Statement Of Project Objectives (SOPO)

A World-Class Smart Grid Education and Workforce Training Center

Topic Area:	Topic B, Smart Grid Workforce Training
Lead Organization:	Illinois Institute of Technology
Principal Investigator:	Mohammad Shahidehpour

A. Introduction: Building a World-Class Smart Grid Education and Workforce Training Center

Illinois Institute of Technology (IIT) will lead an extensive effort in building a world-class smart grid education and workforce training center to facilitate the development of a well-trained, highly skilled smart grid workforce which is vital to implementing a national clean-energy smart grid. The Center will use IIT's strong Smart Grid and power engineering infrastructure to engage utilities, corporations, Labor, Veterans, K-12 educators and community colleges in a collaborative initiative to train the strongest workforce in the world to meet the global challenges in Smart Grid, energy independence, clean and sustainable energy.

The Smart Grid program supported by the American Recovery and Reinvestment Act of 2009 (ARRA) will modernize the nation's electric system and significantly affect utility investment in the electric power sector, thereby contributing to job creation, preservation and economic recovery. These efforts are critical to achieving the nation's ambitions for renewable energy development, electric vehicle adoption, and energy efficiency improvements. Achievement of a national smart grid will require extensive workforce training. The nation's capability to manufacture the electrical equipment and new technology needed to achieve a national clean-energy smart grid also hinges on successful establishment of a manufacturing workforce that can support the changing electricity industry. Building and maintaining an adequate, knowledgeable workforce to keep pace with this demand, especially given existing skills shortages in the power sector, requires an increased commitment to training and workforce development.

The proposed smart grid education center will work with the IEEE Power and Energy Society, Argonne National Laboratory, National Renewable Energy Laboratory, selected power companies, other academic institutions, and training organizations to provide a world-class education opportunity on smart grid. The potential clients of the proposed smart grid education center include, but not limited to, college and high school students, power industry employees, high school teachers, government sectors, veteran administration, law firms, investors and venture capitalists, banks and other financial institutions, unions and line workers, entrepreneurs and general audiences, individuals seeking new careers in smart grid, IT professionals, telecom professionals, and service professionals.

The Center's organizational chart is shown in Figure 1. The proposed smart grid education center consists of a world-class leading team and advisory board. The principal investigator (PI) is Dr. Mohammad Shahidehpour, who is the Bodine Distinguished Professor and Chair of IIT's ECE Department and has a 30-year experience in electric power system research. Dr. Shahidehpour is the Vice President for Publications of the IEEE Power and Energy Society and has recently facilitated the publication of two new and very prestigious IEEE Transactions on Smart Grid and Sustainable Energy. Dr. Shahidehpour is also leading a DOE-funded Perfect Power project at IIT with a total budget of $12,000,000, a DOE-funded Wind Integration project with a two-year budget of $750,000, a DOE-funded Wind Energy Consortium project with a total budget of $8,000,000, and several NSF-funded projects on wind energy research and utilization. The Center director is Kurt Yeager, former CEO of the Electric

Power Research Institute (EPRI), who is currently the director of Galvin Electricity Initiative. Yeager brings to the Center his many years of managerial, scientific, and engineering experience to help address the workforce challenges in implementing a national clean-energy smart grid. The Center advisory board is composed of Ms. Wanda Reder, President of IEEE Power and Energy Society, Dr. Richard Gowen, former President of the Institute of Electrical and Electronics Engineers (IEEE), the world's leading professional association for the advancement of technology; Mr. Robert Galvin, former Chairman of the Motrola Corporation and the Founder of Galvin Electricity Initiative, which intends to demonstrate that Perfect Power can be delivered to consumers by applying Six Sigma quality principles; Mr. Dick DeBlasio, Laboratory Program Manager of Electricity in the National Renewable Energy Laboratory (NREL); Dr. Leon Lederman, 1988 Nobel Laureate in Physics, Pritzker Professor of Physics at IIT, co-founder of the Teachers Academy for Mathematics and Science, instrumental in founding the Illinois Mathematics and Science Academy, and co-chair of a Congressionally mandated national Commission on 21st Century Education in Science, Technology, Engineering, and Mathematics, run by the National Science Board; and Mr. Michael Polsky, President and CEO of Invenergy, one of the top five largest owners of wind generation assets in the United States.

