
- Power System Chair Professor: Dr. George Karady, Arizona State University
- Associate Professor: Dr. Lalitha Sankar, Arizona State University
- Program Director: William Torre, UC-San Diego
- Associate Professor: Jan Kleissl, UC-San Diego
- Associate Professor: Dr. Sridhar Seshagiri, San Diego State University
- Assistant Professor: Reza Ghorbani, University of Hawai'i at Mānoa
- Senior RESG Program Manager: Edwin Noma, Hawai'i Natural Energy Institute, University of Hawai'i at Mānoa
- Director Customer Innovation & Academia, John Matranga, OSI Soft
- Mr. Matt McNeff, Maui Electric Company
- Mr. Ray Okazaki, Maui Electric Company

5.1 What other organizations have been involved as partners?

Organization Name	**Southern California Edison**
Location of Organization	Westminster, CA
Partner's contribution to the project (identify one or more)	Principal Investigator Technical Advisory
Financial support	DOE Funds: $89,435
In-kind support (e.g., partner makes software, computers, equipment, etc., available to project staff)	Cost Share: 255,631
Facilities (e.g., project staff use the partner's facilities for project activities);	SCE is equipped with a set of laboratories at its Westminster facility that includes a large Real-Time Digital Simulator (RTDS), extensive inverter testing facility, substation and distribution automation test labs, and home area network lab to test communication and control systems behind-the-meter. SCE also has a separate facility in Pomona to test storage devices and electric transportation technologies. These facilities support SCE's ongoing work to thoroughly understand emerging technologies and effectively build the grid of the future. The labs have been instrumental in deploying technologies like IEC-61850 for substation controls, smart circuit switches for the ISGD feeder protection system, and testing smart inverters to identify the characteristics and benefits of these devices as they are interconnected to the grid.
More detail on partner and contribution (foreign or domestic)	

Organization Name	Maui Electric Company (MECO)
Location of Organization	Maui, HI
Partner's contribution to the project (identify one or more)	Technical Advisory
Financial support	DOE Funds: $50,000
In-kind support (e.g., partner makes software, computers, equipment, etc., available to project staff)	Cost Share: $0
Facilities (e.g., project staff use the partner's facilities for project activities);	Provide input and feedback on the engineering curriculum to be developed by UH to better prepare graduating engineers to contribute to utility needs. Participate in an annual Advisory Steering Committee meeting of the consortium partners which includes the universities and utilities somewhere in the mainland (California most likely). Participate in the SWUSA-DTTC Technical Advisory Committee Meetings via teleconference. Provide power system data to the Partner Universities to incorporate into their curriculum development. The intent is provide agnosticized data as it will not be directly tied to any uniquely identified grid asset so to preserve information security.
More detail on partner and contribution (foreign or domestic)	NA

Organization Name	OSI Soft
Location of Organization	San Leandro, CA
Partner's contribution to the project (identify one or more)	Provide software under license, installation services, training and expertise in support of all phases.
Financial support	DOE Funds: $0
In-kind support (e.g., partner makes software, computers, equipment, etc., available to project staff)	Cost Share: $943,800
Facilities (e.g., project staff use the partner's facilities for project activities);	Provide software under license, installation services, training and expertise in support of all phases. Provide software updates and support services for duration of the program.
More detail on partner and contribution (foreign or domestic)	NA

Organization Name	Arizona State University
Location of Organization	Phoenix, AZ

Partner's contribution to the project (identify one or more)	Currently ASU is participating in the NSF sponsored FREEDM project that develops an electronically supported distribution grid, and also the NSF sponsored RESIN project which investigates interaction of the distributed generation supported distribution grid and the local gas and water supply.
Financial support	DOE Funds: $450,001
In-kind support (e.g., partner makes software, computers, equipment, etc., available to project staff)	Cost Share: $125,026
Facilities (e.g., project staff use the partner's facilities for project activities);	In-house and online Web presentations via Virtual Laboratory which permits online students to perform laboratory experiments on the smart grid.
More detail on partner and contribution (foreign or domestic)	ASU will supply 1-2 students to participate in the Student Innovation Board.

Organization Name	**San Diego State University**
Location of Organization	San Diego, CA
Partner's contribution to the project (identify one or more)	SDSU is developing a short course program, offered on campus (in a classroom environment) to anyone in the power systems industry. SDSU will also leverage their partnership in CUSP to offer the online version of the short course on the CUSP website (http://cusp.umn.edu/).
Financial support	DOE Funds: $374,049
In-kind support (e.g., partner makes software, computers, equipment, etc., available to project staff)	Cost Share: $0
Facilities (e.g., project staff use the partner's facilities for project activities);	SDSU classroom
Collaborative research (e.g., partner's staff work with project staff on the project)	CUSP
More detail on partner and contribution (foreign or domestic)	SDSU will supply 1-2 students to participate in the Student Innovation Board.

Organization Name	**University of California, San Diego**
Location of Organization	San Diego, CA
Partner's contribution to the project (identify one or more)	UCSD is developing new 2 to 8 hour short courses on solar energy forecasting, solar energy performance monitoring and modeling, renewable energy integration, and power system simulation. UCSD is modifying and extending the course offering to incorporate Power Systems Engineering: This task will uniquely leverage the availability and accessibility of real-time data

	from UC San Diego's highly instrumented 42 MW microgrid.
Financial support	DOE Funds: $460,000
In-kind support (e.g., partner makes software, computers, equipment, etc., available to project staff)	Cost Share: $100,000
Facilities (e.g., project staff use the partner's facilities for project activities);	UC San Diego's highly instrumented 42 MW microgrid
More detail on partner and contribution (foreign or domestic)	UCSD will supply 1-2 students to participate in the Student Innovation Board.

Organization Name	**University of Hawaii, Manoa**
Location of Organization	Honolulu, HI
Partner's contribution to the project (identify one or more)	Develop High Impact Training program on Smart PV Inverters for distribution grid with creation of new research activity and attendant PhD program that focuses on model based control of smart grid with high penetration of PV; program contains 30 - 60 students Develop the following new 10 hours short courses. 1) Power system distribution; 2) Smart grid; 3) Power delivery management for communities; 4) Solar Power Systems
Financial support	DOE Funds: $409,340
In-kind support (e.g., partner makes software, computers, equipment, etc., available to project staff)	Cost Share: $104,250
Facilities (e.g., project staff use the partner's facilities for project activities);	UH Classroom
Collaborative research (e.g., partner's staff work with project staff on the project)	Hawaii natural energy institute
More detail on partner and contribution (foreign or domestic)	UH will supply 1 student to participate in the Student Innovation Board.

Organization Name	**Lawrence Berkley National Lab**
Location of Organization	Berkley, CA
Partner's contribution to the project (identify one or more)	Technical Advisor
Financial support	DOE Funds: $0
In-kind support (e.g., partner makes software, computers, equipment, etc., available to project staff)	Cost Share: $0
Facilities (e.g., project staff use the partner's facilities for project activities);	

Collaborative research (e.g., partner's staff work with project staff on the project)	
More detail on partner and contribution (foreign or domestic)	

5.2 Have other collaborators or contacts been involved?

Electricore's Technical Advisory Board consists of the following contributors during this reporting period:

Organization	Point of Contact	Affiliation
Independent Consultant to SDGE	Troy Strand	Largest solar installer in SDGE territory.
Southern California Edison	Leanne Swanson Robert Sherick	Utility Principal Manager of Distribution Engineering
SDGE	John Holmes	Utility
MECO	Matt McNeff Okazaki, Ray	Utility
Electricore BOD	Oner Yurtseven	IUPUI Dean Retired
PG&E	Kevin Dasso	Utility
CAISO	Peter Klauer	Oversight
Eaton Corporation	Bryan Farrens	Industry Oversight
Cal Poly San Luis Obispo	Rakesh Goel	Associate Dean, Research, Graduate Programs and Partnerships

6.0 IMPACT

6.1 What is the impact of the project? How has it contributed?

This award was discontinued on September 30, 2014. Electricore issued stop work orders on September 30, 2014 to all SWUSA-DTTC partners.

6.2 What is the impact on the development of the principal discipline(s) of the project?

Please see the Evaluation Plan matrix shown in **Appendix A** for an update on course development and number of students reached.

6.3 What is the impact on the development of human resources?

The impact of this discontinuation of the SWUSA-DTTC is severe to the Southwest and Hawaii region.

ASU developed during the first year two short courses, which are available for the SWUSA-DTTC utilities. ASU is not able to present these short courses without GEARED funding. The short course development has been an effort which was devoted to this GEARAD project. The cancellation of the SWUSA-DTTC funding will delay the graduation of one MS student working on the project.

ASU's Jicheng Yu, PhD student is working on the Virtual laboratory for Smart Distribution Grid. He already updated the existing Virtual laboratory programming method using the latest edition of the MATLAB program. This program allows that utility technician practice on the use of smart meters and smart appliances using a computer without interfering with the actual operation of the system. This effort will be completely shut down by the cancellation of the SWUSA-DTTC consortium.

The shutdown of the project is a significant financial loss for ASU participating professors, Dr. Karady and Dr. Sankar. They will both lose one month summer salaries.

SDSU leveraged the award as an "incentive" to strengthen our undergraduate program in power, but more importantly to *start* a new graduate emphasis program in "energy systems". The graduate program is of immense importance to the Southern California region. No university in this region offers a graduate program in power, and as a result, utilities and other companies have to recruit graduates from Northern California (Berkeley) or Arizona. There was very much enthusiasm about growing this program both at SDSU and UCSD. SDGE's "Young Engineers Society" was very interested in such a program and requested a Q/A session to discuss the specialization in power which will be cancelled.

SDSU's Dr. Seshigiri is currently teaching a new course (Renewable Energy Systems and the Smart Grid) this semester directly related to this GEARED award which will no longer be offered.

SDSU made an offer to hire an expert from SDGE in Spring 2015 using GEARED grant funds to teach a graduate course on power systems planning and reliability; this will be cancelled. Having industry experts teach courses part time is a model that many universities follow, and students provided feedback that they believe it is valuable to have industry teach advanced

topics. With this shutdown, SDSU will a) have to cancel the course in Spring, and b) postpone establishing the graduate specialization area in energy systems.

UHM's Dr. Ghorbani prepared a 10-hour graduate level course concerning power conversion for photovoltaic and wind energy; this work will be cancelled. Dr. Ghorbani canceled a 3-day workshop being held in 2014 on embedded control of inverters for PV, Wind, and EV for utilities. There are 30-50 participants from utilities and universities from the United States and Japan that were expected to attend.

UHM offered a position to Dr. Sasidharan Sreedharan who joined UHM August 18th and will prepare and teach course modules. Dr. Sreedharan's position was cancelled due to the discontinuation of this award.

ASU developed two short courses during Budget Period 1 which are available for the SWUSA-DTTC utilities. ASU is not able to present these short courses without GEARED funding. The short course development has been an effort which was devoted to this GEARED project. The discontinuation of the SWUSA-DTTC funding will also delay the graduation of one MS student working on the project.

The UCSD team has registered for a course to be taught by the lead faculty from January – March 2015. This course will be canceled. Course materials that have been and are being developed for the short course will most likely never be used as a result of this shutdown.

UCSD is in negotiations with conference organizers to add workshops and tutorials to power engineering conferences in Southern California. These negotiations will be terminated.

The momentum is building for a MS program in power engineering to be opened at UC San Diego, but this effort would stall without the DOE funding as well.

6.4 What is the impact on physical, institutional, and information resources that form infrastructure?

- Please see the deliverable matrix shown in **Appendix A** for an update on course development and number of students reached.
- ASU developed the Virtual Laboratory for Smart Distribution Grid. It has been transferred to the latest edition of MATLAB.
- USCD is providing development of a power systems lab with the Integrated Test Facility.
- SCE is equipped with a set of laboratories at its Westminster, CA facility that includes a large Real-Time Digital Simulator (RTDS), extensive inverter testing facility, substation and distribution automation test labs, and home area network lab to test communication and control systems behind-the-meter. SCE also has a separate facility in Pomona, CA to test storage devices and electric transportation technologies. These facilities support SCE's ongoing work to thoroughly understand emerging technologies and effectively build the grid of the future. The labs have been instrumental in deploying technologies like IEC-61850 for substation controls, smart circuit switches for the ISGD feeder protection system, and testing smart inverters to identify the characteristics and benefits of these devices as they are interconnected to the grid.

6.5 What is the impact on technology transfer?

Please see Section 2.4 above.

6.6 What dollar amount of the award's budget is being spent in foreign country(ies)?

0% of the award's budget is being spent in foreign country(ies).

7.0 CHANGES/PROBLEMS

This award was discontinued on September 30, 2014. Electricore issued stop work orders on September 30, 2014 to all SWUSA-DTTC partners.

DOE's notice of discontinuation was the first indication provided to Electricore that the work completed against Task 1 - Program Planning and Evaluation during Budget Period 1 was inadequate. Significantly, the discontinuation was based in large part on the erroneous assertion that many of the tasks were incomplete as indicated in the Continuation Application. However, the Continuation Application was submitted July 29, 2014, while the period of performance for this last quarter in Budget Period 1 did not end until September 30, 2014. Accordingly, the performance for this last quarter in Budget Period 1 is being reported in this Quarterly Report which is not due until October 30, 2014. Nevertheless, in response to DOE's letter and in further support of Electricore's Continuation Application, we provided a detailed status demonstrating adherence to all program requirements for each Task 1, Budget Period 1 SOPO activity and milestones in response to the DOE review on October 22, 2014.

Subtasks and Milestones in Budget Period 1 have all been substantially completed. In accordance with the SWUSA-DTTC SOPO, at the end of each Budget Period, DOE will decide whether or not to proceed into the next Budget Period based on the "*successful completion of 85%"* of the Subtasks and Milestones in the previous Budget Period. Electricore demonstrates in the enclosed information that the team successfully met at least 20 out of 22 subtasks and milestones in Budget Period 1 equating to a *successful completion of 91%* of the criteria, exceeding the requirement to move into Budget Period 2.

The SWUSA-DTTC Program is critical to increase U.S. capacity to integrate high penetrations of solar and other distributed technologies. Utilities (Southern California Edison, San Diego Gas & Electric, Maui Electric and Pacific Gas & Electric), and California ISO encountering the highest distributed technologies in the country and the problems associated with their integration have committed support and manpower to drive curricula at key Certified Engineering Universities (University of California San Diego, San Diego State, Arizona State University and University of Hawaii) with the assistance of Lawrence Berkeley National Labs. The resulting changes will improve power system capabilities, promote electric grid security, and create a talent pool of trained specialists through the curricula taught at these key universities and a growing list of others that are interested. This highly qualified team is under contract and actively working toward ground-breaking results.

The work accomplished during Budget Period 1 has already resulted in new course offerings, new degree emphasis and new laboratory investigations. The momentum from these important curricula changes is creating interest in growing the consortium with several universities (Caltech and California Polytechnic University San Luis Obispo and Pomona campuses among others) seeking the opportunity to join. An upcoming California Energy Commission program may offer the occasion to fund expansion to the team and further the goal of SWUSA-DTTC self-sufficiency.

Should DOE continue with the planned cancellation of the SWUSA-DTTC program, courses at three universities will cease to be offered in engineering disciplines, key professors will lose funding for planned research, contracted expert lecturers contracts will be cancelled, several graduate students will lose their thesis funding, placing their graduation in jeopardy and one of the most powerful teams to be assembled in this arena will be prevented from implementing

changes that are desperately needed to address the quickly evolving landscape of the utility grid.

7.1 Changes in approach and reasons for change

San Diego Gas & Electric (SDG&E) withdrew from the Principal Investigator (PI) role on this program due to issues which have dramatically changed their organization's research and development budgets. SDG&E's leadership on this important program and good faith efforts per the past year have been critical to the success of the development and launching the program. Going forward, SDG&E will remain on the Technical Advisory Committee to ensure program continuity and a seamless transition as the Team adjusts to our replacement Principal Investigator (PI).

Building on a shared vision, Southern California Edison's (SCE) Mr. Robert Sherick agreed to assume the PI role along with the associated scope of work, budget and cost share commitment. Electricore presented DOE with a formal request for contract modification on June 3, 2014 to replace SDG&E's John Holmes with SCE, Robert Sherick as the PI along with the requested contractual documentation; this request was approved by DOE on August 26, 2014.

7.2 Actual or anticipated problems or delays and actions or plans to resolve them

This award was discontinued on September 30, 2014. Electricore issued stop work orders on September 30, 2014 to all SWUSA-DTTC partners.

7.3 Changes that have a significant impact on expenditures

This award was discontinued on September 30, 2014. Electricore issued stop work orders on September 30, 2014 to all SWUSA-DTTC partners.

7.4 Significant changes in use or care of human subjects, vertebrate animals, and/or Biohazards

Not applicable; nothing to report.

7.5 Change of primary performance site location from that originally proposed

SCE, Robert Sherick is the new PI on this program. SCE is equipped with a set of laboratories at its Westminster, CA facility that includes a large Real-Time Digital Simulator (RTDS), extensive inverter testing facility, substation and distribution automation test labs, and home area network lab to test communication and control systems behind-the-meter. SCE also has a separate facility in Pomona, CA to test storage devices and electric transportation technologies. These facilities support SCE's ongoing work to thoroughly understand emerging technologies and effectively build the grid of the future. The labs have been instrumental in deploying technologies like IEC-61850 for substation controls, smart circuit switches for the ISGD feeder protection system, and testing smart inverters to identify the characteristics and benefits of these devices as they are interconnected to the grid.

8.0 SPECIAL REPORTING REQUIREMENTS

Nothing to report.

APPENDIX A: DELIVERABLE AND EVALUATION PLAN MATRIX

Legend:

Internship
Curriculum
Short Course
Laboratory
Technical Advisory

Partner	Deliverable	Outreach Plan	Est. Number Reached	Notes/Update Status
ARIZONA STATE UNIVERSITY	Leverage existing Electrical Power & Energy teaching program, degree in EPES. Deals with "Smart Grids" & "Distribution Systems with Renewables"	The program offers eight (8) undergraduate, sixteen (16) graduate power courses	More then 250 Students	ASU started the development of the Virtual laboratory for Smart Distribution Grid. June 2014 the Virtual Laboratory program will be transferred to the latest edition of MATHLAB
	Series of 5 short courses to utility professionals audience (BS engineering level)	3 sections of 10 online, one-hour long lectures	50 participants per course = 250 participants	ASU started the development of the short course: "Smart Transmission and Smart Distribution Grid with renewables. This month literature was collected and 50 new slides were produced
	Series of 5 short courses to utility technicians and foremen	3 sections of 10 online, one-hour long lectures	50 participants per course = 250 participants	
	Short courses for the general public describing smart distribution grid and its benefits	5 one-hour long lectures	50 participants per lecture = 250 participants	
SAN DIEGO STATE UNIVERSITY	Leverage the newly developed Graduate Emphasis Program in Energy Systems. Specifically EE681 - Power Systems Reliability and Planning and EE682 - Power System Operation and Control. These 2 classes will have inputs and faculty from SDG&E.	Masters Degree Program	5 courses, 15-20 Students per class = around 100 students (These 2 courses are specifically being offered in response to requests from SDG&E, whose employees have shown interest in enrolling in a Masters Degree program)	Met with Dr. Hassan Ghoudjehbaklou from SDG&E to discuss teaching the course. If things go as planned, will use funds for faculty from the award to have Dr. Ghoudjehbaklou partially replace Dr. Betancourt's involvement.
	Leverage the new Undergraduate Emphasis Program in Energy Systems. Specifically newly developed course EE586 - Renewables Energy Systems and Smart Grid. Dr. Seshagiri is teaching.	Undergraduate Degree Program	25 -40 students per class (Many students from EE581 (Power System Dynamics) and this class will end up working at SDGE.)	EE586 is being offered for the first time in Fall 2014 as a Special Topics course. Sridhar will send a syllabus shortly.
	Develop a short course program by condensing the material from EE586 into a 2-4 day course	Short Course offered on campus to anyone in the Power Systems Industry - Class room environment	25 people each time the course is offered. Tentatively to be offered in summer and length TBD.	Short courses require discussion with the College of Extended Studies. Will discuss with the Chair/Dean on how to do this. This can only be done once EE586is formally offered in Fall 2014, so we have a clear picture of the syllabus/assignments/projects etc.
	Develop a new simulation lab on all aspects of power system dynamics, including network	Undergraduate Degree Program,	15-20 students each Spring.	Current plan is to offer the new lab in Spring 2015, pending Dept approval.

	performance in both steady-state and dynamic conditions, power flow, optimal power flow, and fault analysis and protection, using industry-standard software.	offered along with EE581.		
UNIVERSITY CALIFORNIA, SAN DIEGO	Incorporate existing data from UCSD microgrid and collaborating utilities to current Graduate and Undergraduate class	New research activity and attendant PhD program, "Renewable Resources and Integration", will be initiated	30 - 60 students	UCSD Microgrid data was or is being included into two undergraduate and six graduate courses. 100 students were reached.
	Develop protocol for sharing data in curriculum while preserving utility IP	MOUs in place with SDGE, in process of developing NDAs with CEC, PGE, SCE	N/A	NDAs with SDG&E, SCE, CEC executed.
	Offer new courses: system design / power system analysis methods for solving network flow problems.	Short courses where professional credit is offered through UC San Diego Extension	Twice per year, 10 - 20 students per course.	Two advanced training courses are being developed and are scheduled to be taught first in winter 2015.
	Expand power systems engineering and renewable generations scholarships and internships.	Students apply through UCSD website via UCSD Team Internship Program	10 teams of 4 students = 40 students	92 internships were offered in summer 2014 including one at PG&E
	Five new GEARED related short courses.	Newly developed 2 to 8 hour courses in advanced power systems technology under Advanced Topics option. Open to students, professionals, and the public.	Up to 50 people per course.	Three short courses are under development. Local conferences where courses could be taught in 2015 have been identified.
UNIVERSITY OF HAWAII, MANOA	Series of 4 short courses for utility professionals audience from the Inverter Mgmt. Control Software	Each course will contain 10 online one-hour lectures	50 participants per course = 200 participants	1. UHM offered postdoctoral position to Dr. Sasidharan Sreedharan and he accepted the position. We expect Dr. Sreedharan to join the group in August 18. He will work to teach and prepare the course modules. 2. Dr. Ghorbani is working to prepare slides for 10 hour graduate level course on power conversion for PV and Wind. Hi is coordinating with Dr. Seshagiri. 3. Dr. Ghorbani is working with a Japanese company (Myway Plus Inc.) on organizing a 3 day workshop in Nov or Dec 2014 on embedded control of inverters for PV, Wind and

				EV. We expect to have 30-50 participants from utilities and universities in USA and Japan. We are working on the outline of the course.
	Coordinate deployment of the Smart Grid-enabled inverters on Maui with MECO and HECO	Leverage UH - HNEI (Hawaii Natural Energy Institute) consortium	N/A	
	High Impact Training program on Smart PV Inverters for distribution grid	Create new research activity and attendant PhD program focuses on model based control of smart grid with high penetration of PV	30 - 60 students	

Appendix B: Draft Technology to Market Plan

Grid Engineering Advancing Renewable Energy Development (GEARED)
Southwest USA Distributed Technology Training Consortia (SWUSA-DTTC)

The SWUSA-DTTC is currently composed of four universities (UCSD, SD State, ASU, and University of Hawaii at Manoa) and four industry partners (SCE, Maui Electric, OSI Soft, and SAFT).

The consortium is currently focused on developing curriculum for university classes, professional workshops, and short courses. These courses will offer immediate value to students and industrial professionals and improve the development of a power engineering emphasis at each university.

One key strategic issue in developing this power engineering emphasis will be the interdependencies amongst professors, students, and research activities. Professors will be brought on to teach specific technology topics as students have an interest in those technology topics. Research dollars can often stimulate a university to explore hiring professors in a particular area if there are associated research dollars. The research dollars will seek expertise and mature undergraduate and particularly graduate programs. Therefore, without a combination of all three concurrently, it is challenging to develop a new program that is sustainable. Students need professors. Professors need students. Both need to be present to attract research dollars. Research dollars will gravitate to professors and students with a track record of research experience in power systems.

This issue of concurrent development of new course offerings and a sustainable program in power engineering has been discussed within the consortia. A strong driver to the success of the SWUSA-DTTC is the leading edge experiences within Hawaii, California, and Arizona for high penetration of Solar PV resources. In addition to the unique experiences that will provide an immediate need to resolve real-world issues, the State of California in particular has devoted a significant amount of research and demonstration funding to addressing the issues associated with high penetration of Solar PV, the integration of these resources, and the use of storage and demand response to assist in managing these resources. This particular funding source and the opportunity of each university to access these funds will be a key driver to the overall success of the consortia.

To develop a sustainable consortium several existing research consortia have been reviewed. These include:

Power Systems Engineering Research Center (PSERC) – PSERC is a National Science Foundation Industry-University Cooperative Research Center. The consortium includes 13 universities and approximately 40 industry sponsors. The consortium is supported through sponsor annual membership fees and federal, state, or member sponsorship of specific projects (e.g. Department of Energy funding of the Future Grid Initiative). PSERC is organized around three research concentrations: Markets, Transmission and Distribution Technologies, and Systems.

Energy Production & Infrastructure Center (EPIC) – EPIC was originally funded through the State of North Carolina and key industry partners (e.g. Duke Energy, Siemens, Westinghouse, and Areva) as well as funding from the National Science Foundation. EPIC is housed at the University of North Carolina Charlotte. The EPIC research facility cost $76M with an additional $15M in research equipment. The research facility coordinates education and applied research

opportunities with a variety of colleges within the university (e.g. Civil and Environmental Engineering, Electrical and Computer Engineering, Business Administration).

Future Renewable Electric Energy Delivery and Management Systems Center (FREEDM) – FREEDM is a National Science Foundation Engineering Research Center focused on distributed renewable resource integration. FREEDM has a 20,000 square foot research facility on the campus of North Carolina State University and includes within its network the ASU, Florida State University, Florida A&M, and Missouri University of Science and Technology. FREEDM includes various levels of industry sponsorship: full members (e.g. ABB, Duke Energy, Itron); associate members (e.g. CISCO, GE, Hitachi, Quanta Technology, SCE); and affiliate members (e.g. EPRI, Ford, Fairchild Semiconductor).

University of California Advanced Solar Technologies Institute (UC Solar) – UC Solar is a consortium of nine UC universities headquartered at UC Merced. UC Solar is partially funded through 13 industry sponsors (e.g. APG Solar, Entech Solar, Merced Irrigation District). The research is focused on Solar technologies including concentrated photovoltaics, solar thermal, and thermoelectric materials.

These examples provide a view of mature and developing research institutes with different focus and different regional aspects to their makeup. As the SWUSA-DTTC develops, it will be important to leverage these research institutes (as existing SWUSA-DTTC members are leaders or contributors to these institutes) as well as distinguish the SWUSA-DTTC effort from these institute efforts.

Key to all of these efforts is a community of industry sponsors to support and provide feedback to the research institute. A strong component of the sponsorship is the ability the sponsors to recruit talented graduates with foundational understanding of power systems, renewable technologies, control systems, product development, and industry knowledge. Geography counts, particularly on the western region as many graduates wish to remain in the area after graduation.

Extend the geographic reach on universities

- ✓ UCLA, UC Riverside, UC Irvine, CSULB, CSULA, Cal Poly Pomona, CalTech, USC, Cal Poly San Luis Obispo, Stanford, UC Berkeley, Washington State University
- ✓ Focus (on something) while meeting the Sunshot Initiative goals and our stated work
- ✓ Cost-Effective Storage
- ✓ Transactive Energy
- ✓ New Business Model New York NEV and California More than Smart
- ✓ Microgrid/Macrogrid/Nanogrid
- ✓ Control and Optimization of Devices Strategies (Distributed Energy Resource Management Systems)

Major vendors – Toshiba, Solar City, Hitachi, SEL
Student development and utility hiring
UCSD (Microgrid)/SD State (UG Program)
U of Hawaii and High Penetration Solar

Appendix C: Internal University Meetings with PI and Electricore Meeting Minutes

April 17, 2014

1. **INTRODUCTIONS**
2. **ADMINISTRATIVE UPDATE & UPCOMING DELIVERABLES**
   a. **Student Centered Conference**
   - In conjunction with the SEPA Utility Solar Conference in Newport Beach, CA
     - Student Conference is 4/28-4/29
     - Registered university participants

School	Staff	Student	Year	Contact Information	Poster Title	Conference Registration	Hotel	Flight
UCSD	Jan Kleissl	Andu Dung Nguyen	3rd year PhD student	andunguyen@ucsd.edu	Powering the Future with Solar Energy: Forecasting and Integration Strategies	Yes	Booked 3/28	N/A
ASU	Dr. George Karady	Jicheng Yu	1st year PhD student	jichengy@asu.edu	Development of the Virtual Laboratory for Electric Machines and Power Electronics	Yes	Booked 4/01	Booked 4/02
SDSU	Dr. Sridhar Seshagiri	Azad Ghaffari	PhD Grad	aghaffari@eng.ucsd.edu	Extremum Seeking for Wind and Solar Energy Applications	Yes	Booked 04/05	N/A
UH	Reza Ghorbani	Ehsan Reihani	1st year PhD student	ereihani@hawaii.edu	Voltage and Reactive Power Control in Distribution System	Yes	Waiting on additional SEPA rooms	Booked 04/06

   - 1 day participants

Faculty	
Sridhar Seshagiri	seshagiri@engineering.sdsu.edu
Graduate Students	
Ethan Block	ethan.block@hotmail.com
Undergraduate Students	
Eric Alcomes Aquino	aquinoer@gmail.com
Bryan D. Rodriguez	bryandrodriguez@hotmail.com
Pedro Ramos	pedroskids34@yahoo.com
Priscila Moreno	priscila.moreno87@hotmail.com
Cuong Nguyen	nmcuong1910@yahoo.com

   - Posters - Any issues w/ the posters?
     - UH/ASU – If you need to have it FedEx'd to Electricore prior to we can drive it down or get it printed here.

   b. **SWUSA-DTTC Advisory Board**
     - Electricore is in the process of inviting members to join the advisory board. This board will consist of the following:
       - 1-2 Industry Members (including Troy Strand (troy.r.strand@gmail.com). Troy is the largest solar installer in SDGE territory).
       - One member from each SWUSA-DTTC utility (SDGE, SoCal Edison, MECO)
       - One "regulatory" type member. First will be from the ABET accreditation board – Need this name from J. Holmes

- One from Calif state education leadership – CalPoly SLO Dean

c. SunShot Summit

- Monday May 19-22, 2014 at the Hilton Anaheim, CA
- UCSD will have 2-3 people there presenting projects; Jan Kleissl, Byron, Carl
- Kodie will route the poster information to the team. Please glance over and let me know if you'd like anything revised.
- I owe this ppt to DOE on 4/30

d. Quarterly Report covering Jan-March 2014

- Due April 30th
- Kodie has received input from all University partners
- Please submit your invoices to Kodie for work completed through March asap
  - If you have questions on invoicing please contact me
- Kodie will route to the team tomorrow for final review

3. University Updates

- UCSD
  - Compiled synopsis of new courses
  - Assigned tasks for summer courses
  - Hold courses in conjunction w/ local conferences in SoCal – also in conjunction w/ SEPA
- SEPA – J. Holmes was asked to present at Student Centered Conf. Has not confirmed yet.
- SDSU
  - Power systems group had a discussion with four items
    - Offering a new class undergrad and grad "energy systems" this fall as a special topics class – if there is enough participation over next three years, it will become a class
    - Creating new lab "power simulations"
- UH
  - Hopefully finishing contract soon to be a part of project; will start developing more courses in collaboration with utilities
  - Renewable energy to cross into college of engineering and hoping to get more student involvement
  - Following up on graduate certificate program on renewable energy
- SDGE
  - Sunshot curriculum UCSD solar forecasting development
  - iTron – DC meter in production now; system might be relevant to the discussion here
  - Discuss this opportunity at a separate time – J. Holmes will discuss off line
- ASU
  - Smart meter – learn how to computer simulation of the meter; students make connections and testing to do response simulations
  - Ready to work on this in the summer time; need input from utility and follow up w/ ASU and UCSD directly
  - Sent list of all courses teaching for power electronic students – KA will route to the team
  - 210 students this year
- Funding development to support campuses

- Seeking funding for project work
- 1 large industrial affiliate support
- GEARED deserving recipient; should serve as testimony as the project
- Seek additional funding as vendors
- Faculty recruitment – just interviewing assistant professor

May 15, 2014

1. INTRODUCTIONS

2. ADMINISTRATIVE UPDATE & UPCOMING DELIVERABLES

a. Student Centered Conference – Complete, thank you! Press Release will be distributed to the team if Michelle hasn't done so already

-

b. SWUSA-DTTC Advisory Board

- Electricore is in the process of inviting members to join the advisory board. This board will consist of the following:
  - 1-2 Industry Members (including Troy Strand (troy.r.strand@gmail.com). Troy is the largest solar installer in SDGE territory).
  - One member from each SWUSA-DTTC utility (SDGE, SoCal Edison, MECO)
  - One "regulatory" type member. First will be from the ABET accreditation board – Need this name from J. Holmes
  - One from Calif state education leadership – CalPoly SLO Dean
- Kick off Call being held tomorrow
- MECO – who would like to stand on the board and I will send official invite letter

c. SunShot Summit

- Posters delivered today
- Deborah Jelen - GEAERED: Tuesday, May 20th 4:15pm
- Who will be there?

d. Quarterly Report covering Jan-March 2014

- Submitted

3. University Updates

- UCSD
  - Compiled synopsis of new courses
  - Assigned tasks for summer courses
  - Hold courses in conjunction w/ local conferences in SoCal – also in conjunction w/ SEPA
  - Compile courses with conferences locally in UCSD relevant
  - Representation at Co
  - Carlos, Jan and Byron will be at DOE SunShot Conference
- SDSU
  - Power systems group had a discussion with four items
    - Offering a new class undergrad and grad "energy systems" this fall as a special topics class – if there is enough participation over next three years, it will become a class.

  - Creating new lab "power simulations"
- SDGE
  - Sunshot curriculum UCSD solar forecasting development
  - iTron – DC meter in production now; system might be relevant to the discussion here
  - Discuss this opportunity at a separate time – J. Holmes will discuss off line
  - Contracting concerns
- Edison
  - Sr. Engineer at Research Dev. Group 10 years
  - First monthly meeting – Araya Gebeyehu
- UH – online outline for power systems course by summer
  - In August
  - Results of research by August; use results to convert into modules in smart grid
- Funding development to support campuses
  - Seeking funding for project work
  - 1 large industrial affiliate support
  - GEARED deserving recipient; should serve as testimony as the project
  - Seek additional funding as vendors
  - Faculty recruitment – just interviewing assistant professor

June 19, 2014

1. INTRODUCTIONS

2. ADMINISTRATIVE UPDATE & UPCOMING DELIVERABLES

1. **PI Memo sent to team 6/19**– SCE was reassigned as PI and SDGE no longer a subrecipient under this award for BP1; Memo sent to team on 6/19/14
   - John Holmes will remain on the Tech Advisory Board
   - Electricore and SCE will schedule short meeting w/ each university for plan path forward
2. **Quarterly Report –** Period APR-JUNE report is due July 30th
   - Electricore will update the Report using information recently received from team on updating deliverable matrix; will route end of June for additional updates and submit end of July
3. **BP2 Continuation App for Funding** - due July 30
   - Electricore is drafting this document; compilation of past Q reports
   - Electricore will send an email for input as needed
4. **SWUSA-DTTC Advisory Board**
   - Held Advisory Board Kick Off on May 16, 2014
   - Electricore will include Meeting Minutes in the Q Report and also route to the team
5. **SunShot Summit – Attended May 20, 2014, presented poster and presented project to review panel**
   - Review w/ panel went very well; no issues
   - Will follow up with DOE to see when/if we get a copy of the formal review evaluation
6. **NNA Student Innovation Board**
   - Subcommittee meeting with NNA held on 6/17 – Electricore is on the subcommittee meeting and will disseminate information as necessary

- Electricore will send the team the Information for students describing membership requirements, and the roles and responsibilities of SIB participation – Universities please review and let me know if you see anything that should be included or requested to remove by **Monday, June 23rd**
- The SIB will meet regionally (most likely via teleconference) and then if funds are available, once a year in person for a National Board Meeting with all DTTCs.

3. University Updates

a) UCSD

What?	Who?	Due Date / Status
Task 2.2.1.: New 2 to 8 hour short courses on		
Solar energy forecasting & solar energy performance monitoring and modeling	JK CC	07/2014
Advanced applications of interfacing renewables to power system	RdC	07/2014
Power system simulation: fundamentals and applications	WT	07/2014
Task 2.2.2. Advanced training courses Coordinate content with SDSU, fill niches These courses could be added to Master of Advanced Studies (optional for GEARED)		
Power System Engineering: combination of power electronics and power engineering	RdC	09/2014
System Planning and Operation	WT	09/2014
Combine advanced training and short courses into jointly taught, 4 unit 'Advanced Topics' MAE207 in Advanced Power Systems Technology	TSR + others	W2015
Task 2.2.3. Modify and extend the course offering at UCSD to incorporate Power Systems Engineering: These courses could become the core of a Master of Advanced Studies in Renewable Energy and Power Systems (optional for GEARED)		
MAE255 Solar Energy Meteorology MAE256 Radiation for Energy Applications	JK CC	Done Done 11 students in S2014.
MAE280A: Added content on microgrid data integration, synchrophasors	RdC	Done. 11 students in S2014.
EE180 Power Electronics II EE188 Introduction to Power Electronics	RE	Done. 28 and 50 students in S2014 and W2014
CSE "Introduction to Embedded Systems" (4 units) will cover the basics of power systems. It will also discuss details of embedded sensors/actuators needed to manage SmartGrid interfaces CSE291 Smart Grid (1 unit): Introduction to Smart Grid; Basics of Power Systems; Smart Grid Communication, Measurement, and Control; Renewable Energy & Energy Storage; System Reliability & Ancillary Services; Microgrids;	TR	9/2014
Power systems lab in coordination with SDG&E	WT	12/2014

Other UCSD meeting notes:

- Overarching Theme: Grid operation in the presence of high penetration renewables.
- Intervention (teaching) will start in Y2 (start Oct 2014) and continue until Y5.
- Check MOOC materials.
- SDG&E resources: Energy Innovation Center is more generic. Integrated Test Facility has immersion in the power electronics environment. ITF consists: DERlab, Smartgarage.
- Offer courses contemporary with large meetings in San Diego in 2015-2018.
- Obtain training needs from HR of industry affiliates.
- Good Resource: http://cusp.umn.edu/napa_2013.php

b) SDSU

- Syllabus for the new course (Fall 2014) –send to Electricore
- Updates provided in the deliverable matrix
- Power systems group had a discussion with four items
  - Offering a new class undergrad and grad "energy systems" this fall as a special topics class – if there is enough participation over next three years, it will become a class
  - Creating new lab "power simulations"

ASU

- ASU hired Meenakshi Saravanan a minority foreign women MS students. She started the upgrade of the existing draft lectures for the short courses:
  a. Smart Transmission System short course,
  b. Smart Distribution Grid with Renewables short course
  These two short course will cover 10 hours of lectures with about 450-500 slides
  ASU sent the course information for this
- Jicheng Yu, PhD student working on the Virtual laboratory for Smart Distribution Grid
  a. The existing Virtual laboratory programing method has been updated for the latest edition of the MATLAB program
  b. Signed up for virtual lab and developing 2 short courses; distribution systems in renewable energy
     i. 150-200 slides;
     ii. ASU send over the slides for SCE/MECO review if you'd like their input - 10 hour course program
- Issues
  a. The short courses that development started must be recorded in a studio, the budget does not allocate any funding for the recording studio cost –
  b. The revolutionary virtual laboratory requires the smart equipment. Smart Domestic meter and Smart Appliances. The equipment must be provided by the participating utilities. ASU working with the AZ utilities to rent the equipment.

c) UH – MANOA

- UHM offered postdoctoral position to Dr. Sasidharan Sreedharan and he accepted the position. We expect Dr. Sreedharan to join the group in August 18. He will work to teach and prepare the course modules.