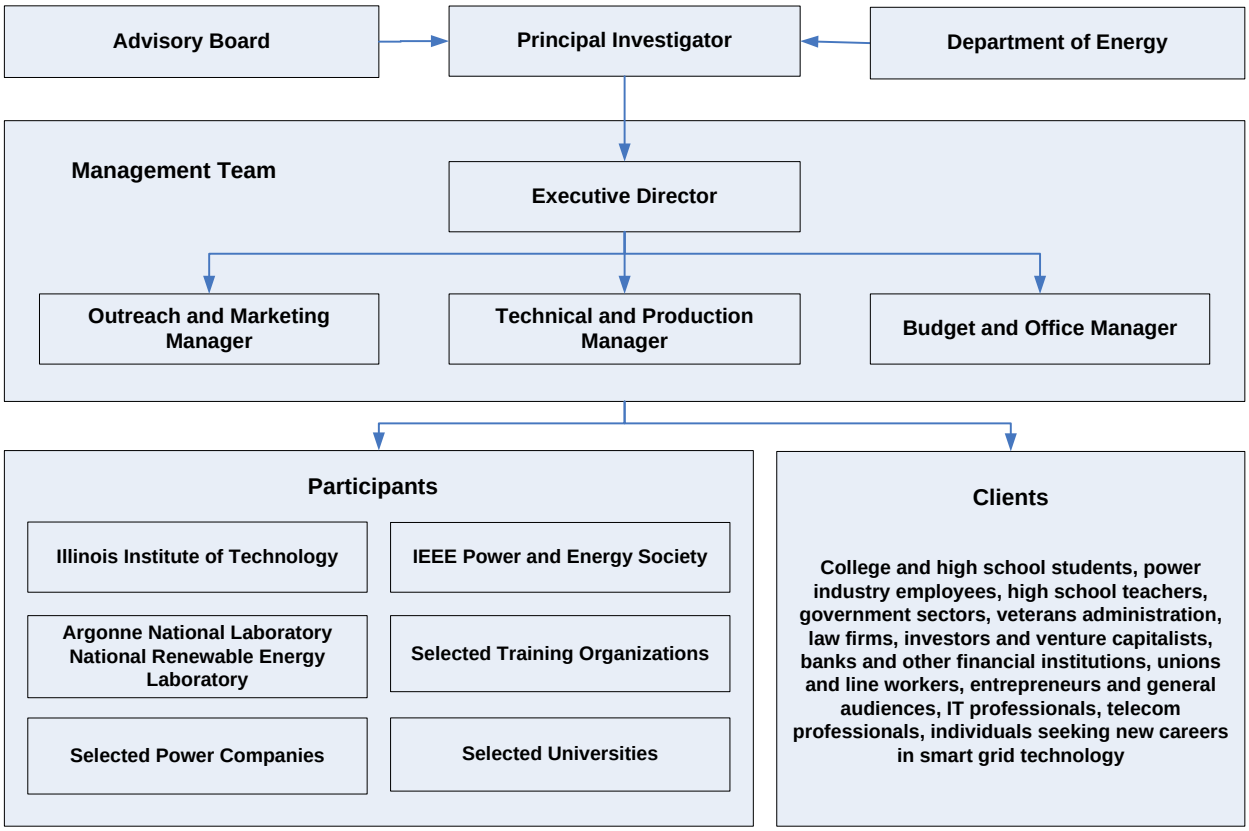

Figure 1: Organizational Structure of the Proposed Smart Grid Education Center

The proposed smart grid education center is led by IIT, which has a long history of offering one of the finest electrical power programs since 1930's. Participating universities that contribute to the proposed smart grid education center include the world-renowned University of Chicago, as well as Northwestern University, University of Illinois, University of Wisconsin, Southern Illinois University, Mississippi State University, University of São Paulo (Brazil), University of Castilla - La Mancha (Spain), Aristotle University of Thessaloniki (Greece), and Polytechnic University of Bucharest (Romania). The industry members include all types of smart grid stakeholders: **Power transmission system operators**