- Dr. Ghorbani is working to prepare slides for 10 hour graduate level course on power conversion for PV and Wind. Hi is coordinating with Dr. Seshagiri.
- Dr. Ghorbani is working with a Japanese company (Myway Plus Inc.) on organizing a 3 day workshop in Nov or Dec 2014 on embedded control of inverters for PV, Wind and EV for utilities. We expect to have 30-50 participants from utilities and universities in USA and Japan. We are working on the outline of the course.
- Smart Grid – 10 student short course
    a. Revise course after summer and present as online course
- UH-Manoa will work with MECO to review course work and align with utility
- Problems
    a. The expenses of workshop were not fully covered by the Geared and we have to consider a fee from each participant in order to make it self-sustainable.
    b. We are working with UHM College of engineering to facilitate in preparing media modules of short courses.
    c. Most of the course material is used from the reference books and papers. Thus, permission for Copyright needs to be obtained before posting the material online.

UCSD Internal Meeting August 20, 2014

Internal notes – Path Forward

- Leverage CA state funds
- Develop power systems curriculum at UCSD w/ SCE
  - UCSD did not have any power engineering courses a few years ago
  - ID existing content
  - Developing new content
- Power Systems Eng. Degree - How far away is UCSD?
  - Still somewhat far away; years away
  - Cultural change vs. a set of courses to pull together
  - Limited amount of faculty w/ this expertise
  - Driver – funding to solve solutions; will drive this interest
- In discussion w/ SDSU w/ a longer history and do not want to create overlap
  - Shared course? Outside of UC system w/ SDSU
  - How is this evolving? B. Torre –
    - Faculty relationships. Investing in power program
    - Power electronics professor also teaching controls and renewables
    - Challenges – not a substantial amount of RD funding; depending on "big budget" for academic program; hard to expand; need external funding
    - Help to develop a closer relationship w/ industry. Beneficial to rate payers and industry
    - UCSD working closely w/ SDGE
- SDGE Power Systems Lab
- Short Courses – 1 or 2 days, conference, etc.
  - Power industry professionals – main audience
  - SCE feedback – difficult to get professionals into longer courses unless it's tied to a graduate degree
- Sustainability Plan
  - Getting industry involved is key
  - Great Example: Univ. North Carolina –$75M by State $15M by industry investment (CEO Duke Energy)
    - New on campus facility for education and research
    - Produce own solar panels on campus
  - Energy Research Park at UCSD – develop something like Un. North Carolina on the west coast. EPIC Funds?? Develop something similar as NREL
  - Need to develop a Strategic Plan
  - Example Models: ASU impressive build out of power system curriculum; Virtual Lab Model; PSERC somewhat sustainable w/ industry sponsorship; mechanism for feedback from industry (broad, we will want to stay West Coast focused).
  - West Coast opportunity to engage Asian companies to join a west coast research center (East coast engages in mostly European).
  - Solar/PV – west coast/Hawaiian market opportunity to leverage the learning in CA

University California, San Diego Accomplishments

- UCSD held internal meetings to discuss the courses and curriculum provided in the statement of work.
    - Curricula for short courses, advanced training courses, and upgrades of existing courses were compiled this budget period.
- UCSD assigned coursework and faculty participation for each course
    - On account of their physical proximity, and with the idea of not duplicating efforts, UCSD and SDSU will plan on course sharing. This will be done at the level of the Dept. Chairs/Deans through the Open University Enrollment mechanism that both universities allow.
- USCD finished modifying courses to incorporate Power Systems Engineering, including MAE255 Solar Energy Meteorology, MAE256 Radiation for Energy Applications, MAE280A, EE180 Power Electronics II, and EE188 Introduction to Power Electronics.
    - CSE "Introduction to Embedded Systems" and CSE291 Smart Grid should be complete by the beginning of the fall semester.
- UCSD is also working to develop two to eight hour short courses. The topics include: solar energy forecasting & solar energy performance monitoring and modeling, advanced applications of interfacing renewables to power system, and power system simulation. These are expected to be complete by the end of July 2014.
- The group is developing advanced training courses, including power system engineering and system planning & operation. Both these courses should be complete by the beginning of the fall semester.
- Teaching will begin this fall and continue through the end of the program.
- UCSD may offer courses for large meetings in San Diego in 2015-2018.
- The group will obtain training needs from human resources divisions of industry affiliates.

SDSU Internal Meeting 8.21.14 Internal

- SCE RD group very interested in getting graduate engineers hired onto the utility in the RD department
- Power systems undergrad/graduate level
  - Course sharing w/ UCSD in power systems and power electronics
  - Most concentration is undergrad
  - Do not offer graduate program in power systems –
    - Want to grow a graduate program!
    - Sridhar teach renewables integrating into the grid – experimental class
      - Senior undergrad and first year graduate class
    - Power systems advance and analysis controls class
    - Power electronics professor was hired – hasn't taught any NEW power electronics class yet. Working w/ him to develop a power electronics NEW class
    - 1 PhD student at UCSD in controls distributed power/converters went on to do post doc at Univ. Michigan
- Research Dollars
  - NSF proposals submitted but not successful
  - 1 application to the CEC declined
  - Looking for more funding – CEC EPIC?
  - UCSD Microgrid involved in this program; collaborate w/ SDSU
- Mechanical engineering dept.
  - Concentrated Solar - $4M grant from DOE
- Relationship w/ UCSD and SDSU
  - Joint PhD program – 20 yrs old
  - Most important is to have a SDSU graduate program! Committee needs to submit a proposal for new programs / teaching
  - What classes would be apart of graduate program
  - Funds for 3 years to teach plus course development
- Power systems software lab – in approval process from graduate committee
  - Still developing new classes
  - Course descriptions submitted
- Joint Energy Institute between UCSD and SDSU
  - SDSU do the teaming
  - UCSD do the research
  - Beneficial when you get the students involved in the research – intern at a utility
  - Challenges – 99.9% of students are not interested in power dynamics – if there's no interest in the students then why would they create a program. Will only do it if there's competition.
- Future – get HR campus recruiting on SCE radar to help develop the relationship
  - Short courses – a lot of work being done on this
  - Prof. Engineers do NOT have continuing education REQUIREMENTs. If they'll commit to a program then usually it will be an advanced degree
  - SCE can help market short course – web based/ online
  - Professionals won't pay for a short course unless it goes toward a degree
  - SCE will follow up w/ HR
  - SCE happy to look over any proposal SDSU writes and provide support
  - If any students want to go on a Lab Tour at Edison let Robert know
  - SDSU will send latest NSF proposal that was declined for a review

- Industry
    - Needs quality recruitment in power systems
    - Opportunity to showcase the DTTC as a starting point for industry to commit and be involved in on a research and recruiting standpoint! Opportunity for CEC EPIC funds
        - Great that SDSU is looking for research dollars
        - Industry partnering is very helpful

- The energy systems group presented their plans for new course offerings to the faculty at large in the department.
- Based on faculty inputs, and what is standard procedure in the department, new courses and labs will have to be offered on an experimental basis before becoming regular course offerings.
- The university discussed offering a new class for undergraduate and graduate students in the fall called "Energy Systems" as a special topic. With enough participation over the next three years, it will become a full class.
- SDSU also created a new lab called "Power Simulations."

Future Work

- EE586 is being offered for the first time in Fall 2014 as a Special Topics course.
- Short course preparation and discussion with the College of Extended Studies.
- Continue work on the new lab in Spring 2015.

University of Hawaii Meeting 09.08.14
SOPO Addendum: University of Hawaii Specific Scope of Work

Subtask 2.1.2 B: A university partner will develop a high Impact Training program on Smart PV Inverters for distribution grid.
The Subtask 2.1.2 B is linked to Milestone 2.15: High Impact Training program on Smart PV Inverters for distribution grid with creation of new research activity and attendant PhD program that focuses on model based control of smart grid with high penetration of PV; program contains 30 - 60 students

- Advanced inverter function as used in distribution grid
- Focused on smart advanced PV inverter functions on LOCAL distribution grid

Subtask 2.2.1 C: A natural energy institute in partnership with a university partner will develop the following new 10 hours short courses.

1) Power system distribution: Substation configuration and design; feeder design fault detection and isolation; restoration; voltage regulation; secondary circuit design; distribution system reliability analysis; distribution automation;

- Foundation PV smart grid distribution - introductory

2**) Smart grid: Smart power grid operation and control**; distributed generation and renewable energy integration to power grid; power system automation; demand side management; smart home and smart appliances; smart meter and advanced metering infrastructure; energy storage and electrical vehicle; information and communication technology applications in smart grid; energy saving; smart agent for efficiency optimization;

3) Power delivery management for communities: Delivering electricity safely, reliably, cost-effectively and environmentally friendly in communities. Supplying reliable electricity to buildings. Meeting and surpassing customers' expectations in supply reliability, power quality and associated services. Asset management and maintenance strategies. State-of-the-art protection, control and metering systems. Legislative requirements for safe and green power transmission and distribution;

4) Solar Power Systems: Basics of solar photovoltaic, concentration technologies and advancement, structure and maintenance, material degradations and modeling, maximum power point tracking, smart inverters, micro inverter for modules, system integration and analysis, economy and future market, starting business in solar power.

- 4 short courses as described above broken into 2 modules
    - 1 – introductory and 2- much more advanced; research/modeling
    - 10 – 1 hour lectures broken into 2 modules

Milestone 2.14: Series of 4 short courses for a utility professional audience from the Utility Short Courses, with each course containing 10 online one-hour lectures with 50 participants per course for a total of 200 participants

NOTE: The Milestone 2.14 is achieved by modifying the short courses of subtask 2.2.1 C (listed above) in two sections of introductory and advanced modules. Each of four introductory and advanced modules includes 5 one-hour sessions. Both introductory and advanced modules will be taught at the summer workshops each year at UHM with participants from utilities and universities.
NOTE: The Milestone 2.15 is achieved by modifying the short courses of subtask 2.2.1 C (listed below) in two sections of introductory and advanced modules. Each of four advanced modules includes 5 one-hour sessions. The advanced modules will be available at all graduate level and senior undergraduate level courses at UHM and consortia.

Current Accomplishments
University Hawaii at Manoa

- Held discussions to develop additional courses in collaboration with the SWUSA-DTTC utilities.
- Held discussions regarding possibility of renewable energy crossing into college of engineering and developing ideas for increased student involvement.
- Following up on graduate certificate program on renewable energy
- UHM offered a position to Dr. Sasidharan Sreedharan, who accepted. He will join the group August 18th and will prepare and teach course modules.
- Dr. Ghorbani is preparing a 10-hour graduate level course concerning power conversion for photovoltaic and wind energy, in coordination with Dr. Seshagiri.
- Dr. Ghorbani is also collaborating with Myway Plus Inc. to organize a 3-day workshop in late 2014 on embedded control of inverters for PV, Wind, and EV for utilities. 30-50 participants from utilities and universities from the United States and Japan are expected to attend.
- UHM is also holding a short course on the Smart Grid, which it will revise after the summer and offer as an online course.
- UHM is working with the College of Engineering to facilitate the preparation of media modules for short courses.
- Permission from copyright owners needs to be obtained before posting course material online.

<u>SCE Notes</u>

- How this team works among the other partners
- interested in sustainability in energy research among SoCal and Hawaii
    - Many issues are ahead of the curve in CA and HI; some other places don't have the sense of urgency that we do here.
- Web based training
- CA – lack of universities with developed energy programs
    - Power systems courses seem to be the CalState schools and PolyTechnic
    - Would like to get more of the Research type institutions more involved

<u>UH Notes</u>

- 300Mw of PV
- Hawaii Electric – in court on their plans for forecasting
    - New plans add 900mW PV; 200 mW of wind also incorporated in Oahu
    - % of energy/ power among the highest
- Leverage the concerns into the curriculum that will benefit those that are catching up to CA and HI
- Education directly for engineers in the workforce at the utilities

- MECO working close w/ UH to figure out what is relevant for the current workforce and new students
- High penetration – UH lead/focus/expert
    - 100% over penetration relative to daytime load of circuit
    - Hitting barrier issues; important for inverter capability
- Models/data as part of the class work as examples to audience
- Workshops are more interactive; online courses more foundational
    - Ideas on how to market the courses?
    - Ideas on sustainability of courses?
        - CEC EPIC Funds; good annual investment of funding for demonstration/research; human power
        - Anything like that in Hawaii? Not a lot, but HNEI has funding from the barrel tax
        - Leverage on PV focus activities
        - HNEI has a lot of DOE funding
        - Seeking industry funding
- UH – leverage/combine research activities driven by necessity right now; combine w/ experienced professors in curriculum development, teaching and power systems w/ data and modeling…bring this into the curriculum
- UH will look at the EPIC/CEC funding

<u>Current Power Systems Courses</u>

- Renewable Energy
- Smart Grid
- 10-15 grad students working on Power Systems
- Challenge – hiring
- No smart grid; power systems courses developed yet in great detail yet
    - PS has been on the outs for about 15 years
    - Need to rally up the excitement at the university
    - Get professors on board
    - Research component very important to get the attention of the dean
- Some funding from NSF but what happens when funding dyes out
- HNEI faculty environment is diff than the UH faculty

Appendix D: Evaluation of Training Outcomes

Mon 8/11/2014 12:25 PM

Kodie Arnold <kodie@electricore.org>

RE: GEARED Metrics question (hopefully easy!)

To 'matt@docchampagne.com'

Cc 'brandon@electricore.org'

Click here to download pictures. To help protect your privacy, Outlook prevented automatic download of some pictures in this message.

Message | Fulton Engineering Teaching Eval Questions FA14 ASU.pdf (18 KB) | Evaluation Sheet.pdf (42 KB) | Survey_ME481_Nejhad_Trimble.pdf (20 KB) | Survey_ME482_Nejhad_Trimble.pdf (20 KB)

Hi Matt,

I was on travel all last week and will get to this request today or early tomorrow.

In the meantime, I attached ASU and UH evaluation forms along with UH ABET survey for Senior design class.

UCSD is just in the process of developing materials and have not developed a form for instructor evaluation, but plan to have the following general ratings:

- Instructor displays a proficient command of the material.
- Instructor's speech is clear and audible.
- Instructor explains the course material well.
- Instructor promotes appropriate questions/discussion.
- The course material is intellectually stimulating.
- I learned a great deal from this course.
- The course is relevant for my job.

SDSU will be teaching a new course related to GEARED in Fall 2014. SDSU will send me the metrics once they have the evaluation form created.

Thank you,

Kodie Arnold
Program Manager
B (661) 607-0285
F (661) 607-0264
kodie@electricore.org

Tue 8/12/2014 2:16 PM

Kodie Arnold <kodie@electricore.org>

FW: GEARED Metrics question (hopefully easy!)

To 'matt@docchampagne.com'; '<brandon@electricore.org>'

Message | Electricore - August 2014_ecore_edit.docx (19 KB)

Hi Matt,

Electricore's edit to your metrics document is attached.

The TBD means that this will occur but the course has not been developed or been taught yet.

Best regards,

Kodie Arnold
Program Manager
B (661) 607-0285
F (661) 607-0264
kodie@electricore.org
www.electricore.org

From: Matthew Champagne [mailto:matt@DocChampagne.com]
Sent: Tuesday, August 05, 2014 12:45 PM
To: 'Kodie Arnold'
Subject: RE: GEARED Metrics question (hopefully easy!)

Hey Kodie – hope your Tuesday is rolling along! I compared the excel sheet you sent me on Friday against the Metrics "master list". Can you take a peek at the attached when time?

The master list was a summary of every metric mentioned by any DTTC. So now want to see how many common metrics used by every project. I put an "x" in the 8 boxes that seem to me to be ones Electricore plans to collect, based on my reading of the SWUSA-DTTC sheet. I also put 9 "?" marks, meaning the sheet didn't say directly this would be collected but seemed reasonable that you might collect these en route.

Can you add/delete any "?" and "x" that truly don't belong (i.e., impossible or difficult to collect)? I can already see that every DTTC is measuring the # of new courses and enrollments and modified courses, but perhaps there are others. Note that page 2

Evaluation Sheet

1=lowest, 5=highest

1) Instructor had adequate knowledge of subject matter.

1 2 3 4 5

2) Instructor was consistently well prepared and organized for class.

1 2 3 4 5

3) Instructor was able to explain difficult concepts.

1 2 3 4 5

4) Instructor was open to comments and questions.

1 2 3 4 5

5) Instructor was available for consultation outside of class and was helpful when students had problems.

1 2 3 4 5

6) Exams and homework were relevant and sufficient.

1 2 3 4 5

7) Grading was fair and impartial.

1 2 3 4 5

8) My general evaluation of the instructor's teaching effectiveness.

1 2 3 4 5

Please circle below the letter grade that you expect to receive in this course.

F D C B A

You are strongly encouraged to write comments in the space below and on the reverse side of this sheet.

A Brief Description of ABET Accreditation Criteria:
STUDENT ASSESSMENT (ME481)
Department of Mechanical Engineering University of Hawaii at Manoa

ABET has adopted a set of accreditation criteria which require the Department of Mechanical Engineering (DME) to assess how well its MISSION is accomplished by achieving eleven program outcomes ("a" through "k"), three general academic objectives (Objectives 1, 2, and 3), and two Major Design Experience of Professional Components (PC1 and PC2).

Proper assessment of the effectiveness of the DME's program must include input from students. Attached below are forms whereby the student assessment of the DME's program can be documented for presentation to ABET. The DME earnestly requests that its students execute these forms thoughtfully and forthrightly.

The attached student assessment forms enumerate the DME's program outcomes and objectives as well as the major design experience professional components. Associated with each item is a "value line" with a scale from 0 to 1 in increments of 0.1. The numerical values on these value lines indicate student's opinion as to how significantly the goal indicated in each item has been achieved by the DME program: the value "0" indicates "insignificant achievement" and "1" indicates "significant achievement." The letters "NA" indicate that the activity being assessed is "Not Applicable" here.

Students are requested to circle "NA" or any number from 0 to 1 for each item. Further, and most important, if a student circles a number less than 0.5, he/she is encouraged to explain briefly the reason(s) for the decision to circle that number, in the space provided.

Mission

To prepare graduates for successful engineering and professional careers and leadership roles with lifelong learning and ethical conduct that will lead them to be engaged good citizens, engineers, and professionals in their community and the world. Achievement of the mission statement requires the achievement of the following three objectives:

Objective 1: Our graduates will be accomplished professionals by being able to formulate, communicate, and solve problems using engineering principles, methodologies, and modern tools

Objective 2: Our graduates will be professionals and leaders in industry, national laboratories, academia, and society by employing engineering fundamentals, design skills, thinking creatively, communicating effectively, working collaboratively, and implementing emerging and innovative technologies

Objective 3: graduates will be professionals and leaders who accept and practice their professional and ethical responsibilities, respect diversity of opinion and culture, and have a proper understanding and consideration for a healthy and aesthetic environment

Student Assessment Form
(see Page 1, paragraph 3, for definition of "value line")

Date _____

ME 481

Activity (Course or other activity) Faculty (Instructor or other function)
Outcome a: An ability to apply knowledge of mathematics, science, and engineering

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1 NA

Outcome b: An ability to design and conduct experiments, as well as to analyze, and interpret data

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1 NA

Outcome c: An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1 NA

Outcome d: An ability to function on multidisciplinary teams

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1 NA

Outcome e: An ability to identify, formulate, and solve engineering problems

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1 NA

Outcome f: An understanding of professional and ethical responsibility

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1 NA

Outcome g: An ability to communicate effectively

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1 NA

Outcome h: The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1 NA

Outcome i: A recognition of the need for, and an ability to engage in life-long learning

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1 NA

Outcome j: A knowledge of contemporary issues

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1 NA

Outcome k: An ability to use the techniques, skills, and modern engineering tools necessary for mechanical engineering practice

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1 NA

Objective 1 (see Page 2):

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1 NA

Objective 2 (see Page 2):

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1 NA

Objective 3 (see Page 2):

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1 NA

General Comments

Please indicate how the DME program could be improved to better prepare our graduates for their professional career.

A Brief Description of ABET Accreditation Criteria:

STUDENT ASSESSMENT (ME 482)

Department of Mechanical Engineering University of Hawaii at Manoa

ABET has adopted a set of accreditation criteria which require the Department of Mechanical Engineering (DME) to assess how well its MISSION is accomplished by achieving the program outcomes ("a" through "k"), three general academic objectives (Objectives 1, 2, and 3), and two Major Design Experience components i and ii. In ME 482, the relevant Objectives and Outcomes are O1 & O2; a, b, c, d, g, i, & k, and PC1 & PC2.

Proper assessment of the effectiveness of the DME's program must include input from students. Attached below are forms whereby the student assessment of the DME's program can be documented for presentation to ABET. The DME earnestly requests that its students execute these forms thoughtfully and forthrightly.

The attached student assessment forms enumerate the DME's program outcomes and objectives as well as the major design experience components. Associated with each item is a "value line" with a scale from 0 to 1 in increments of 0.1. The numerical values on these value lines indicate student's opinion as to how significantly the goal indicated in each item has been achieved by the DME program: the value "0" indicates "insignificant achievement" and "1" indicates "significant achievement." The letters "NA" indicate that the activity being assessed is unrelated (Not Applicable) to the particular item under consideration.

Students are requested to circle "NA" or any number from 0 to 1 for each item. Further, and most important, if a student circles a number greater than 0.5, he/she is encouraged to explain briefly the reason(s) for the decision to circle that number, in the space provided.

Thank you for your helpful cooperation.

Mission

To prepare graduates for successful engineering and professional careers and leadership roles with lifelong learning and ethical conduct that will lead them to be engaged good citizens, engineers, and professionals in their community and the world. Achievement of the mission statement requires the achievement of the following three objectives:

Objective 1: Our graduates will be accomplished professionals by being able to formulate, communicate, and solve problems using engineering principles, methodologies, and modern tools

Objective 2: Our graduates will be professionals and leaders in industry, national laboratories, academia, and society by employing engineering fundamentals, design skills, thinking creatively, communicating effectively, working collaboratively, and implementing emerging and innovative technologies

Objective 3: Our graduates will be professionals and leaders who accept and practice their professional and ethical responsibilities, respect diversity of opinion and culture, and have a proper understanding and consideration for a healthy and aesthetic environment

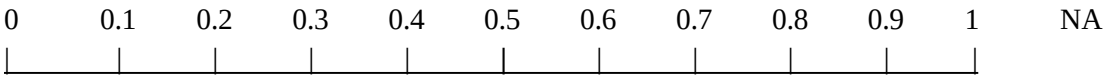
STUDENT ASSESSMENT FORM
(see Page 1, paragraph 3, for definition of "value line", 0=lowest, 1=highest, NA=not applicable)

Date _____

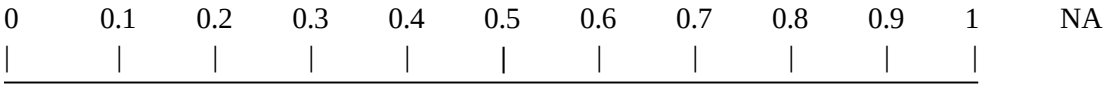
ME 482

Activity (Course or other activity) **Faculty (Instructor or other function)**

Outcome a: An ability to apply knowledge of mathematics, science, and engineering



Outcome b: An ability to design and conduct experiments, as well as to analyze, and interpret data



Outcome c: An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1 NA

Outcome d: An ability to function on multi-disciplinary teams

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1 NA

Outcome g: An ability to communicate effectively

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1 NA

Outcome i: A recognition of the need for, and an ability to engage in life-long learning

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1 NA

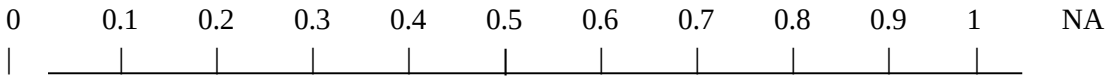
Outcome k: An ability to use the techniques, skills, and modern engineering tools necessary for mechanical engineering practice

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1 NA

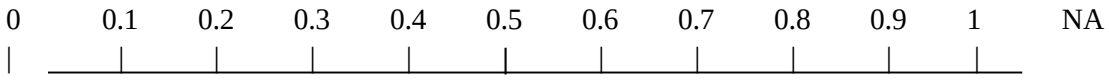
Objective 1 (see Page 2):

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1 NA

Objective 2 (see Page 2):



Objective 3 (see Page 2):



General Comments

Please indicate how the DME program and/or this course could be improved to better prepare our graduates for their professional career.

Ira A. Fulton Schools of Engineering Arizona State University

Teaching Evaluation Questions Fall 2014

Part 1: Student Evaluation of the Course **Five point scale – Very Good (5) Good (4) Fair (3) Poor (2) Not Applicable (null)**

1. Textbook/supplementary material in support of the course.
2. Value of assigned homework in support of course topics.
3. Value of laboratory assignments/projects in support of the course topics.
4. Reasonableness of exams and quizzes in covering course material.
5. Weight given to labs or projects, relative to exams and quizzes.
6. Weight given to homework assignments, relative to exams and quizzes.
7. Definition and application of criteria for grading.

Part 2: Student Evaluation of Instructor **Five point scale – Almost Always (5) Usually (4) 50% of the time (3) Occasionally (2) Never (1)**

8. The instructor was well prepared.
9. The instructor communicated ideas clearly.
10. The instructor or assistants were available for outside assistance.
11. The instructor exhibited enthusiasm for and interest in the subject.
12. The instructor's approach stimulated student thinking.
13. The instructor related course material to its applications.
14. The instructor's methods of presentation supported student learning.
15. The instructor's grading was fair, impartial, and adequate.
16. The instructor returned graded materials within a reasonable period.

Overall Evaluation of the Course and Instructor **Five point scale – Excellent (5) Very Good (4) Good (3) Fair (2) Poor (1)**

17. Overall quality of the course and instruction.
18. How do you rate yourself as a student in this course?

General Information

19. Is this a required course in your program of study? **Yes or No**
20. What are the average hours/week spent studying for this course? **1, 2, 4, 8, 16**
21. What is your class standing? **Graduate Student, Senior, Junior, Sophomore, Freshman**
22. What % of the class meetings have you attended? **10 to 29, 30 to 49, 50 to 69, 70 to 89, 90 to 100**
23. What did you like most about this course? **Free form response**
24. What did you like least about this course? **Free form response**

Online Course Quality **Additional for online courses Five point scale – Strongly Agree (5) Agree (4) Disagree**
(3) **Disagree (2) Not Applicable (null)**

1. The online discussions helped me learn the subject matter
2. The amount of interaction I had with the instructor was sufficient (e.g., e-mail,phone,fax,chat, or discussion).
3. The amount of interaction I had with other students was sufficient (e.g., e-mail,phone,fax,chat, or discussion).

Technology and the Course Experience **Additional for online courses Five point scale – Strongly Agree (5) Agree (4) Disagree (3) Disagree (2) Not Applicable (null)**

4. The course navigation system was easy to use.
5. The course site typically loaded quickly.
6. The graphics and images were of good quality.
7. The video and audio (presentations, streaming video/audio, etc. were consistently accessible).

Online Overall Evaluation **Additional for online courses Five point scale – Strongly Agree (5) Agree (4) Disagree (3) Disagree (2) Not Applicable (null)**

8. The course met my expectations.
9. I was satisfied with the online experience.
10. I would take another online course.
11. I would recommend this course to others.
12. I will use the skills I learned in this course.
13. Overall, I found the course worthwhile.

14. Comments regarding the online aspects of the course **Freeform comments**

Additional comments sent to NNA and evaluation expert include:

UCSD is just in the process of developing materials and have not developed a form for instructor evaluation, but plan to have the following general ratings:

- Instructor displays a proficient command of the material.
- Instructor's speech is clear and audible.
- Instructor explains the course material well.
- Instructor promotes appropriate questions/discussion.
- The course material is intellectually stimulating.
- I learned a great deal from this course.
- The course is relevant for my job.

SDSU will be teaching a new course related to GEARED in Fall 2014. SDSU will send me the metrics once they have the evaluation form created.

GEARED Metrics – Summary of all DTTCs

COURSES/CURRICULUM	MARMET	Electricore	EPRI	FEEDER
# new courses developed (e.g., non/credit, online, short, modules)		X		
# courses modified/revised/archived/converted to online		X		
Demonstrate that more courses being made available to more students		X		
quality of curriculum improvement		TBD		
# instructional hours (lecture, hands-on training, online)		X		
Assessment of syllabi, training material, labs, other course content		TBD		
PROGRAMS/DEGREES				
# degrees/certificates/theses/dissertations/demonstrations of achievement		X		
Programs developed: certificates, grad/UG, other		X		
# of topics, # of credit hours		X		
STUDENTS				
# enrolled in courses, short courses, online, other		X		
# participating in workshops/labs		X		
# internships		X		
# presentations & publications		X		
# attending annual student conference		X		
# participating on Student Innovation Board		X		
FACULTY/ Professional Development				
# Professional development events offered (e.g., train the trainer, summer institutes) & # faculty participating				
# Faculty credentials awarded				
Internal workshops produced/held & # of workshop attendees				
Materials produced for workshops				
End-of-term faculty evaluations		X		
LEARNING OUTCOMES				
Student learning outcomes added/updated/reconsidered		TBD		
# physical skills evaluations				
# residential solar installations reviewed/inspected/installed				
Quality of tools to assess learning outcomes				
New or innovative measures of student performance		TBD		
New or innovative measures of self-assessment or peer assessment		TBD		
FORMATIVE ASSESSMENT / FEEDBACK				
Midterm Evaluations of course and instructor		TBD		
DISSEMINATION				

# Training events, workshops, seminars, symposia, webinars produced/hosted; instructional hours and revenue produced from these events		X		
Faculty presentations, keynotes, addresses given				
Conferences, workshops, seminars attended by faculty		X		
Faculty publications				
	MARMET	**Electricore**	**EPRI**	**FEEDER**
SHARING / PARTNERSHIPS / SUSTAINABILITY	**MARMET**	**Electricore**	**EPRI**	**FEEDER**
Courses shared among multiple universities & course enrollments		X		
Course, credit, and tuition exchange agreements				
Training courses or e-learning modules revised/produced offered to utilities and industry		X		
Participation in GEARED brand development and outreach		X		
Sustainability Plan		TBD		
Market needs and coverage				
New research contracts and funding amounts				
UNIQUE Metrics				
Host for training activities		●		
Develop Smart Grid Lab		●		
Develop simulation lab		●		
	MARMET	**Electricore**	**EPRI**	**FEEDER**

Appendix E - Briefing of the Consortia Organization to the DOE on August 28, 2014

Utility Partners	University Partners	Industry Partners	Oversight
✓ Southern California Edison (PI) ✓ Maui Electric Company	✓ UCSD ✓ SDSU ✓ ASU ✓ UH, Manoa	✓ OSI Soft ✓ Saft	✓ Berkley Lab ✓ Cal ISO ✓ Electricore (Prime)

BP1 Advisory Board:

- Industry Members from the largest solar installer in SDG&E territory.
    - Mr. Troy Strand, an Independent Consultant of SDG&E
    - Eaton Corporation
- Utility Members
    - Southern California Edison's Ms. Leanne Swanson, Principal Manager of Distribution Engineering Technologies/Consulting
    - Maui Electric Company's Mr. Matt McNeff
    - Maui Electric Company's Mr. Ray Okazaki
    - San Diego Gas & Electric, Mr. John Holmes
    - Recent commitment received by PG&E Mr. Kevin Dasso
- Education leadership
    - Dr. Oner Yurtseven; Retired Dean from the School of Engineering and Technology at IUPUI
    - Support received by Cal Poly San Luis Obispo's – personnel TBD

Budget Period 1 Program Planning and Evaluation

- **Detailed evaluation matrix**
    - **Planned deliverable: Internships, New Curriculum, Short Courses, and Labs**
        - ✓ **Outreach Plan**
        - ✓ Estimated Number of Students or Working Professionals Reached
        - ✓ Ongoing status updates as this document is intended to be a live working document during the duration of the program

University accomplishments include:

- ASU - development of the Virtual laboratory for Smart Distribution Grid.
- ASU - developed short course: "Smart Transmission and Smart Distribution Grid with renewables.
- UCSD - developed New short courses on
    - ✓ Solar energy forecasting & solar energy performance monitoring and modeling
    - ✓ Advanced applications of interfacing renewables to power system
    - ✓ Power system simulation: fundamentals and applications
- UCSD - working towards Advanced training courses Coordinating the content with SDSU
- UCSD - Modified and extended course offering to incorporate Power Systems Engineering:
    - ✓ Solar Energy Meteorology
    - ✓ Radiation for Energy Applications
    - ✓ Added content on microgrid data integration
    - ✓ Introduction to Power Electronics
    - ✓ Power Electronics II
    - ✓ Introduction to Embedded Systems

- ✓ Introduction to Smart Grid
- ✓ Power systems lab in coordination with SDG&E and/or SCE

- SDSU
  - ✓ Developed a new undergraduate/graduate course - offered in Fall 2014 as a special topics course in Renewable Energy Systems and the Smart Grid.
  - ✓ Working towards developing a new power simulations lab, to be offered for the first time in Spring 2015 or Fall 2015 (latest).
    - Goa: the lab and any new courses can be taught "virtually", as online courses.
- UH Manoa
  - ✓ Preparing slides for 10 hour graduate level course on power conversion for PV and Wind - Coordinated with SDSU
  - ✓ Organizing a 4 day workshop in Dec 2014 - Embedded control of inverters for PV, Wind and EV. Expect: 50 participants from utilities and universities.

Other accomplishments include:

- The University partners selected students for the Student Innovation Board being directed by the NNA.
  - Reach out to our industry partners for ideas on requests for student projects.
- Website presence on main Electricore website. Working towards further developing
- OSI Soft - under contract and working with each university to get agreements in place
  - Integrate the PI System

Planned Work in Budget Period 2

- Holding next Advisory Board meeting.
- Support Student participation in SIB
- Begin holding courses mentioned previously
- Ongoing Evaluation of training materials
- Capture the course work presently in place by each university
- Work with universities to developed road map curriculum expansion plan on a yearly basis.
- Begin proposal of consortium expansion and first steps toward sustainability.
  - Monitoring California Energy Commission EPIC funds for Leveraging Innovation Clusters to Accelerate Deployment of Early Stage Technologies
- Identify 2015 conferences in San Diego that would benefit from training activities.

APPENDIX F: UHM Smart Grid & Renewable Integration Modern Power Systems Workshop

Program Coordinators:

Dr. Reza Gorbani
2540 Dole St. – Holmes Hall 201 ,
Honolulu HI
Phone: (808) 956-2292
Fax: (808) 956-2373
Email: rezag@hawaii.edu

RESOURCE PERSONS

Experts in the concerned topics hailing from Academic, Industrial and Utilities will be engaging the sessions.

DATE AND VENUE

Course will be held from **27th-28th February, 2015** at University of Hawaii, Manoa, Hawaii, USA. The nearest airport is Honolulu International Airport, which is at a distance of 8 miles from the university.

LAUNGUAGE

The working language is English.

PARTICIPATION AND ACCOMMODATION

Attendees are requested to register online for this training in advance. The registration fee is USD 1500 per participant which include all the cost of materials, Working Lunuch and hands on training will be provided.

.

For more details contact:

1. Dr. Reza Gorbani, reza@hawaii.edu
2. Dr. Sasidharan Sreedharan, sasi@hawaii.edu

TWO DAY TRAINING WORKSHOP

SMART GRID & RENEWABLE INTEGRATION IN MODERN POWER SYSTEMS

27th & 28th February, 2015
at
University of Hawaii
Manoa, USA

Organized by:

REDLAB
Renewable Energy Design Laboratory
Mechanical Engineering Department
University of Hawaii, Manoa,
Honolulu - 96822, HI, USA.

SMART GRID & RENEWABLE INTEGRATION IN MODERN POWER SYSTEMS

The major challenge nowadays is the successful integration of Renewable energy sources into the grid. Since most of the distributed energy sources are renewable based and they exist at the distribution level, the solution demands redesigning of the present distribution systems. The importance of the topic lies in the fact that distribution system is the source of largest losses, non-uniformity, instability, complexity, and quality issues. Hence the great love for this topic among the research community.

A smart grid delivers electricity from suppliers to consumers using digital technology and communication to save energy, reduce cost and increase reliability along with anticipating and responding to system disturbance in self-healing manner. Focused on demonstrating micro grids or its enabling elements such as communications and control strategies for demand response, distributed renewable generation systems, storage technologies, advanced sensors, and energy efficient building sub-systems.

The general objective of this training course is to expose participants to methodologies that ensure a sustainable and cost-effective Renewable energy integrated grid that can meet the demand for new power generating capacity and best practices in distribution planning to ensure the same. Moreover the course will provide participants with insight into major tasks of energy policy and regulation and their impact on the customers.

TOPICS

The training is conducted as a part of South West United States of America Distributed Technology training consortia. The main topics, which will be covered in the training program, are as follows

- Renewable Integration & Smart Grid
- Modeling of Micro Grid Systems
- Micro Grid Analysis Stability & Control
- Hardware Support Modules and Solutions

WHO SHOULD ATTEND

Academicians, Electric power utility staff of both technical and management disciplines, personnel from electric manufacturing and R&D organizations, and policy makers, will find this workshop beneficial. The course fee is 1500 USD.

SPONSORS

U.S. DEPARTMENT OF ENERGY

REGISTRATION FORM

Please register me for the training course on "Smart Grid and Renewable Integration in Modern Power Systems"

Name: _____ **Title:** _____

Company: _____

Address: _____

Tel: _____ **Fax:** _____ **E-mail:** _____

Please fax this form to:
Dr. Reza Gorbani
2540 Dole Street, Homes Hall -201
Honolulu HI ,

Fax: (808) 956-2373
Tel: (808) 956-2292
e-mail: rezag@hawaii.edu
Website: http://manoa.hawaii.edu/me/redlab

Appendix G: SWUSA-DTTC Program Summary Brief

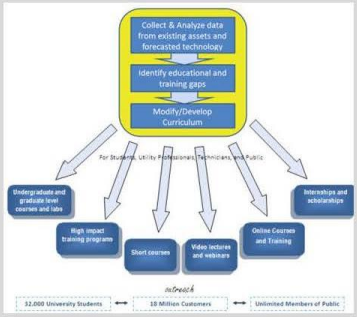
Southwest United States of America - Distributed Technology Training Consortia (SWUSA-DTTC)

Powered by SunShot U.S. Department of Energy

DOE Award Number:
DE-EE0006339

DOE Award Name:
Energy Efficiency & Renewable Energy, SunShot Initiative

Period of Performance:
2013 to 2018



Principal Investigator:
Robert Sherick
Southern California Edison
Direct: (714) 934-0813
Email: robert.sherick@sce.com

Program Manager:
Kodie Arnold
Electricore, Inc.
Direct: (661) 607-0285
Fax: (661) 607-0264
Email: kodie@electricore.org
Website: www.electricore.org

Program Summary

The collaborative Southwest United States of America - Distributed Technology Training Consortia (SWUSA-DTTC) team is leveraging the highest concentration of renewable resources in the U.S., as well as operation of five leading independent microgrid installations and other distributed technologies to collect and analyze real-time data streams, advance power system simulation and analysis, identify educational and training gaps and develop solutions-focused curricula.

Team members possess world class laboratories for the advancement and validation of techniques, tools and systems. Utility members are developing new control methodologies to incorporate systems which automate the control of and increasingly diverse generation mix. Researchers and Industry members will contribute to the program, forecasting technology entering the grid framework, accelerating timeframes for adoption, and contributing pre-commercial advanced technology hardware, firmware and software.

Objectives

In order to support the increase in power systems research, development, and analytical capacity, the SWUSA-DTTC has brought together respected professors in Power Systems education, student/professor research and development, and valuable industry and utility experience.

Through this program, the partnered universities are creating and modifying existing curricula available to students and professionals in the form of university courses, short courses, videos, consortia-led training, and online materials. Supporting vendors and utilities are providing the SWUSA-DTTC with technical advisory support as well as feedback in terms of utility and related energy industry needs.