(ComEd/Exelon, ISO New England, British Columbia Transmission Corporation, Southern California Edison, Pacific Gas and Electric, Entergy, Mississippi Power, South Mississippi Electric Power Association, Tennessee Valley Authority, Southern Company); **Smart grid manufacturers and software companies** (Boeing Advanced Global Services & Support, Honeywell, Dakota Power, EnerNex Corporation, SmartSignal Corporation, Innovation Technology Applications Company, OSIsoft, Schweitzer Engineering Laboratory, Camgian Microsystems)**; Energy system consultants** (Electric Power Research Institute, AREVA T&D, Keyworks, Intelligent Power Solutions, McCoy Energy, Wiedman Power System Consulting); **Wind turbine companies** (GE Energy, Viryd Technologies, Acciona Wind Energy USA); **Renewable energy developers** (Invenergy, Pampa Energia Eolica (Brazil), PS Wind Management (Romania)).

The niche points of the smart grid education center includes its location, existing resources funded by the DOE, collaboration with DOE national labs, participation of IEEE Power and Energy Society, and IIT's extensive experiences. (1) The Center will be situated in IIT's main campus, which is located in the City of Chicago and provides convenient access to people to participate in the training. Chicago also is the home to one of the Nation's largest utility, Exelon/ComEd, which provides a large number of potential participants. (2) IIT has two smart grid and renewable energy projects funded by the DOE. One is the IIT Perfect Power Project and the other is the IIT Wind Energy Consortium Project. The two projects provide two living labs for educating people on smart grid. (3) IIT has extensive collaborations with several DOE national labs, including Argonne National Laboratory, and National Renewable Energy Laboratory. IIT has the history of offering joint master degree programs with the national labs. Students take fundamental classes at IIT and the labs offer research internship options. The close collaboration will take full advantages of the research and education resources existing in the labs thus promoting research and education the nation anticipates. (4) The Center will have the active participation of the IEEE Power and Energy Society (PES), which is the largest power and energy organization in the world. The PI is the VP for Publications in the IEEE/PES and has close connections. IEEE/PES has more than 10,000 members and has huge influence on members. IEEE/PES has large amount of existing resources and a huge database. The Center will offer classes in PES conferences to reach its members. (5) IIT has extensive experiences in workforce training. Internet-based courses have been offered at IIT for more than 10 years. IIT's Center for Professional Development (CPD) has been in operation for several decades. IIT has the experiences in offering course ranging from power systems, power electronics, digital controls, communication, cyber security, industrial and organizational psychology, environment, entrepreneurship program, energy laws, professional development, and government policy. The above niche points enable IIT to build a world-class smart grid education center that facilitates the development of a well-trained, highly skilled electric power sector workforce which is vital to implementing a national clean-energy smart grid.

B. Project Objectives

The objectives of the proposed world-class smart grid education center will be focused on the development and deployment of training programs, as well as the actual training of personnel. In particular, (1) The Center will offer the state of the art training topics in electric power systems, sustainable energy, and smart grid, train the strongest workforce in the world to meet the global challenges and to sustain the United States' leading edge in the production, delivery, and utilization of energy; (2) The Center will provide the best education in program content, format, organizational management and continuously enhance the quality of the training programs to respond to evolving constituent needs. The center will also provide access to a wide range of educational opportunities scheduled at times, places, and in formats that fit individuals' life styles; (3) The Center will offer workshops, short-courses, and national conferences for better educating the stakeholders on critical issues related to the smart grid research and development; (4) The world-class smart grid education programs developed in the center will be sustained and last much beyond the proposed three-year period. The above objectives will be achieved by performing the following tasks.