The outcome of the program will result in better prepared and greater numbers of graduates ready to contribute to the field of power systems which depend upon the safe, reliable and efficient generation sources which make up an increasingly diverse mix of renewable power. Additionally, the program is delivering critical training modules intended to support mid-career professionals and capable of being woven into utility training programs all over the country.

APPENDIX H: SDSU EE596 Syllabus

EE596- Renewable Energy Systems and the Smart Grid - Fall 2014
Electrical and Computer Engineering, San Diego State University

Instructor: Dr. Sridhar Seshagiri (seshagir@engineering.sdsu.edu) (E403G)
Off hrs: Mon & Wed 3:00 - 4:30 pm (or by appointment)

Prerequisites by topic/course
EE480 - Power Systems Analysis.

Catalog Description
Wind energy conversion systems, and micro grids with hybrid power sources. Modeling and control of renewable energy sources such as wind turbine generation, solar panel and fuel cell and power electronics interfaces. Integration of renewable energy systems.

Textbook
Design of Smart Power Grid Renewable Energy Systems - Ali Keyhani, Wiley-IEEE Press

Additional References (Suggested reading)
1. Grid Converters for Photovoltaic and Wind Power Systems - Remus Teodorescu, Marco Liserre, Pedro Rodriguez, Wiley.
2. Bin Wu, Yongqiang Lang, Navid Zargari, Power Conversion and Control of Wind Energy Systems. WILEY 2011.
3. J. W. Tester, E. M. Drake, M. W. Golay, M. J. Driscoll, and W. A. Peters, Sustainable Energy: Choosing Among Options. The MIT Press.

Grading

Quizzes & PSIM assignments - 10 %	Project - 10 %	2 Midterms - 25x2 = 50%	Final - 30 %

Tentative Course Outline

- Week 1: Introduction to energy conversion principle.
- Week 2: Basic power systems.
- Weeks 3-5: Modeling Converters in Microgrid Power systems, DC/AC Inverters, DC/DC Converters, AC/DC Rectifiers, Converters Sizing
- Mid-term Exam 1
- Weeks 6-7: Introduction to Smart Power Grid Systems
- Weeks 8-10: Solar energy systems (photovoltaic materials, performance, MPPT and energy storage)
- Mid-term Exam 2
- Weeks 11-13: Wind Energy Systems (Wind turbines, Induction and PM Machine dynamics and control.
- Weeks 14-15: Integration of renewable energy to smart grid, load flow analysis and fault studies

Learning objectives

Renewable energy is widely recognized in power and related industry as the future of electric power. Knowledge of theory and practice of formal methods is becoming a requirement for design and verification engineers. The objective of the course is to introduce students to the theory and practice of renewable energy and its integration to smart grid.

Upon completion of the course, the student should be able to do the following:
• Understand general physical mechanism of energy conversion.
• Understand basic power electronics principles, like the dc-dc converter and dc-ac inverter.
• Understand renewable energy generation, especially wind and solar energy generations.
• Understand the basic principles of renewable energy integration to smart grid.
• Know how to design a renewable energy system for smart grid.

Academic Misconduct

I plan on following the University rules on academic misconduct. Specifically,
(i) collaborations with a colleague on homeworks must be acknowledged, and
(ii) collaboration is not permitted in the exams, nor looking into someone else's work.
If your work is similar to someone else's (and especially if it is so in an idiosyncratic or erroneous manner), this constitutes evidence of academic dishonesty. Instances of academic misconduct will
(i) result in a failing grade in the course and
(ii) will be reported to the Office of Judicial Procedures.

Please note that your colleagues are watching you and have as much interest in a fair grading environment as I do. In the past, I have had students report offending activities, and follow up action has resulted in suspension.

Disability Accommodation
Students who need accommodation of their disabilities should contact me privately to discuss specific accommodations for which they have received authorization. If you have a disability, but have not contacted Disabled Student Services, please do so at 619-594-6473 (SS-1661) before making an appointment to see me.

Makeup Policy
The University Policy File includes the following statement on Absence for Religious Observances: "By the end of the second week of classes, students should notify the instructors of affected courses of planned absences for religious observances". Moreover, California Education Code 89320 states: "The Trustees of the California State University shall require that each state university, in administering any test or examination, to permit any student who is eligible to undergo the test or examination to do so, without penalty, at a time when that activity would not violate the student's religious creed. In keeping with the above, I will make every reasonable attempt to accommodate any requests for rescheduling midterms/exams as long as I have been notified sufficiently in advance. The only other valid grounds for a makeup will be medical reasons, as longs as they are substantiated by a physician.

Appendix I: SWUSA-DTTC Internal Collaboration Meetings

March 27, 2014

4. INTRODUCTIONS
- **a. Electricore**
- **b. National Network Admin – Joe Sarubbi & Mary Lawrence/ IREC**
- **c. SEPA Bob Gibson**
- **d. Universities**
  - **i. USCD**
  - **ii. SDSU**
  - **iii. ASU**
  - **iv. Hawaii**

5. ADMINISTRATIVE UPDATE & UPCOMING DELIVERABLES

a. Student Centered Conference – Bob or Joe Discuss
- PG&E has donated $25,000 (if one student from each university joined would be $19k)
- Covers all onsite costs, hotel stay for two nights
- Monday afternoon from 2pm-8pm; would like to have more students from the GEARED universities
- Up to 25 students to come from SD schools; NNA will help cover bus costs
- $125/day roughly covers faculty
- In conjunction with the SEPA Utility Solar Conference in Newport Beach, CA
- Student Conference is 4/28-4/29 – Agenda has been routed to team on March 13th
- Must register by April 7th
- Posters
- Poster guidelines have been routed to team on March 13th
- Electricore needs the Poster Title from each University by April 7th to Michelle Mason

- In conjunction with the SEPA Utility Solar Conference in Newport Beach, CA
  - Student Conference is 4/28-4/29 – Agenda has been routed to team **on March 13th**
  - Must register by **April 7th**
  - Would like to have more students drive up; not necessarily present posters but to join the conference and the reception.
  - Hoping to get up to 25 students (paid by PG&E sponsorship)
    - $25k budget from SEPA/PG&E for entire consortium not just SWUSA-DTTC
    - Most inexpensive students are coming from CA
    - Faculty invited but don't have budget to cover the faculty; $250 registration + hotel; or just come for 1 day
    - Bill Torre – Thanks to PG&E for the sponsorship. Yes, PHD graduate; Andu Nygen will plan to attend and present a poster. SEPA support Andu's expenses including mileage
    - If students from UCSD want to come for 1 day then the registration fee will be waived. Is there a class that would like to participate, charter a bus for 1 day and (25 students) then work with IREC to get this coordinated. Bill will look into this on his end. Probably be charged to the GEARED project.
    - SDSU – many students actually work for SDGE and would be interested in participating; master students interested in participating
    - SDSU - Get a sign-up sheet to start marketing this

        - Dates do fall during a time when classes take place
        - UCSD will talk to professors and see what they can do to participate
- Posters
    - Poster guidelines have been routed to team **on March 13th**
    - Electricore needs the Poster Title from each University by **April 7th** to Michelle Mason

b. SWUSA-DTTC Advisory Board

- Electricore is in the process of inviting members to join the advisory board. This board will consist of the following:
    - 1-2 Industry Members (including Troy Strand (troy.r.strand@gmail.com). Troy is the largest solar installer in SDGE territory).
    - One member from each SWUSA-DTTC utility (SDGE, SoCal Edison, MECO)
    - One "regulatory" type member. First will be from the ABET accreditation board.
    - One from Calif state education leadership
        - Perhaps sec of education designee or one of the state college leadership

- Electricore is in the process of inviting members to join the advisory board. This board will consist of the following:
    - 1-2 Industry Members (including Troy Strand (troy.r.strand@gmail.com). Troy is the largest solar installer in SDGE territory).
    - One member from each SWUSA-DTTC utility (SDGE, SoCal Edison, MECO)
    - One "regulatory" type member. First will be from the ABET accreditation board.
    - One from Calif state education leadership
        - Perhaps sec of education designee or one of the state college leadership

c. SunShot Summit

- Monday May 19-22, 2014 at the Hilton Anaheim, CA
- The SunShot Portfolio Review will provide SunShot and your GEARED awardee team with valuable feedback about how your project and the SunShot BOS (Soft Costs) team portfolio are building progress toward the SunShot Initiative goals.
- Electricore submitted our 2 page summary and is preparing the Poster
- An overview of what we've accomplished to date along with general info such as goals, actual partners, outcomes and structure of our DTTC
- Required to attend, the PI (John Holmes) and 1 POC from Electricore
- We welcome participants in California to join but the travel/registration cost will not be covered by this GEARED budget.
- UCSD will have 2-3 people there presenting projects; Jan Kleissl, Byron, Carl

- **Monday May 19-22, 2014 at the Hilton Anaheim, CA**
    - The SunShot Portfolio Review will provide SunShot and your GEARED awardee team with valuable feedback about how your project and the SunShot BOS (Soft Costs) team portfolio are building progress toward the SunShot Initiative goals.
        - Electricore submitted our 2 page summary and is preparing the Poster
        - An overview of what we've accomplished to date along with general info such as goals, actual partners, outcomes and structure of our DTTC

- Required to attend, the PI (John Holmes) and 1 POC from Electricore
- We welcome participants in California to join but the travel/registration cost will not be covered by this GEARED budget.

d. Quarterly Report covering Jan-March 2014

- Due April 30th
- Kodie in process of updating and will route to the team for additional updates/accomplishments by **Friday, April 4th**; feedback due to Kodie by by **Friday, April 11th**
- Please submit your invoices to Kodie for work completed through March by April 11th
- Received notice from DOE that any unused funds in BP1 can be carried over into future BPs
- Schedule individual invoicing meetings for the Universities
  - Next week Ecore will reach out to contacts at Uni's
  - There is a standard invoice format that Sara Odom has already sent out

6. University Updates

- UCSD
  - Internal meeting to discuss all classes that were included in statement of work
  - Assigned coursework and faculty participation
    - Course sharing with SDSU
- SDSU
  - Power systems group had a discussion with four items
    - Offering a new class undergrad and grad "energy systems" this fall as a special topics class – if there is enough participation over next three years, it will become a class
    - Creating new lab "power simulations"
- UH
  - Hopefully finishing contract soon to be a part of project; will start developing more courses in collaboration with utilities
  - Renewable energy to cross into college of engineering and hoping to get more student involvement
  - Following up on graduate certificate program on renewable energy

April 17, 2014

1. **INTRODUCTIONS**
    e. **Electricore**
    f. **Universities**
        i. **USCD**
        ii. **SDSU**
        iii. **ASU**
        iv. **Hawaii**
    g. **Utility - SDGE**
2. **ADMINISTRATIVE UPDATE & UPCOMING DELIVERABLES**
    a. **Student Centered Conference**

- In conjunction with the SEPA Utility Solar Conference in Newport Beach, CA
    - Student Conference is 4/28-4/29
    - Registered university participants

School	Staff	Student	Year	Contact Information	Poster Title	Conference Registration	Hotel	Flight
UCSD	Jan Kleissl	Andu Dung Nguyen	3rd year PhD student	andunguyen@ucsd.edu	Powering the Future with Solar Energy: Forecasting and Integration Strategies	Yes	Booked 3/28	N/A
ASU	Dr. George Karady	Jicheng Yu	1st year PhD student	jichengy@asu.edu	Development of the Virtual Laboratory for Electric Machines and Power Electronics	Yes	Booked 4/01	Booked 4/02
SDSU	Dr. Sridhar Seshagiri	Azad Ghaffari	PhD Grad	aghaffari@eng.ucsd.edu	Extremum Seeking for Wind and Solar Energy Applications	Yes	Booked 04/05	N/A
UH	Reza Ghorbani	Ehsan Reihani	1st year PhD student	ereihani@hawaii.edu	Voltage and Reactive Power Control in Distribution System	Yes	Waiting on additional SEPA rooms	Booked 04/06

- 1 day participants

Faculty	
Sridhar Seshagiri	seshagiri@engineering.sdsu.edu
Graduate Students	
Ethan Block	ethan.block@hotmail.com
Undergraduate Students	
Eric Alcomes Aquino	aquinoer@gmail.com
Bryan D. Rodriguez	bryandrodriguez@hotmail.com
Pedro Ramos	pedroskids34@yahoo.com
Priscila Moreno	priscila.moreno87@hotmail.com
Cuong Nguyen	nmcuong1910@yahoo.com

- Posters - Any issues w/ the posters?
    - UH/ASU – If you need to have it FedEx'd to Electricore prior to we can drive it down or get it printed here.

    b. **SWUSA-DTTC Advisory Board**

    - Electricore is in the process of inviting members to join the advisory board. This board will consist of the following:
        - 1-2 Industry Members (including Troy Strand (troy.r.strand@gmail.com). Troy is the largest solar installer in SDGE territory).

- One member from each SWUSA-DTTC utility (SDGE, SoCal Edison, MECO)
- One "regulatory" type member. First will be from the ABET accreditation board – Need this name from J. Holmes
- One from Calif state education leadership – CalPoly SLO Dean

c. SunShot Summit

- Monday May 19-22, 2014 at the Hilton Anaheim, CA
- UCSD will have 2-3 people there presenting projects; Jan Kleissl, Byron, Carl
- Kodie will route the poster information to the team. Please glance over and let me know if you'd like anything revised.
- I owe this ppt to DOE on 4/30

d. Quarterly Report covering Jan-March 2014

- Due April 30th
- Kodie has received input from all University partners
- Please submit your invoices to Kodie for work completed through March asap
  - If you have questions on invoicing please contact me
- Kodie will route to the team tomorrow for final review

3. University Updates

- UCSD
  - Compiled synopsis of new courses
  - Assigned tasks for summer courses
  - Hold courses in conjunction w/ local conferences in SoCal – also in conjunction w/ SEPA
- SEPA – J. Holmes was asked to present at Student Centered Conf. Has not confirmed yet.
- SDSU
  - Power systems group had a discussion with four items
    - Offering a new class undergrad and grad "energy systems" this fall as a special topics class – if there is enough participation over next three years, it will become a class
    - Creating new lab "power simulations"
- UH
  - Hopefully finishing contract soon to be a part of project; will start developing more courses in collaboration with utilities
  - Renewable energy to cross into college of engineering and hoping to get more student involvement
  - Following up on graduate certificate program on renewable energy
- SDGE
  - Sunshot curriculum UCSD solar forecasting development
  - iTron – DC meter in production now; system might be relevant to the discussion here
  - Discuss this opportunity at a separate time – J. Holmes will discuss off line
- ASU
  - Smart meter – learn how to computer simulation of the meter; students make connections and testing to do response simulations
  - Ready to work on this in the summer time; need input from utility and follow up w/ ASU and UCSD directly
  - Sent list of all courses teaching for power electronic students – KA will route to the team
  - 210 students this year
- Funding development to support campuses

- Seeking funding for project work
- 1 large industrial affiliate support
- GEARED deserving recipient; should serve as testimony as the project
- Seek additional funding as vendors
- Faculty recruitment – just interviewing assistant professor

May 15, 2014

1. **INTRODUCTIONS**
    - **h. Electricore**
    - **i. Universities**
        - **i. USCD**
        - **ii. SDSU**
        - **iii. ASU**
        - **iv. Hawaii**
    - **j. Utility**
        - **i. SDGE**
        - **ii. Edison**

2. **ADMINISTRATIVE UPDATE & UPCOMING DELIVERABLES**
    - **a.** Student Centered Conference – Complete, thank you! Press Release will be distributed to the team if Michelle hasn't done so already
    - **b. SWUSA-DTTC Advisory Board**
        - Electricore is in the process of inviting members to join the advisory board. This board will consist of the following:
            - 1-2 Industry Members (including Troy Strand (troy.r.strand@gmail.com). Troy is the largest solar installer in SDGE territory).
            - One member from each SWUSA-DTTC utility (SDGE, SoCal Edison, MECO)
            - One "regulatory" type member. First will be from the ABET accreditation board – Need this name from J. Holmes
            - One from Calif state education leadership – CalPoly SLO Dean
        - Kick off Call being held tomorrow
        - MECO – who would like to stand on the board and I will send official invite letter
    - **c. SunShot Summit**
        - Posters delivered today
        - Deborah Jelen - GEARED: Tuesday, May 20th 4:15pm
        - Who will be there?
    - **d. Quarterly Report covering Jan-March 2014**
        - Submitted

3. **University Updates**
    - UCSD
        - Compiled synopsis of new courses
        - Assigned tasks for summer courses
        - Hold courses in conjunction w/ local conferences in SoCal – also in conjunction w/ SEPA
        - Compile courses with conferences locally in UCSD relevant
        - Representation at Co
        - Carlos, Jan and Byron will be at DOE SunShot Conference
    - SDSU
        - Power systems group had a discussion with four items
            - Offering a new class undergrad and grad "energy systems" this fall as a special topics class – if there is enough participation over next three years, it will become a class
            - Creating new lab "power simulations"
    - SDGE

    - Sunshot curriculum UCSD solar forecasting development
    - iTron – DC meter in production now; system might be relevant to the discussion here
    - Discuss this opportunity at a separate time – J. Holmes will discuss off line
    - Contracting concerns
- Edison
    - Sr. Engineer at Research Dev. Group 10 years
    - First monthly meeting – Araya Gebeyehu
- UH – online outline for power systems course by summer
    - In August
    - Results of research by August; use results to convert into modules in smart grid
- Funding development to support campuses
    - Seeking funding for project work
    - 1 large industrial affiliate support
    - GEARED deserving recipient; should serve as testimony as the project
    - Seek additional funding as vendors
    - Faculty recruitment – just interviewing assistant professor

June 19, 2014 2:00pm PST

1. **INTRODUCTIONS**
    - k. **Electricore** – Kodie Arnold, Deborah Jelen, Brandon Yauch
    - l. **Universities**
        - i. **USCD** – Bill Torre
        - ii. **SDSU** – Not present
        - iii. **ASU** – George Kardy, Meenakshi Saravanan, Jicheng Yu and Lalitha Sankar
        - iv. **Hawaii** – Reza Ghorbani
    - m. **Utility**
        - i. **SDGE** – John Holmes
        - ii. **Edison** – Robert Sherick, Araya Gebeyehu
        - iii. **MECO** – Mathew McNeff

2. **ADMINISTRATIVE UPDATE & UPCOMING DELIVERABLES**
    7. **PI Memo sent to team 6/19**– SCE was reassigned as PI and SDGE no longer a subrecipient under this award for BP1; Memo sent to team on 6/19/14
        - John Holmes will remain on the Tech Advisory Board
        - Electricore and SCE will schedule short meeting w/ each university for plan path forward
    8. **Quarterly Report –** Period APR-JUNE report is due July 30th
        - Electricore will update the Report using information recently received from team on updating deliverable matrix; will route end of June for additional updates and submit end of July
    9. **BP2 Continuation App for Funding** - due July 30
        - Electricore is drafting this document; compilation of past Q reports
        - Electricore will send an email for input as needed
    10. **SWUSA-DTTC Advisory Board**
        - Held Advisory Board Kick Off on May 16, 2014
        - Electricore will include Meeting Minutes in the Q Report and also route to the team
    11. **SunShot Summit – Attended May 20, 2014, presented poster and presented project to review panel**
        - Review w/ panel went very well; no issues
        - Will follow up with DOE to see when/if we get a copy of the formal review evaluation
    12. **NNA Student Innovation Board**
        - Subcommittee meeting with NNA held on 6/17 – Electricore is on the subcommittee meeting and will disseminate information as necessary
        - Action Item – Electricore will send the team the Information for students describing membership requirements, and the roles and responsibilities of SIB participation – Universities please review and let me know if you see anything that should be included or requested to remove by **Monday, June 23rd**
        - The SIB will meet regionally (most likely via teleconference) and then if funds are available, once a year in person for a National Board Meeting with all DTTCs.
        - ASU Action Item – need Contact information from ASU's Meenakshi Saravanana and UH Alireza Eshragi