Phase I – Establishment of the Smart Grid Education Center

Task 1.0: Furnishing the Space for the Center

Task 2.0: Purchasing Equipment for the Center

Task 3.0: Staffing the Center

Phase II – Assessment of Training Needs for Smart Grid Workforce

Task 1.0: Identifying Specific Job Classifications and Skills Deficiencies

Task 2.0: Identifying Gaps in Training Needs

Phase III – Development of Smart Grid Workforce Training Programs

Task 1.0: Coordinating the Development of Training Program

Task 2.0: Developing Courses related to the Training Program

Task 3.0: Producing Teaching Materials and Textbooks on Smart Grid

Phase IV – Offering of Smart Grid Workforce Training Programs

Task 1.0: Offering Graduate Degree Program on Smart Grid

Task 2.0: Offering Graduate Certificates on Smart Grid

Task 3.0: Offering Short-Courses on Smart Grid

Task 4.0: Offering Workshops for Outreach and Public Awareness on Smart Grid

Task 5.0: Offering Smart Grid Education for High School Teachers

Task 6.0: Offering Smart Grid Courses through Community Colleges

Task 7.0: Offering Tailored Education Programs

Task 8.0: Holding Annual Conference on Smart Grid

Phase V – Development of Strategies to Self-sustain the Center

Task 1.0: Evaluating the Training Programs

Task 2.0: Operating the Production Center

Task 3.0: Developing Membership Program

Phase VI – Final Reporting

Task 1.0: Final Reporting

C. Tasks to be Performed

The tasks to be performed are discussed in this section.

Phase I – Establishment of the Smart Grid Education Center

Task 1.0: Furnishing the Space for the Center

This task will furnish the space for the administrative offices of the Center as well as the space for classrooms, production studios, and server rooms.

Task 2.0: Purchasing Equipment for the Center

This task will purchase the equipment for the production center. IIT will provide expertise to operate the production center. The production center will include two studios for taping demonstrations of smart grid related experiments, four IITV Classrooms for offering and taping classes, a server room for hosting course materials, and a production room for the printing, copying, and binding of course materials, books, etc.

Task 3.0: Staffing the Center

This task will staff the Center by establishing the advisory board, hiring an executive director to manage the daily operation of the Center, hiring a technical production manager to manage the production studios, hiring an outreach and marketing manager, and hiring an office and budget manager.

Phase II – Assessment of Training Needs for Smart Grid Workforce

Task 1.0: Identifying Specific Job Classifications and Skills Deficiencies
This task will identify specific job classifications that will be targeted for training, and the skills deficiencies that will be addressed through the workforce improvement efforts. The job classifications and the skills deficiencies will reflect needs identified from, but not limited to, organizational assessments, field surveys and workforce training evaluations.

Task 2.0: Identifying Gaps in Training Needs
This task will identify gaps in training needs, with respect to any combination of curriculum, capacity and accessibility of current training opportunities. This task shall include a comprehensive overview of training practices in use today for the specified job classifications.

Phase III – Development of Smart Grid Workforce Training Programs

Task 1.0: Coordinating the Development of Training Program
The task will develop a plan that coordinates the development of courses and laboratories on smart grid that will be used for the training programs.

Task 2.0: Developing Courses related to the Training Program
The Center will develop new courses and enhance existing courses on smart grid, including, but not limited to electric power systems, electric machines, power electronics, communications, network and cyber security, interoperability, hardware and computer networks, industrial and organizational psychology, environment, entrepreneurship, energy laws, and policies. Course materials, textbooks, laboratory setups, lab manuals, and PowerPoint lecture presentations will be developed for the proposed courses and experimental teaching laboratories. This task will also engage undergraduate students in the smart grid research and development through innovative methods such as the Inter-professional (IPRO) courses offered at IIT.

Task 3.0: Producing Teaching Materials and Textbooks on Smart Grid
Course materials, textbooks, laboratory setups, lab manuals, and PowerPoint lecture presentations will be produced for the proposed courses and experimental teaching laboratories in the production center.

Phase IV – Offering of Smart Grid Workforce Training Programs

The workforce development is very crucial for sustaining the prominence in U.S. smart grid research and development. The objective of this task is to offer smart grid related courses and degree programs to college students, and continuing education courses, targeted seminars and workshops, and multi-day conferences to the general public for training a skilled workforce on smart grid. The IIT Perfect Power prototype provides a tremendous asset for training electricity system leaders, technical staff, and students on the smart grid designs and benefits. IIT is offering to develop the education, training, and workshop programs to leverage this asset to promote smart grid.