3. **University Updates**
    d) UCSD

What?	Who?	Due Date / Status
Task 2.2.1.: New 2 to 8 hour short courses on		

Solar energy forecasting & solar energy performance monitoring and modeling	JK CC	07/2014
Advanced applications of interfacing renewables to power system	RdC	07/2014
Power system simulation: fundamentals and applications	WT	07/2014
Task 2.2.2. Advanced training courses Coordinate content with SDSU, fill niches These courses could be added to Master of Advanced Studies (optional for GEARED)		
Power System Engineering: combination of power electronics and power engineering	RdC	09/2014
System Planning and Operation	WT	09/2014
Combine advanced training and short courses into jointly taught, 4 unit 'Advanced Topics' MAE207 in Advanced Power Systems Technology	TSR + others	W2015
Task 2.2.3. Modify and extend the course offering at UCSD to incorporate Power Systems Engineering: These courses could become the core of a Master of Advanced Studies in Renewable Energy and Power Systems (optional for GEARED)		
MAE255 Solar Energy Meteorology MAE256 Radiation for Energy Applications	JK CC	Done Done 11 students in S2014.
MAE280A: Added content on microgrid data integration, synchrophasors	RdC	Done. 11 students in S2014.
EE180 Power Electronics II EE188 Introduction to Power Electronics	RE	Done. 28 and 50 students in S2014 and W2014
CSE "Introduction to Embedded Systems" (4 units) will cover the basics of power systems. It will also discuss details of embedded sensors/actuators needed to manage SmartGrid interfaces CSE291 Smart Grid (1 unit): Introduction to Smart Grid; Basics of Power Systems; Smart Grid Communication, Measurement, and Control; Renewable Energy & Energy Storage; System Reliability & Ancillary Services; Microgrids;	TR	9/2014
Power systems lab in coordination with SDG&E	WT	12/2014

Other UCSD meeting notes:

- Overarching Theme: Grid operation in the presence of high penetration renewables.
- Intervention (teaching) will start in Y2 (start Oct 2014) and continue until Y5.
- Check MOOC materials.
- SDG&E resources: Energy Innovation Center is more generic. Integrated Test Facility has immersion in the power electronics environment. ITF consists: DERlab, Smartgarage.
- Offer courses contemporary with large meetings in San Diego in 2015-2018.
- Obtain training needs from HR of industry affiliates.
- Good Resource: http://cusp.umn.edu/napa_2013.php

e) SDSU

- Action Item - Syllabus for the new course (Fall 2014) –send to Electricore
- Updates provided in the deliverable matrix

- Power systems group had a discussion with four items
  - Offering a new class undergrad and grad "energy systems" this fall as a special topics class – if there is enough participation over next three years, it will become a class
  - Creating new lab "power simulations"

ASU

- ASU hired Meenakshi Saravanan a minority foreign women MS students. She started the upgrade of the existing draft lectures for the short courses:
  a. Smart Transmission System short course,
  b. Smart Distribution Grid with Renewables short course
  These two short course will cover 10 hours of lectures with about 450-500 slides ASU sent the course information for this
- Jicheng Yu, PhD student working on the Virtual laboratory for Smart Distribution Grid
  a. The existing Virtual laboratory programing method has been updated for the latest edition of the MATLAB program
  b. Signed up for virtual lab and developing 2 short courses; distribution systems in renewable energy
     i. 150-200 slides;
     ii. ASU send over the slides for SCE/MECO review if you'd like their input - 10 hour course program – Action Item
- Issues
  a. The short courses that development started must be recorded in a studio, the budget does not allocate any funding for the recording studio cost –
  b. The revolutionary virtual laboratory requires the smart equipment's. Smart Domestic meter and Smart Appliances. The equipment's must be provided by the participating utilities. ASU working with the AZ utilities to rent the equipment.

f) UH – MANOA

- UHM offered postdoctoral position to Dr. Sasidharan Sreedharan and he accepted the position. We expect Dr. Sreedharan to join the group in August 18. He will work to teach and prepare the course modules.
- Dr. Ghorbani is working to prepare slides for 10 hour graduate level course on power conversion for PV and Wind. Hi is coordinating with Dr. Seshagiri.
- Dr. Ghorbani is working with a Japanese company (Myway Plus Inc.) on organizing a 3 days workshop in Nov or Dec 2014 on embedded control of inverters for PV, Wind and EV for utilities. We expect to have 30-50 participants from utilities and universities in USA and Japan. We are working on the outline of the course.
- Smart Grid – 10 student short course
  a. Revise course after summer and present as online course
- UH-Manoa will work with MECO to review course work and align with utility needs – Action
- Problems
  a. The expenses of workshop were not fully covered by the Geared and we have to consider a fee from each participant in order to make it self-sustainable.
  b. We are working with UHM College of engineering to facilitate in preparing media modules of short courses.
  c. Most of the course material is used from the reference books and papers. Thus, permission for Copyright needs to be obtained before posting the material online.

July 17, 2014 2:00pm PST

1. **INTRODUCTIONS**
    - n. **Electricore** – Kodie Arnold, Brandon Yauch, Kyle Morris
    - o. **Universities**
        - i. **USCD** – Bill Torre
        - ii. **ASU** –Meenakshi Saravanan, Jicheng Yu and Lalitha Sankar
        - iii. **Hawaii** – Reza Ghorbani, James Rawson
    - p. **Utility**
        - i. **SDGE** – John Holmes
        - ii. **Edison** – Robert Sherick, Araya Gebeyehu
        - iii. **MECO** – Mathew McNeff, Ray Okazaki
    - q. **Industry**
        - i. **OSI Soft** – Candace Keys, John Matranga

2. **ADMINISTRATIVE UPDATE & UPCOMING DELIVERABLES**

13. Quarterly Report – Period APR-JUNE report is due July 30th

- Received input from ASU, UCSD, UH and SDSU
- The Q report will be used to finalize the BP2 App for funding

14. BP2 Continuation App for Funding - due July 30

- Electricore will send an email for input as needed – Electricore Lead

15. SWUSA-DTTC Advisory Board

- Need to schedule the next Advisory Board Meeting will hold internal discussion w/ Robert Sherick to discuss agenda – Action Item

16. NNA Monthly Meeting – July 31st 2pm – 3pm Eastern Time

- GEARED: DTTC Monthly Conf Call – EPRI will be giving overview of their program/accomplishments
- Call-in Information:
  1-800-406-5448
  guest code: 864157#
- Open to entire team if you'd like to join.

17. NNA Student Innovation Board

- Kodie routed new plan to team from NNA – Need feedback by COB, July 24th – University Action
- Subcommittee meeting with NNA held on 6/17 – Electricore is on the subcommittee meeting and will disseminate information as necessary
- Action Item – Electricore will send the team the Information for students describing membership requirements, and the roles and responsibilities of SIB participation – Universities please review and let me know if you see anything that should be included or requested to remove by **Monday, June 23rd**
- The SIB will meet regionally (most likely via teleconference) and then if funds are available, once a year in person for a National Board Meeting with all DTTCs.
- ASU Action Item – need Contact information from ASU's Meenakshi Saravanana and UH Alireza Eshragi

18. Please submit your invoice for June performance if you haven't done so already

19. OSI Soft Intro – John Matranga Intro

- Role in utility market
- University gain value from Pi at academic, research and work into curriculum at each university
- Consortium w/ large group coming together to solve a problem – industry and academic is a great solution

3. University Updates

g) UCSD

What?	Who?	Due Date / Status
Task 2.2.1.: New 2 to 8 hour short courses on		
Solar energy forecasting & solar energy performance monitoring and modeling	JK CC	07/2014
Advanced applications of interfacing renewables to power system	RdC	07/2014
Power system simulation: fundamentals and applications	WT	07/2014
Task 2.2.2. Advanced training courses Coordinate content with SDSU, fill niches These courses could be added to Master of Advanced Studies (optional for GEARED)		
Power System Engineering: combination of power electronics and power engineering	RdC	09/2014
System Planning and Operation	WT	09/2014
Combine advanced training and short courses into jointly taught, 4 unit 'Advanced Topics' MAE207 in Advanced Power Systems Technology	TSR + others	W2015
Task 2.2.3. Modify and extend the course offering at UCSD to incorporate Power Systems Engineering: These courses could become the core of a Master of Advanced Studies in Renewable Energy and Power Systems (optional for GEARED)		
MAE255 Solar Energy Meteorology MAE256 Radiation for Energy Applications	JK CC	Done Done 11 students in S2014.
MAE280A: Added content on microgrid data integration, synchrophasors	RdC	Done. 11 students in S2014.
EE180 Power Electronics II EE188 Introduction to Power Electronics	RE	Done. 28 and 50 students in S2014 and W2014
CSE "Introduction to Embedded Systems" (4 units) will cover the basics of power systems. It will also discuss details of embedded sensors/actuators needed to manage SmartGrid interfaces CSE291 Smart Grid (1 unit): Introduction to Smart Grid; Basics of Power Systems; Smart Grid Communication, Measurement, and Control; Renewable Energy & Energy Storage; System Reliability & Ancillary Services; Microgrids;	TR	9/2014
Power systems lab in coordination with SDG&E	WT	12/2014

Other UCSD meeting notes:

- Internal meeting to discuss courses and short courses
- Exploring ideas of course sharing w/ SDSU to be sure we do not duplicate efforts at level of dept. chair and dean of engineering
- Question from SCE – short courses targeting university extension – primarily for professionals and not necessarily new students?
    - Yes, reaching out to industry
    - SCE and UCSD to talk more offline and coordinate efforts

- SCE interested in attendance and also don't want to duplicate efforts. – schedule internal call – Action Item

h) SDSU

- SDSU sent tentative syllabus for EE596- Renewable Energy Systems and the Smart Grid - Fall 2014
  - Electricore included in Q Report
- Dr. Betancourt, Dr. Seshigiri and + Dept Chair) met with Dr. Hassan Ghoudjehbaklou from SDG&E to request that he teach 2 graduate power system courses augmenting Dr. Betancourt's courses.
  - Once we sign a contractual agreement (soon after the semester starts) we hope he will be teaching 1 course each semester for the next 3 years, and that he will be reimbursed from the grant money. Of course, the courses will require the approval of the Graduate Curriculum Committee and Department, and i will continue to work on those.
- Next steps: contact Dr. Karady to discuss online/virtual labs/ short courses to "replicate" what he has been doing at ASU.
- Work with Bill Torre on a formal mechanism to share courses between SDSU/UCSD. Initial efforts are under way.

ASU

- Virtual laboratory for Smart Grid components
  - The existing virtual laboratory for EEE 360 Energy Systems and Power Electronics (4) course has been updated and transferred to latest edition of MATLAB.
  - The local utility promised but did not deliver the Smart Meter which hinders the further development of this section of the project. ASU request the participating utilities to lend Smart Grid components to ASU. We cannot develop the virtual laboratory without components
  - PhD Student Jicheng Yu (jichengy@asu.edu) works on this project

- ASU continued the development of two required short courses.
  - **Smart Transmission System**, progressed well and the short course will be ready within two month
  - **Distribution Grid with Renewables.** Ms. Meenakshi Saravanan reviewed the literature and produced about 50 slides for this short course.
  - MS Student Meenakshi Saravanan (msaravan&asu.edu) works on this project

- Number of students you are reaching out to in your curriculum efforts.
  - The enrollment of EEE 360 Energy System and Power Electronics in the next semester string in August is 64 students
  - The enrolment of EEE 571 Power System Transients in in the next semester string in August is 51 on-campus students and 15 online students
- **PhD student** Jicheng Yu participated and presented a poster at GEARED meeting at the end of April and he did not receive the reimbursement for his trip. The recite for the trip has been sent to Himali Shah (hshah@solarelectricpower.org)
- The students at the University are living on limited amount of salary and need immediate reimbursement for their expenses. ASU request reimbursement of Mr. Yu – KA will follow up and look to see if NNA received invoice documentation

- Issues
    d. The short courses that development started must be recorded in a studio, the budget does not allocate any funding for the recording studio cost.
    e. The revolutionary virtual laboratory requires the smart equipment's. Smart Domestic meter and Smart Appliances. The equipment's must be provided by the participating utilities. ASU working with the AZ utilities to rent the equipment.

i) UH – MANOA

- UHM offered postdoctoral position to Dr. Sasidharan Sreedharan and he accepted the position. We expect Dr. Sreedharan to join the group in August 18. He will work to teach and prepare the course modules.
- Dr. Ghorbani is working to prepare slides for 10 hour graduate level course on power conversion for PV and Wind. Hi is coordinating with Dr. Seshagiri.
- Dr. Ghorbani is working with a Japanese company (Myway Plus Inc.) on organizing a 3 days workshop in Nov or Dec 2014 on embedded control of inverters for PV, Wind and EV for utilities. We expect to have 30-50 participants from utilities and universities in USA and Japan. We are working on the outline of the course.
    a. This is on track ; received travel info!
- Smart Grid – 10 student short course
    a. Revise course after summer and present as online course
- UH-Manoa will work with MECO to review course work and align with utility needs – Action Item
- Problems
    a. The expenses of workshop were not fully covered by the Geared and we have to consider a fee from each participant in order to make it self-sustainable.
    b. We are working with UHM College of engineering to facilitate in preparing media modules of short courses.
    c. Most of the course material is used from the reference books and papers. Thus, permission for Copyright needs to be obtained before posting the material online.
- Edison
    a. Training; opening up RDTS to external training – working through this
    b. Hold individual meetings w/ each university – Action SCE and Electricore

August 21, 2014 2:00pm PST

1. **INTRODUCTIONS**
   - r. **Electricore** – Kodie Arnold, Brandon Yauch
   - s. **Universities**
     - i. **USCD** – Jan Kleissl
     - ii. **ASU** –George Karady, Jicheng Yu
     - iii. **Hawaii** – Reza Ghorbani
   - t. **Utility**
     - i. **SDGE** – John Holmes
     - ii. **Edison** – Robert Sherick
     - iii. **MECO** –Ray Okazaki
   - u. **Industry**
     - i. **OSI Soft** –John Matranga

2. **ADMINISTRATIVE UPDATE & UPCOMING DELIVERABLES**

20. Quarterly Report – Period APR-JUNE – SUBMITTED

21. Quarterly Report – Period JULY-SEPT – Due October 30th

22. BP2 Continuation App for Funding - SUBMITTED
- DOE will begin review w/ SunShot managers on 8/21. BP1 ends 9/30/14

23. SWUSA-DTTC Advisory Board
- Working w/ SCE to develop agenda

24. NNA Monthly Meeting – August 28th 11am PST (2pm EST)
- GEARED: DTTC Monthly Conf Call – Electricore SWUSA-DTTC will be giving a short 10-15 min update and future activities to the group
- Call-in Information:
  1-800-406-5448
  guest code: 864157#

25. NNA Student Innovation Board
- Kodie will route the final SIB plan to the team
- Brandon Yauch (brandon@electricore.org) will be the SIB main POC

26. Please submit your invoice for July performance if you haven't done so already – Including Cost Share

University Updates

j) UCSD

What?	Who?	Due Date / Status
Task 2.2.1.: New 2 to 8 hour short courses on		
Solar energy forecasting & solar energy performance monitoring and modeling	JK CC	07/2014
Advanced applications of interfacing renewables to power system	RdC	07/2014
Power system simulation: fundamentals and applications	WT	07/2014
Task 2.2.2. Advanced training courses Coordinate content with SDSU, fill niches These courses could be added to Master of Advanced Studies (optional for GEARED)		Will send an overview; Winterer Quarter Wednesday evenings will recruit non UCSD students as well. Solar Grid Integration course – broad on solar

		forecasting and power electronics Graduate course; elective 4 credits undergrads can also take as an elective for entire quarter. Utility professionals are able to take through the UC extension and will have to pay for this course $500-$2k? Utilities often provide an option for education reimbursement. Classroom based training for now. Jan will send this syllabus to Kodie to route.
Power System Engineering: combination of power electronics and power engineering	RdC	09/2014
System Planning and Operation	WT	09/2014
Combine advanced training and short courses into jointly taught, 4 unit 'Advanced Topics' MAE207 in Advanced Power Systems Technology	TSR + other	W2015
Task 2.2.3. Modify and extend the course offering at UCSD to incorporate Power Systems Engineering: These courses could become the core of a Master of Advanced Studies in Renewable Energy and Power Systems (optional for GEARED)		
MAE255 Solar Energy Meteorology MAE256 Radiation for Energy Applications	JK CC	Done Done 11 students in S2014.
MAE280A: Added content on microgrid data integration, synchrophasors	RdC	Done. 11 students in S2014.
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CSE "Introduction to Embedded Systems" (4 units) will cover the basics of power systems. It will also discuss details of embedded sensors/actuators needed to manage SmartGrid interfaces	TR	9/2014

CSE291 Smart Grid (1 unit): Introduction to Smart Grid; Basics of Power Systems; Smart Grid Communication, Measurement, and Control; Renewable Energy & Energy Storage; System Reliability & Ancillary Services; Microgrids;		
Power systems lab in coordination with SDG&E	WT	12/2014

k) SDSU

- Not present

ASU

- Resource available for existing MS Program utility professionals – no credit from universities – MS Program submitted a while back – now available for professionals
- Developed smart grid distribution grid – short course 400 slides; need a few more months
- Transmission short course
  - Define how it will be used? Presentation given my Dr. Karady; no media available at ASU
- Issues
  c. The short courses that development started must be recorded in a studio, the budget does not allocate any funding for the recording studio cost. Action Item – Send Kodie a quote
  d. The revolutionary virtual laboratory requires the smart equipment's. Smart Domestic meter and Smart Appliances. The equipment's must be provided by the participating utilities. ASU working with the AZ utilities to rent the equipment. Action Item – Send Kodie a description of your need

l) UH – MANOA

- Post doc arrived
- Kodie will route the syllabus to team
- 4 day Workshop in December focus on smart grid
  - Planning in next 2 weeks and will send flyer when available

m) Edison

a. Training; opening up RDTS to external training – working through this
   i. Will be working through a plan of action if SDG&E is not authorized to hold training
   ii. SCE investigating option to use a portable RDTS for UCSD and use OSI Soft Cloud connection
b. Hold individual meetings w/ each university – Held UCSD and SDSU this week
   i. Need to schedule UH and ASU still
c. Drafting agenda for Tech Advisory Board meeting
d. Robert Sherick is reaching out to Schweitzer and UCI (Scott Samuelson) for support – at least to become a member on the board until additional funding is available.

n) OSI Soft

- Need to get agreements in place w/ ASU and UH
- Will send email on PI system to UH
- OSIsoft will host our 14th annual T&D User Conference:
  - Where: Hilton, Albany NY
  - When: Sept 10th/11th/12th

- Host: NYISO (there will be a tour on the morning of the 10th)
- Agenda: https://www.eiseverywhere.com/file_uploads/0e658678a4ee3292a156bd4ad0c3ac17_TDUCagenda818142.pdf
- Sign UP: https://www.etouches.com/ereg/newreg.php?eventid=93074
- Some highlights in this year's agenda:
    i. We will be visiting NYISO Energy Control Center on the morning of Wednesday, September 10, 2014.
    ii. So far we have several distinguished utility speakers confirmed. Stay tuned for frequent updates to our meeting agenda!
    iii. Due to popular demand, our training will again be extended to 14:00 on Friday, September 12th to cover more content and include utility use case examples
    iv. It is a great set of customers presenting information and a great chance to network with like-minded people.
    v. If you need more information or have questions about the event please email John Matranga at jmatranga@osisoft.com.

September 18, 2014 2:00pm PST

4. INTRODUCTIONS

v. Electricore –Brandon Yauch

w. Universities

i. Hawaii – Reza Ghorbani, Ed Noma (HNEI)

x. Utility

i. SDGE – John Holmes

ii. Edison – Araya Gebeyehu

5. ADMINISTRATIVE UPDATE & UPCOMING DELIVERABLES

27. EPRI made a big splash regarding their team's activities. Their presentation given to Tom Reddick's team, very warm reception. 4 universities represented on panel. Gave a 2 hour presentation. Not many questions, but audience was very attentive. Good for outreach into utility sector.

28. Quarterly Report – Period APR-JUNE – SUBMITTED

29. Quarterly Report – Period JULY-SEPT – Due October 30th

30. BP2 Continuation App for Funding - SUBMITTED

- BP1 ends 9/30/14.

31. SWUSA-DTTC Advisory Board

- Working w/ SCE to develop agenda.

32. NNA Student Innovation Board

- Kodie will route the final SIB plan to the team
- Brandon Yauch (brandon@electricore.org) will be the SIB main POC

6. University Updates

o) UH – MANOA

- Ed Noma helping with management part of work.
- Post doc currently doing work.
- Planning actions based on contract, trying to catch up
- Getting graduate students and others to help refine current and future courses
- Solar Power Systems course hopefully good to go next semester
- Planning workshop for January, still working on flyer
- Reza traveling to California October 20th, extending invitation to meet up with consortium partners to discuss program in person. Main trip is to San Francisco.
  - Invitation going out to San Diego in particular.

p) Edison

e. Trying to bring in residence scholar from UCLA to develop training program using RTDS

f. Developing training manual as well

g. Having some difficulty getting professor from university, hoped to get it by summer.

APPENDIX J: High Level Mapping

Industry Challenges

Challenges	Possible Solutions
• Difficult to get professionals to take courses unless they are tied to an advanced degree. • Hitting barriers tied to high solar penetration, especially in Hawaii, where there is 100% penetration relative to daytime load of the circuit. • Difficulty finding graduate engineers with experience in power systems to hire. • Professional engineers do not have compulsory continuing education requirements, providing little incentive to invest in courses.	• Leverage industry grid concerns into curriculum, especially in Hawaii: focus courses on advanced inverter functions as used in the distribution grid, as well as the local distribution grid. • Provide more on-campus recruiting to directly market to students and further develop industry relationship with universities. • Engage Asian companies to potentially join a West Coast research center. • Continue to strengthen utility relationship with universities.

Education/Training Challenges

Challenges	Possible Solutions
• Limited amount of faculty with Power Systems expertise • Challenges hiring new faculty • Difficulty finding R&D funding to expand Power Systems programs. • Worries that students would not be interested in power dynamics, thus resulting in no program participation • Will need to gain the approval of engineering deans and academic committees to implement new curricula. • Need help marketing courses to students and professionals. • Need to gain permission from copyright owners to make course content publicly available.	• Provide industry support for funding proposals and funding in general. Aggressively seek out DOE, NSF, and CEC grants. • SCE will help market courses to professional community. • Leverage university partnerships, such as the ongoing relationship between UCSD and SDSU. • Continue to strengthen utility and industry relationship with universities.

<u>UCSD Challenges</u>

- UCSD is still somewhat far away (years away) from having a Power Systems Engineering Degree.
- Will have to spark a cultural change to implement curriculum successfully.
- There is a limited amount of faculty with Power Systems expertise.
- Not a substantial amount of RD funding. Need external funding to expand.
- Difficult to get professionals into longer courses unless they are tied to a graduate degree.

<u>UCSD Possible Solutions</u>

- Develop a closer relationship with industry to benefit both rate payers and industry.
- Continue to develop relationship with SDG&E

- Engage Asian companies to join a West Coast research center.
- Use market opportunities on the West Coast/Hawaii to incorporate into the curriculum.
- Leverage ongoing relationship with SDSU.

SDSU Challenges

- Want to offer a graduate program in power systems, but there are worries that students would not be interested in power dynamics, thus there would be no program participation.
- Searching for more funding: recent NSF and CEC proposals have been declined.
- Professional engineers do not have continuing education requirements, so would only commit to a program for an advanced degree.

SDSU Possible Solutions

- SCE is very interested in hiring graduate engineers for its RD group.
- SCE would help market courses to professional community.
- SCE will have HR recruiting on campus to continue to develop relationship with SDSU.
- SCE will look over SDSU funding proposals and provide support.
- Leverage ongoing relationship with UCSD.

UH Challenges

- Hawaii hitting barrier issues with high penetration of PV (100% penetration relative to daytime load of circuit).
- Currently using 300 MW of PV, new plans to add 900 MW more of PV in the near future.
- Permission from copyright owners needs to be obtained before posting course material online.
- Need input on how to market the courses.
- Challenge hiring new faculty
- Power systems curriculum has been on the outs for about 15 years: need to rally up excitement at the university.
- Have some funding from NSF, but concerned about what will happen when the funding runs out.

UH Possible Solutions:

- Leverage Hawaii's grid concerns into curriculum:
    - Will focus on advanced inverter function as used in distribution grid.
    - Focused on smart advanced PV inverter functions on local distribution grid.
- Leverage research activities driven by necessity in the real world, and combine into the curriculum.
- Seeking industry and government funding.

APPENDIX K: UHM ME 696 Modern Power Systems Syllabus

UHM, Mechanical Engineering
ME 696: Modern Power Systems: Control and Conversion
Fall 2014

Course Rationale: In future power systems we are generally interested in integrating more power from distributed and intermittent sources (PV and Wind). Smart grid and power inverters/converters are expected to play a key role in grid modernization and adaptation, across different scales of the electricity grid.

Course Description: Smart grid concepts and power grid converters. Solar energy and wind energy systems. Load flow and optimal power flow analysis. Power inverters and their grid interactions.

Prerequisites: Control systems, Intro to power systems, Electric circuits, Optimization, MATLAB, Linear Algebra

Course Schedule: MW 12 to 1:15

Instructor:

Dr. Reza Ghorbani 201 Holmes Hall Rezag at Hawaii dot edu Office Hours: By appointments only	Dr. Sasidharan Sreedharan 491 Holmes Hall sasi@hawaii.edu

Course Website: …….

Textbooks: Ali Keyhani, Design of Smart Power Grid Renewable Energy Systems, ISBN: 978-0-470-62761-7, Wiley

Remus Teodorescu, Marco Liserre, Pedro Rodriguez, Grid Converters for Photovoltaic and Wind Power Systems, ISBN: 978-0-470-05751-3, Wiley

James Momoh, Smart Grid: Fundamentals of Design and Analysis ISBN: 978-0-470-88939-8, Wiley

Software: PSIM, http://powersimtech.com/products/psim/

Grading Basis: Project Assignments: 50%
Course Project: 50%

Class Logistics:
The tentative class schedule, including topics to be covered, is listed below. The schedule is subject to change depending on time constraints. During lectures, tables/figures from the textbook or other sources will often be shown as slides.

Tentative Lecture Schedule:

The primary reference for course lectures will be the Keyhani and Teodorescu textbooks. NOTE: Recommended readings listed for each section in parentheses after the topic list start with K for Keyhani's, T for Teodorescu's and M for Momoh's. (1500 slides)

1st week: **Energy and Civilization. Why Smart Power Grids.** (K: Ch. 1, 2) (60 slides)

2nd week: **Modeling Converters in Microgrid Power Systems.** (K: Ch. 2) (160 slides)

4rd week: **Analysis of Microgrid Systems & Despatch.** (160 slides)

5th week: **Grid Stability.** (230 slides)

6th week: **Grid Stability.**

7th week: **Grid Control Systems and Fault Studies.** (K: Ch. 8) (160 slides)

8th week: **Market Model and Pricing.** (100 slides)

9rd week: **Photovoltaic Inverter Structures.** (T: Ch. 2) (60 slides)

10th week: **Solar Energy Systems**. (K: Ch. 5) (60 slides)

11th week: **Islanding Detection.** (T: Ch. 5) (50 slides)

12th week: **Wind Energy Systems.** (K: Ch. 6) (100 slides)

13th week: **Grid Converter Structures for Wind Turbine Systems.** (T: Ch. 6) (100 slides)

14th week: **Student presentations.**

Project Assignments:

Project assignments are designed to allow for the application of theory covered in the class, as well as implementing the techniques in PSIM and MATLAB. They will provide practical experience in solving real-world problems involving real data and models. Due to limited lecture time, some concepts and applications will be introduced in the project assignments. ***Note: The assignments do not simply consist of "book problems", but involve a significant amount of data analysis, modeling and implementation. As such, they are more like "lab" assignments and will take a significant amount of time and form the primary basis of the course.***

Most of the problems will involve numerical computing and/or data analysis and processing using PSIM and MATLAB. You expect to learn more from project assignments than the lectures!

You should submit the assignments in M files or PSIM files.

Course Project:

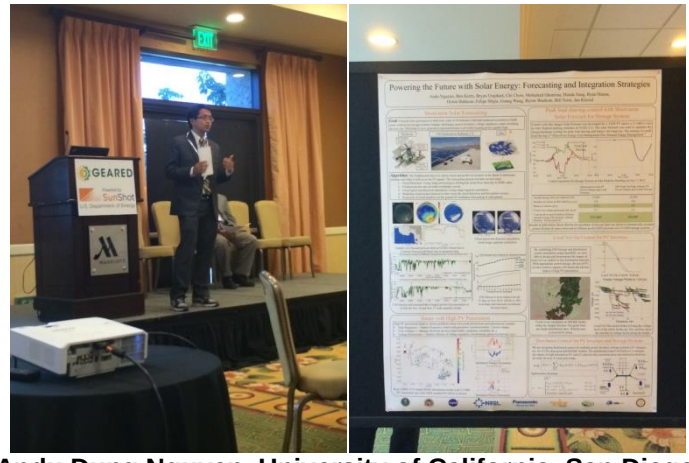
For your course project you are asked to choose a topic related to smart grid. Once your topic is chosen you are responsible for choosing a seminal paper (and its supporting key references) in that area and presenting a ~25-minute mini-lecture on the paper topic to the class. ***A list of your top three choices for topic is due January 18. Once your topic is assigned, a list of 10 potential papers is due February 1. The final selection will be done in collaboration with the instructor.***

Developing the course is sponsored by US DOE Geared Program (SWUSA-DTTC)

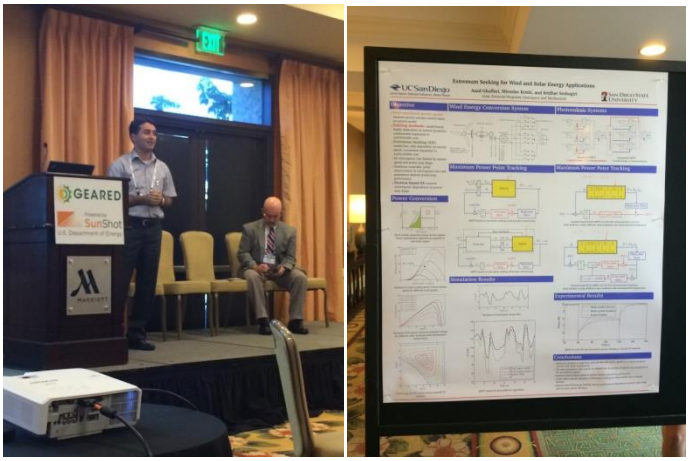
APPENDIX L: STUDENT CENTERED CONFERENCE PRESS RELEASE

Electricore, Inc. and the Electricore Southwest USA - Distributed Technology Training Consortia (SWUSA-DTTC) attended the 1st Annual Student Centered Workshop hosted by Solar Electric Power Association (SEPA) and The Interstate Renewable Energy Council, Inc. (IREC) in conjunction with SEPA's Utility Solar Conference in Newport Beach, CA on April 28-29, 2014.

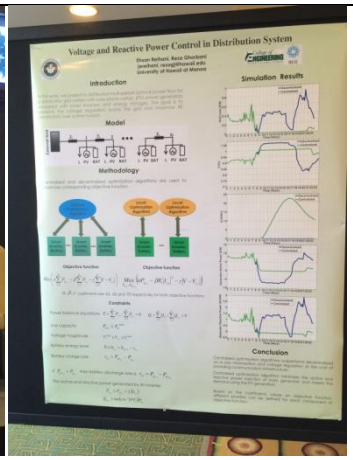
The university partners within the Electricore SWUSA-DTTC each nominated one student to create and present a poster at the workshop and during Utility Solar Conference. The student presentations were as follows:



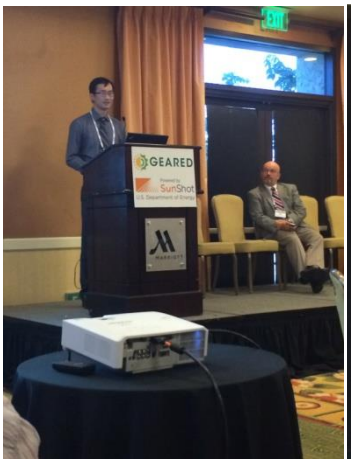
Andu Dung Nguyen, University of California, San Diego
"Powering the Future with Solar Energy: Forecasting and Integration Strategies"

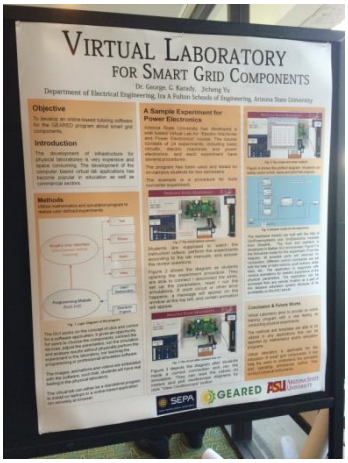


Azad Ghaffari, San Diego State University
"Extremum Seeking for Wind and Solar Energy Applications"



Ehsan Reihani, University of Hawaii at Manoa
"Voltage and Reactive Power Control in Distribution System"





Jicheng Yu, Arizona State University
"Development of the Virtual Laboratory for Electric Machines and Power Electronics"

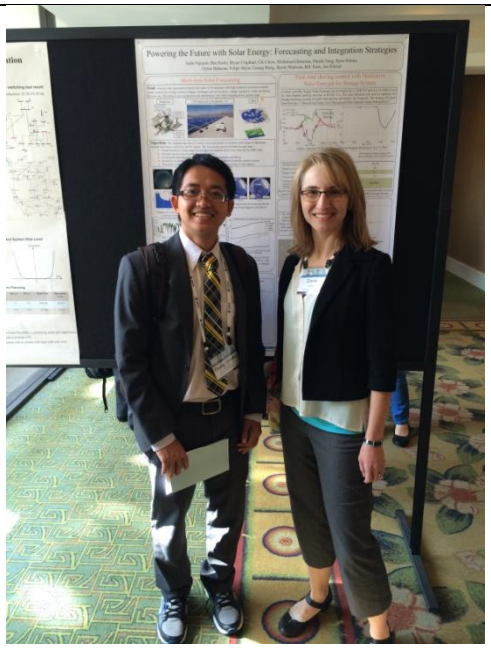
The Electricore Consortium would like to thank SEPA and IREC for hosting this hugely successful workshop and to all students who presented their outstanding projects.

Electricore would also like to thank Pacific Gas and Electric (PG&E) for the generous donation to SEPA that allowed the student presenters to travel and attend the conference. Thirteen (13) additional students from the Electricore SWUSA-DTTC were also able to attend the first day of the conference from this donation.

The Electricore SWUSA-DTTC will leverage utility, university and commercial assets as groundwork for a training network that supports curriculum development and power systems training to promote growth in proficiency and capability using DOE's Distributed Technology Training Consortia (DTTC) model. The SWUSA-DTTC aims to increase U.S. capacity to integrate high penetrations of solar and other distributed energy technologies.

Additional photos are included below.

Dr. Seshagiri from SDSU stands with Azad Ghaffari in front of his poster.



Andu Dung Nguyen stands with Elaine Ulrich, PhD, Acting Lead of the Solar Energy Technologies Program at DOE EERE

Conference attendees discuss posters with SDSU and UH students

APPENDIX M: UCSD SHORT COURSE DESCRIPTION

Task	Due Date / Status
Task 2.2.1: New 2 to 8 hour short courses on:	
Solar energy forecasting & solar energy performance monitoring and modeling	07/2014
Advanced applications of interfacing renewables to power system	07/2014
Power system simulation: fundamentals and applications	07/2014
Task 2.2.2. Advanced training courses Coordinate content with SDSU, fill niches These courses could be added to Master of Advanced Studies (optional for GEARED)	
Power System Engineering: combination of power electronics and power engineering	09/2014
System Planning and Operation	09/2014
Combine advanced training and short courses into jointly taught, 4 unit 'Advanced Topics' MAE207 in Advanced Power Systems Technology	W2015
Task 2.2.3. Modify and extend the course offering at UCSD to incorporate Power Systems Engineering: These courses could become the core of a Master of Advanced Studies in Renewable Energy and Power Systems (optional for GEARED)	
MAE255 Solar Energy Meteorology MAE256 Radiation for Energy Applications	Done Done 11 students in S2014.
MAE280A: Added content on microgrid data integration, synchrophasors	Done. 11 students in S2014.
EE180 Power Electronics II EE188 Introduction to Power Electronics	Done. 28 and 50 students in S2014 and W2014
CSE "Introduction to Embedded Systems" (4 units) will cover the basics of power systems. It will also discuss details of embedded sensors/actuators needed to manage SmartGrid interfaces CSE291 Smart Grid (1 unit): Introduction to Smart Grid; Basics of Power Systems; Smart Grid Communication, Measurement, and Control; Renewable Energy & Energy Storage; System Reliability & Ancillary Services; Microgrids;	9/2014
Power systems lab in coordination with SDG&E	12/2014

Appendix N: November 20, 2013 Kick-Off Meeting Minutes

Discussion

- SunShot Overview Slide Deck –
  - Reduce the impact of climate change
  - US has doubled renewable energy from 2008
  - Other SunShot projects
- Program Overview
  - Project team
    - DOE is excited about team – universities, labs, and industry; make sure everyone has opportunity to interact with each other and communicate.
  - Project Organization
  - Program Communication Plan
    - 100% of team engaged in contracting
    - With respect to communications, knowing how to coordinate people; there will always be IREC; in December, we'll be having discussions about connecting to the larger network as well and wealth of resources as well; and how this will play as a broader role in the network
      - After December meeting, we will have a much better view of what our communication plan will be
    - Work outcome we'd like to come out of December meeting is an understanding of the network of communication structure. DOE would like to establish some sort of protocol of communication between the team, DOE, and network administrator
- Partners Overview
  - ASU – SunShot is familiar with Dr. Karady and his power systems research; happy to have him on team
  - SDSU (at December meeting, how to issue certifications [how to make it consistent across network)
  - LBNL – DOE will look into contracting issues and give control to Electricore
  - UCSD; UH; SDG&E; SCE; SAFT; OSI Soft
- Questions
  - Second thoughts about sending project narratives outside DOE office to National Administrator; did, however, send SOPO. Will discuss when proprietary information is organized
  - DOE introductions:
    - **Joe Sarubbi** – project team is fantastic. Must have a good communication plan especially with the number of people on the team (and the other teams). Excited to hear trainer courses. Bulk of information will be provided in December, but overview of what will be wanted:
      - List of partners, key personnel, roles and responsibilities of each
      - Conducting gap analysis – curriculum is being developed across the country, what are we missing?
      - National Network Administrator's SOPO
      - Student Innovation Board – hoping to get good, creative ideas about working in the utility industry
      - Student Conference – will discuss more in December
    - **Matt Champagne** – focus is on metrics and evaluation. Looked through SOPO and emphasis on evaluation and assessment is impressive, especially dashboard; would love to hear more. Interested in outreach metrics
    - **Bob Gibson** – from SEPA (Solar Electric Power Association, educational nonprofit) and part of NNA. Manage student research conference. Merge student conference with SEPA conference

- **Jerry Ventre** – Photovoltaics (previously at Florida Solar Energy Center)
- **Mary Lawrence** – administrative and logistical support

- December Meeting
  - December 11th – introduction dinner
  - Every team on call today is invited to meeting in December if so inclined (one per team maximum)
  - Be prepared with 30 minute overview
- General Discussion
  - Looking to drive innovation through technology, but would love to focus on human capital assets and what this project will mean for the people involved now and in the future
  - Interested in ideas from everyone so don't hesitate to ask or comment on anything
  - Funding in the next few years – nothing can be committed yet. In general, in the absence of directly committing funds from SunShot, it is always encouraged to leverage this work

Appendix O: NNA Kick-Off Meeting December 11-12, 2013

GEARED NNA KICK-OFF

- New GEARED Logo – available for DTTC use; will provide usage guidelines
- Conscious decision not to use DOE logo with GEARED logo; GEARED will go past 5 year funded opportunity
- Do we still use SunShot logo
- IREC
    - Coordination
    - Connections
    - Consistency
    - Accountability
- IREC communication
    - Center for energy workforce development 2012 survey results