Task 1.0: Offering Graduate Degree Program on Smart Grid
The team will partner in developing academic curricula and internships to train the next generation of smart grid employees and entrepreneurs. IIT will offer the first internet-based master's degree program in the world on Smart Grid. The degree program will educate the next generation of engineers and entrepreneurs on interdisciplinary topics related to Smart Grid. The internet-based degree program will be available to individuals throughout the world and cover courses on engineering, management, business, quality, and ethics. The unique Smart Grid Master's Degree program will be offered at IIT and made available to all team members and their employees. Fellowships and scholarships will be offered to potential students to attract the best candidates to the master's degree program. In addition, graduate degree programs will also be offered for Master of Electricity Markets, Master of Electrical and Computer

Engineering with options in power, communication networks, digital control systems, sensors and wireless technology, hardware design, and computer security.

Task 2.0: Offering Graduate Certificates on Smart Grid
The students may opt to take a smaller fraction of total courses required for the Smart Grid Master's degree program and receive a certificate on smart grid. In addition, certificates will also be offered on electricity markets, power engineering, business administration, energy law, organizational psychology and management, and public administration.

Task 3.0: Offering Short-Courses on Smart Grid
The team will offer, throughout each year, 3-5 day training short-courses on smart grid technologies. The team will offer an annual conference on smart grid. The training courses will help individuals with backgrounds in engineering and other fields to become proficient with principles of Smart Grid and means of starting activities and new ventures on Smart Grid topics. IIT will invite engineers and practitioners from business and industry as instructors and recruit students from across the globe to attend training short-courses at IIT. The training short-courses could also be offered via Internet. Three levels of short-courses will be offered, including beginner short courses, intermediate short courses, and advanced short courses.

Task 4.0: Offering Workshops for Outreach and Public Awareness on Smart Grid
The ability to establish a successful national effort on smart grid and to provide technological and educational resources to accelerate the development of smart grid is contingent upon the supply of concise information to stakeholders. The public approval of such technology and the engagement of communities at large are a significant part of the smart grid development process. Extensive smart grid outreach and public awareness initiatives will be introduced by the team. IIT will offer 1-2 day workshops twice a year for promoting the outreach and public awareness on Smart Grid. Each workshop held in Chicago will invite key individuals from the local and federal government and private sectors to participate and discuss recent events on developing Smart Grid at IIT and elsewhere. The workshop will provide a forum for such individuals to educate the public on the essence of Smart Grid and the path to developing Smart Grid in the United States and around the world.

Task 5.0: Offering Smart Grid Education for High School Teachers
This task will train high school teachers via down-to-earth courses, workshops, and webinars on how smart grid works, plug-in hybrid cars, and renewable energy topics so they can teach their students in practical, easy to understand terms.

Task 6.0: Offering Smart Grid Courses through Community Colleges
Community colleges can develop pre-engineering agreements with IIT to transfer students to green job related programs seamlessly. The focus of this task is on enticing more American students to pursue engineering and green-collar jobs. This task will develop various collaboration opportunities for community colleges, including but not limited to

- Assisting the Center in understanding the training needs of Community Colleges
- Collaborating with Center's curriculum development team to create curriculum and certificate programs for Community College students and workers
- Working with IIT to create a 2+2 articulation program to facilitate easy transition to IIT for students wishing to pursue a 4 year or graduate degree
- Collaborating on creating workshops and webinars on Smart Grid topics

Task 7.0: Offering Tailored Education Programs
Tailored education programs will be offered to meet the specific needs of participating companies.

Task 8.0: Holding Annual Conference on Smart Grid
Annual conferences on the applications of smart grid will be held in Chicago.

Phase V – Development of Strategies to Self-sustain the Center

The objective of this phase is to develop strategies to self-sustain the Center.

Task 1.0: Evaluating the Training Programs
The task will evaluate the training program and develop strategies to improve the training programs.

Task 2.0: Operating the Production Center
The task will evaluate the operation of the production center so that it can be self-sustained.

Task 3.0: Developing Membership Program
The team will develop a membership program that can help sustain the operation of the Center. The membership options include Gold Membership, Silver Membership, Bronze Membership, and Associate Membership.

Phase VI – Final Reporting

The objective of this phase is to assemble and report the results of the Center initiatives and activities.

Task 1.0: Final Reporting
IIT will assemble and finalize a report that will summarize the outcome of the proposed phases of the Center project and send the report to DOE for review and comments. The final report will include: activities and outcomes of the Center; activities and outcomes of the workforce training and development. Technical articles and reports will be prepared by Center members for publication at national meetings.