FEEDER CONSORTIA

- www.feeder/center.org
- 7 universities, 4 utilities, 2 NLabs, and commercial entities
- Graduate studies are able to migrate among universities to specialize in an area that their university may not have available
- Students have access to broader scale teaching opportunity
- How to get universities to work/collaborate together/ share courses/tuition etc.
    - Already have agreements in place, yes. Will be able to share the agreement with GEARED network
    - Who is issuing the credentials? The university that is conducting the program
    - Plan to agree to a particular section, students from other campus can register as a guest student and issue grades etc. back to their home university
    - As long as numbers even out there's no issue; and report back to the universities
    - DOE comment – encourage metrics for students to have this mobility; convince universities there is a benefit! This is a driver for the grant; encourage the cross collaboration; cross institutional coursework ; pilot program

EPRI CONSORTIA

- Focus on - New hires, entry level, mid level and senior level
- Georgia Tech lead educational institution
    - Establish metrics; develop e learning
    - Clarkson university

University of Missouri – (MARMET)

- Course sharing
- Short courses for professionals
- Workforce training
- Assessment and evaluation
- Facilities available for use
    - Solar facility decathlon
    - Smart grid training facility
- Program management
- Annual retreat – team building
- Intercampus visits
- Course certification/curricula
- Influence the establishment of design standards/efficiencies across campuses
    - Sharing info among universities; isn't the professors barriers it's the university agreements in place; and legal contracts needed to be in place; devil is in the details and design strategy

- Mid-America representation
    - Wind energy in Iowa; not a distributed technology; some singular turbines
    - Large wind-farms all over
    - Power systems outreach

ELECTRICORE – SWDTTC

- Get CEC on the advisory board asap
- Pitch geared to CEC for potential funding opportunities
- Show where we started and where we are today
- Reach out to all utilities on advisory role; share internship programs
    - Put Jesse on the HR trail for internships
- Offer IEEE; EPRI reports – give our professors these resources – report in the first quarter

IREC/SEPA

- Monthly meetings – simple; 1 hour via webex
    - Individual awardees; not entire GEARED consortium
- In person meeting –
    - SEPA utility conference student centered – in April 2014 san diego
    - Focus groups; utilities
- SunShot Summit: Peer Review May 19-22 Hilton Anaheim!! (not DC)
    - Present a poster (1 representative); at least 1 individual from each award! Grad students are welcome to participate as well; fee is $500 or less. Week before memorial holiday weekend
    - Program review by peers/assessed looking at entire portfolio as a whole
    - State local initiatives
    - Business learning
    - SUNRISE will also be this weekend as well; need separate poster for GEARED and SUNRISE

SEPA Advisory Boards – Bob Gibson

- Asking for representation from national network
    - 2x a year/virtual meeting
    - Representation from each consortium
    - Form a charter; roles/responsibilities of each partner
    - Some external representation
    - Sharing info on student innovation; student centered conferences
    - Separate from the monthly meetings
    - Board meeting responsibility: What's important to your group? Share info back with SW consortium; broader strategic roles
    - In part an effort to create entity allows strategy to figure out how the larger network will benefit our smaller SW-DTTC
    - Will need nominations from each organization
    - Reporting back to our SW-DTTC – yes 2 way street
- NNA will not be involved with direct deliverables due to DOE; NNA staying out of that
- Naming conventions of the national network
- NNA needs a list of ALL members and their roles of SW-DTTC with all contact info
    - Is Ecore ok with this?
    - NNA thinks this level of collaboration is important
- NNA conducting yearly site visits –
    - Merge SEPA conference with NNA yearly site visit in April
    - NNA is very OPEN with communication sharing – NDA in place?
- NNA Website:
    - Ecore needs a SW-DTTC website…a link on our current site? Yes
    - NNA wants a POC from Ecore for social media – Michelle M.

- Lessons Learned
  - Low enrollment in community colleges; problem – most students live near the college
    - Solar programs interest; over the years enrollment decreased; programs shut down due to low enrollment; low interest
    - Need to decide over time how many courses running and how many are feasible and if there are enough jobs available for graduating students?!
    - Tracking students down the road; are our students getting jobs in this area once they graduate?
    - Where are the jobs
- Solar Instructor Training Network – 4th year
  - Train the trainer
  - IREC is the NNA for this as well

STUDENT CENTERED CONFERENCE – SEPA

- Customer, program and technology smart
- April in New Port, CA April 29-30; Student Conference on April 28th Monday!
- Students are center of attention
- Ecore offer
  - Resume exchange
  - Internship opportunities
  - Resume review
- Cohosting with Utility Solar Conference April 29-30
  - Increase communication as they are increasing solar into their utility integration
- Students to mesh with utility personnel and build solar aware business opportunities and models
- Chance for students to present at their conference
  - Students invited to come to 1st day of utility conference
- Needs commitment and provide POC to work with SEPA to organize the student conference for our organization
  - Nominate via email
  - Consortium to provide support framework for the conf. Did we budget for this effort?? No
- Year 1: already relevant work in undergrad and grad courses
  - Students to nominate projects to present on at first conference
- Year 2 – Research competition nominated by the students
- Deb –
  - Content of the 28th – some speakers from DTTCs but then students give presentations to related goals on existing research programs ongoing in their department
- No Funding from DOE for the conference; need food/bev, AV. Students will need to pay
  - Utility sponsorships for the students!
  - Some budget was included for the universities
- Sponsorship for the students will come from the consortium/utility
- Have students apart of something much larger than just their university program
  - Learn best practices
  - Envision utilities apart of student conf. (future employees)
- North American Power Symposium
  - Student centered in U. Charlotte October/Sept
  - Another option for future years
  - IEEE
- Needs to be easy for the students to get there as well!
  - Tied with a current student centered seminar
  - SEPA – 250 utilities with a possible job offer – great incentive – recruiting

    - What available jobs are open? Poll the utilities and make available to the students via the GEAERD network/ website
- Develop a powerpoint for on GEARED program for each University partner
- Use this event to bring in "undecided" energy followers; need to PUSH students into the energy field – push for undergrads and maybe even H. School science fair winners
    - Grad students already know where they are headed and may also already have a job!
- Need to develop guidelines for the student presentations – asap!! Professors need to be able to "sell" this to the students right after the new year.
    - Posters, papers, presentations
- Michelle Mason as LEAD!!

STUDENT INNOVATION BOARD - DOE Elaine U.

- Get students involved
- DOE Request
    - Student liason POC from our consortium; who our students are able to contact regarding our SW DTTC –
    - Conduit between the innovation board and NNA
    - Innovation board should be in the hands of the students
    - Professors need to ID students to participate in the board
    - No more than 40 students apart of the board total!
    - Faculty member will ID the appropriate student ; others will come from existing "science" clubs
    - Put the board in the hands of the students to determine charter and goals; input how the GEARED network is serving them!
    - Online Innovation Board!
- Students will need to serve at least 1 year – undergrad or graduate
- DOE to pass along the role of the Innovation Board and send to our team
    - 10 members per consortia
- Michelle Mason POC Ecore??
- Something similar – continuing education for Utility orgs (can also be utility existing engineers)
- SDGE HR
-
    - Sends engineering firms to universities for recruiting
    - Having a hard time to "fill" boxes on org chart
- Mentorships! Capture knowledge from workforce who are looking to retire
    - Apply mentorships in the innovation boards and student centered conference
- What's the vision? Leading innovator in this field, networks, job opport, professional development, exposure
- NNA responsible for the innovation board plus 1 Liason per consortium as a contact
- Tie in the Sunshot Summit with student/and retrained personnel participation

METRICS EVALUATION

Dr. Matt Champaign – Embedded Assessment

- SOPO provided in NNA scope
- Need 1 POC for who is doing the data collection
- Continuous assessment – not just at the end once we figure out something might be wrong
    - Real time data collection
    - Mid term evaluations
    - Feedback to make improvements during coursework
- People focused feedback/assessment

- Plan to get expectations from the students prior to an event and compare with the mid term feedback
- Assessment through a hub – ability to go to a single URL and display data that you specifically need; data input based on what info we said is important to see
- Communicate with the consortia
    - Working expectation –
    - Who is responsible for gathering metrics and reporting
    - **Jesse Morris – POC!! Data gathering**
- Will give us access to the Hub
- Elaine will be working with NNA on DOE Metrics
    - Demographics
    - Outcomes
    - How many jobs were created
    - Track students for up to 2 years; where did they end up working?
    - Best practices
    - Use LinkedIn!!
    - Create Geared linkedIn page / create FBook GEARED page
- Standard metric forms?
    - Yes, coming from NNA
    - Need to see what each org is currently using
    - Will have some comparative data
    - Role – standard operation/process/metrics/key performance among multiple organizations.
- Need operational definitions from NNA / look at what we currently have; make it valid, solid, robust so we are measuring exactly what we thought we're measuring
- MOST IMPORTANT – HOW WERE THE COMMENTS USED? ARE YOUR RESPONSES USED? CLOSING THE LOOP
- INNOVATIVE- MENTORSHIPS
- WHAT DIDN'T I SAY? NDA WITH NNA?
- NEXT TIME? FUTURE FOR GEARED. SUSTAINABILITY. ADDITIONAL FUNDS AVAILABLE?
- Each university will have their own internal reporting system course evaluations etc.
    - Are we going to be having separate forms for GEARED or can we tie/have access to the university assessments
    - Don't want to overwhelm students with surveys
    - Can we get access to the university evaluations? Instructors may need to report that info back to the GEARED network
    - We don't want to add another layer of reporting!
- Confidentiality
    - Will need to know where some of the info came from
    - Very difficult if it's all anonymous
    - Consistent with social structure
    - This is no different than the social culture
    - There are categories of anonymity; but not all
    - Also need some info to see if it remains consistent
- What metrics are collected
- What's been collected before

www.theevaluationguy.com
www.embeddedessessment.com

Appendix P: Technology Advisory Board Kick Off Meeting

Technical Advisory Board Kick Off Meeting
May 19, 2014

- Will be providing this DTTC with technical advisory roles as well as providing input and feedback in terms of utility and related energy industry needs.
- The Programs developed in BUDGET PERIODs 1-2 will be reviewed and syllabus critiqued in this task.

Introductions

- J.Holmes – SDGE
- Edison – training for future; Irvine demonstration
- Troy Strand – Edison photovoltaic engineer; NREL; Industry – hybrid inverters
- Dr. Oner Yurtseven – accreditation, mechanical engineering renewable energy

Overview of GEARED

- Prepare workforce for integration of renewable energy
- Support national teams to advance new/existing curriculum development
- Team consisting of universities, utilities, industry, ISO, national lab

Action Items

- Curriculum development review – overall perspectives of curriculum and seminar development as a work product
- 1-2 curriculum offerings; formal training materials;
    - Formal ABET curriculum to add to the university power engineering courses
    - Short courses
    - Training seminars
- Communicate the review directly to DOE in reporting
- Partner universities –
    - Scope and plan curriculum they will be offering
    - Develop existing training programs communicated by web to reach broad cross section – formally through extension coursework or through conference engagement

APPENDIX Q: Briefing of the Consortia Organization to the DOE

Kodie Arnold

From:	Deborah Jelen <jelen@electricore.org>
Sent:	Wednesday, May 21, 2014 3:45 PM
To:	Fania Gordon; RoseMarie Holsing; Christina (CONTR) Nichols; Elaine Ulrich; Steven (CONTR) Cornish
Cc:	john holmes; Kodie Arnold; Sara Odom; Ilker Ilker IKE Bayraktar IKE Bayraktar
Subject:	DOE SUNRISE and GEARED Discussions on May 20, 2014

Dear DOE Team,

As discussed during our face to face meeting yesterday, Electricore has been notified by San Diego Gas & Electric (SDGE) that as of May 16, 2014, SDGE has fully funded their efforts in the SUNRISE program, but plans to withdraw from the GEARED program. SDGE has participated in a lead role on both programs since the Electricore contract was awarded, however severe budget issues have dramatically changed their organization and research and development budgets, driving the changes stated.

Electricore's efforts to address these issues are as follows:

SUNRISE:
Provide DOE with revised budgets from Green Power Labs (GPL) and SDGE as soon as possible. GPL has committed to May 22, 2014 for their revised budget and Electricore has already received a revised cost share letter from GPL. Electricore again requested a revised budget from SDGE, requesting the revision by close of business May 23, 2014. SDGE was asked to immediately respond if the May 23rd date was unachievable. A copy of the letter to SDGE is provided below. SUNRISE funding did receive a vote of full support from the SDGE board of directors.

GEARED:
The GEARED program has proceeded as planned to date with SDGE providing good faith leadership, though they did not execute the subcontract. SDGE withdrawal will require replacement of the Principle Investigator (PI) role and Electricore will have to replace $125k of cost share. Several options are under investigation including:
- Request that SDGE fund GEARED under a budget outside of the R&D realm, such as leveraging their Human Resources/Workforce Development budgets.
- Request that SDGE assist to recruit an acceptable PI replacement. A meeting was held today with Southern California Edison (SCE), Mr. Robert Sherrick. SCE is open to the idea and asked for one week to review the scope of work and to seek potential approval from their management. SCE is a subcontracted participant on GEARED and a participant in the Electricore consortium. Electricore expects an answer from SCE no later than May 29, 2014 on possible assumption of the PI role.
In addition, Electricore has requested SDGE document their significant cost share to date on GEARED and consider remaining active on the program in an advisory role. A copy of the letter to SDGE is provided below.

Electricore has made diligent efforts to maintain contracted progress on both SUNRISE and GEARED to date. The corrective action outlined will be pursued vigorously to immediately address the issues caused by budget changes at SDGE.

Sincerely,

Deborah Jelen
Electricore, Inc.
27943 Smyth Drive
Suite 105
Valencia, CA 91355
(661) 607-0230
jelen@electricore.org
www.electricore.org

SUNRISE letter to SDGE:

Dallas,

Electricore is very pleased to hear that the San Diego Gas & Electric (SDGE) Board of Directors approved on Friday, May 16, 2014 continued SDGE participation in the DOE SUNRISE program.

Electricore held a face to face meeting with DOE yesterday to discuss the program and the planned changes to budget and scope of work (including the exclusion of Oracle from the federal portion of the program). *DOE expressed strong concern for the time it has taken to proceed with contracting (approx. 8 months) and demanded immediate action for re-planning of the effort.* DOE stated that any delay in producing revised budgets may result in cancellation of the program. Both of our organizations have received negative exposure due to these delays. I request your immediate assistance to complete the following actions:

1. Provide revised budgets (federal and cost share) for SDGE SUNRISE efforts (Sara Elton to provide Alisha Stamps with sample format)
2. Provide a signed cost share letter (Kodie Arnold will provide you a recommended draft for review and signature)
3. Proceed with subcontract review and approval (Please advise the correct contact for negotiation of the subcontract agreement)

Our cooperative efforts over the next few days will go far in recovering the program plan, relieving some of DOE's concerns and starting the necessary repairs to the relationship with DOE. **Please provide requested items 1 and 2 above no later than Friday, May 23, 2014.** If SDGE is unable to respond by the requested deadline, please provide me with a date when DOE can expect the requested items.

Thank you for your efforts and attention to these important items.

Respectfully,

Deborah Jelen
Electricore, Inc.
27943 Smyth Drive
Suite 105
Valencia, CA 91355
(661) 607-0230
jelen@electricore.org
www.electricore.org

GEARED letter to SDGE:

John,

Electricore is very disappointed to receive the news that San Diego Gas & Electric (SDGE) plans to withdraw from the GEARED DOE program Principle Investigator (PI) role. SDGE's leadership on this important program and good faith efforts per the past year have been critical to the success of the program and necessary changes to the utility industry and those educated for career participation in it.

Electricore held a face to face meeting with DOE yesterday to discuss SDGE withdrawal from the GEARED program and to present potential alternatives to technical leadership, budget and scope of work . *DOE expressed strong concern for the time it has taken to proceed with contracting (approx. 8 months) and expressed their extreme disappointment over withdrawal at this late date.* DOE stated that any delay in Electricore's ability to produce revised program plans and budgets may result in cancellation of the program. Both of our organizations have received negative exposure due to these developments. I request your immediate assistance to mitigate impacts of the changes:

1. Document evidence of good faith leadership on the part of SDGE by certifying cost share efforts to date. SDGE has provided critical leadership during planning and the first year of the GEARED program, budget that has already been expended. Capturing this effort and documenting the cost will assist to show that both of our organizations were moving forward in good faith to complete the program and recent budget developments are the cause of the withdrawal. Please consider providing a signed cost share letter (Kodie Arnold will provide you a recommended draft for review and signature) documenting efforts to date on the GEARED program.
2. Please explore the possibility of funding the GEARED effort outside of the SDGE R&D budget. Key to the program success is outreach to educators and students and modification of curriculum to impact the future work force for utilities and the renewable industry. Is it possible to fund this effort from another department at SDGE, perhaps Human Resources, by leveraging existing workforce development programs (Total cost share commitment is $125,000 over five years)?
3. If an SDGE leadership role (PI) is not possible, please consider a limited advisory role which could be held to several hours per month, to help identify gaps in education, forecast trends in operations and technology and counsel education partners through the GEARED Advisory Board. Your participation and guidance is important to success of the program.
4. If an SDGE leadership role (PI) is not possible, please assist in recruitment of another utility partner that could take the PI role and assist with transition of the task. Electricore has reached out to Southern California Edison (SCE), a participant on the GEARED program, to inquire about the possibility of an expanded role for SCE.

Our cooperative efforts over the next few days will go far in recovering the program plan, relieving some of DOE's concerns and starting the necessary repairs to the relationship with DOE. **Please provide your response on the above items as soon as possible.**

Thank you for your efforts and attention to these important items.

Respectfully,

Deborah Jelen
Electricore, Inc.
27943 Smyth Drive
Suite 105
Valencia, CA 91355
(661) 607-0230

Appendix R: SWUSA-DTTC Contact List

Electricore, Inc.					
GEARED Project Role(s)	Internal DTTC Role(s)	Name	Organization	Email	Phone
Submitting Official	Financial Advisor	Beatrice Walker	Electricore, Inc.	bea@electricore.org	661-607-0263
Contractual POC	Business Officer	Deborah Jelen	Electricore, Inc.	jelen@electricore.org	661-607-0230
Program Manager	Business Contact / NNA Main POC	Kodie Arnold	Electricore, Inc.	kodie@electricore.org	661-607-0285
Student Liason	Student Innovation Board / Student Conference Contact	Brandon Yauch	Electricore, Inc.	brandon@electricore.org	661-607-0261
Metrics Evaluation	Metrics and Evaluation Contact	Brandon Yauch	Electricore, Inc.	brandon@electricore.org	661-607-0261
PI - Utility	PI - Technical Advisor	Robert Sherick	SCE	robert.sherick@sce.com	714.934.0813
Internship, curriculum, short course	University Partner	George Karady	Ariz. State University	karady@asu.edu	(480) 965-6569
Internship, curriculum, short course	University Partner	William Torre	UC-San Diego	wtorre@ucsd.edu	(858) 692-2592
Internship, curriculum, short course	University Partner	Sridhar Seshagiri	San Diego State Univ	seshagir@engineering.sdsu.edu	(619)-594-1960
Planning, curriculum review, metrics evaluation	National Lab Technical Advisory	Andrew Mills	Lawrence Berkeley Nat'l Lab	ADMills@lbl.gov	(510) 604-8685
Utility/real world data	ISO Technical Advisory	Peter Klauer	Calif. ISO	pklauer@CAISO.com	(916) 608-1104
Internship, curriculum, short course	University Partner	Mr. Reza Ghorbani	Univ. of Hawaii - Manoa	rezag@hawaii.edu	(808) 956-8111
Educational materials	Industry Technical Support	Blake Frye	Saft America Inc.	blake.frye@saftbatteries.com	(904) 861-1510
Maui Smart Grid Support	Utilty Technical Support	Mr. Reza Ghorbani	Maui Electric Co.	rezag@hawaii.edu	
Licensed software, installation services, training and expertise	Industry Technical Support	John Matranga	OSIsoft	jmatranga@osisoft.com	510.297.5893